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LATEST TRENDS IN ENGINEERING & TECHNOLOGY VOL 1

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Dr Vishant Kumar

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Enhancing Service Provision: The Crucial Role of Interpersonal Communication Skills in Fostering Customer Satisfaction and Loyalty

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ABSTRACT:

The study's main focus is on interpersonal communication, one of the interpersonal soft skills. The purpose of this paper is split into two distinct categories. examine the educational staff's interpersonal communication abilities first. Second, to appreciate the influence that this interpersonal contact has. Utilizing qualitative research techniques, this paper's research was examined. This study's methodology involves a series of in-depth interviews with four informants from each faculty who received an A on the accreditation assessment results. According to this study's findings, there are three interpersonal communication abilities that are important for educational staff members. The strength of interpersonal communication skills, on the other hand, has improved the quality of service delivered inside the work unit. In this study, the importance of interpersonal communication skills in improving service delivery and their effects on client loyalty and satisfaction are explored. Effective customer-service provider communication is crucial to determining how consumers feel about their experiences and how they judge the quality of the services they receive across a range of sectors. This study attempts to shed light on the essential components and tactics that support successful interpersonal communication in service contexts by thoroughly examining the body of prior literature and empirical investigations. Organizations may enhance customer satisfaction and loyalty by cultivating pleasant customer encounters, bolstering customer connections, and understanding the crucial value of communication skills.

Keywords: Inter personal communication, service provision, customer satisfaction, customer loyalty, service quality, effective communication, customer experiences, customer interactions, relationship-building.

Introduction:

Interpersonal soft skills have long been recognized as an essential factor in achieving successful performance within any work unit, particularly from a human resource standpoint. These skills play a vital role in the overall quality of service provided.Achieving outstanding service quality requires a careful assessment of how well the customer's expectations are met with the service they receive. In the competitive landscape of the service industry, the

imperative for employees to possess both soft and hard skills to deliver exceptional service. Building trust with customers is essential for employees to provide top-notch service that meets their expectations.Improving the quality of government services is the top priority for the public sector, and they are working hard to enhance their services to match that of the private sector. The focus is primarily on developing the soft skills of public service employees. Educational institutions are one such public sector service that is constantly striving to improve their services to meet the needs of their students.Effective communication and collaboration are crucial in achieving successful performance in any work unit, and this requires interpersonal soft skills. A lack of these skills can be a significant obstacle to achieving the desired outcomes. In today's business world, it is essential for every employee and staff member in any organization to possess both hard and soft skills.

Interpersonal communication skills and their relevance in various industries:

The term "interpersonal communication skills" refers to the capacity to communicate and engage with people in a way that promotes mutual understanding, trust, and healthy relationships. Customer service personnel require good interpersonal communication skills in sectors like retail, hotels, and telecommunications in order to sympathize with clients, solve their issues, and offer suitable solutions. Positive interactions can promote client loyalty and pleasure. It takes great interpersonal communication for sales personnel to establish rapport with potential customers, comprehend their needs, and clearly communicate the advantages of goods or services. In marketing, effective communication is essential for reaching target consumers with brand messages. Healthcare personnel must interact with patients, coworkers, and carers in a productive manner. To comprehend patients' situations, offer psychological encouragement, and accurately communicate medical facts, empathy and active listening are essential. To conduct interviews, resolve disputes, and provide workers feedback, HR professionals require good interpersonal skills.

A productive workplace is fostered through effective communication, which also boosts worker morale and output. In order to establish and sustain connections with clients, stakeholders, and the media, interpersonal communication is also essential in public relations. PR practitioners need to communicate well in order to successfully transmit messages and manage crises. Effective team collaboration in any sector depends on honest and straightforward communication. A productive team dynamic, encouragement of innovation, and dispute resolution all need interpersonal skills. Effective counselling and social work are built on interpersonal communication. To serve their customers, professionals in these disciplines must build trust, actively listen, and exhibit empathy. In order to comprehend each other's points of view, establish areas of agreement, and come to mutually beneficial agreements, parties need to have strong interpersonal communication skills.

How interpersonal Communication skills impact customer interactions and relationships:

Interactions and connections with customers are greatly impacted by interpersonal communication abilities. Customer service personnel may better grasp customers' needs and pain spots by carefully listening to them and understanding their expectations. This knowledge enables the delivery of specialized services and individualized encounters that make clients feel valued and cherished. Employees may connect with consumers and develop rapport by using interpersonal communication skills. Making consumers feel at ease with a warm and sympathetic demeanour encourages more frank and open communication. Customers that have issues or complaints can have their concerns patiently and understandingly addressed by competent communicators. In addition to defusing potentially stressful situations, this demonstrates the company's dedication to client pleasure.

Customer information regarding goods, services, and policies is accurate when it is communicated clearly. Employees may better manage the positive and negative emotions that clients express by communicating emotionally intelligently. A frustrated consumer might become a devoted supporter if you handle sensitive circumstances with understanding and skill. Customers are more inclined to talk about their experiences, both good and bad, with others. A company's reputation may be enhanced through favourable internet evaluations and word-of-mouth referrals that result from effective interpersonal interactions. In order to avoid minor difficulties from becoming major ones and to preserve the company's reputation, skilled communicators are able to handle difficult contacts with grace and professionalism. Customers are more likely to remain devoted to a company in the long run when they feel heard and respected. Relationship nurturing and customer churn prevention is made easier with interpersonal communication.

The importance of active listening in understanding customer needs and concerns:

Understanding client demands and problems requires active listening above all else. It is a method of communication that entails paying close attention, hearing what the consumer is saying, paying attention, and replying. It enables customer support agents to precisely understand the client's demands. Employees can learn important information about the particular goods, services, or solutions that customers are looking for by paying attention to the customer's words, tone, and emotions. Dissatisfaction and irritation can result from misunderstandings. Making sure both parties are speaking the same language and actively listening helps prevent misunderstandings. To learn more and confirm their comprehension, employees might clarify inquiries. Trust and rapport are built when clients feel that they are being carefully listened to. Long-lasting connections and client loyalty may be fostered by this satisfying experience. Sometimes, clients may not be completely clear in expressing all of their needs or worries. Employees may deliver more thoroughanswers by using active listening to detect subtle clues and unstated demands. Customers are less likely to contact a firm repeatedly for the same issue if they feel heard and have their concerns addressed effectively in the initial engagement. Both the client and the business save time and resources as a result. Customers are more likely to feel happy with the service they receive when they witness active listening during encounters. Overall client satisfaction is boosted by this favourable feeling.

Enhancing Customer Satisfaction through Interpersonal Communication:

Promoting client satisfaction through interpersonal connection is an essential approach used by organizations to create close bonds with their clients. Encourage staff to pay attention to the needs, wants, and feedback of consumers. Paying close attention to what consumers are saying shows that you appreciate their opinions and it also enables you to understand their unique needs. Use clients' names and remember prior experiences to customize conversations with them wherever feasible. Customers are made to feel valued and appreciated when they receive personalized service. Whether a consumer contacts you in person, on the phone, or through a digital channel, do so as soon as possible. Quick answers reveal the business' dedication to providing excellent customer service. Find the most appropriate solutions along with your consumers. When it's feasible, be flexible, and be prepared to go above and beyond to fulfil their expectations.

Empathy and emotional intelligence can positively influence customer satisfaction:

Customer satisfaction is significantly influenced by emotional intelligence and empathy. An emotionally intelligent and satisfying client experience is produced when customer service reps and other staff members show empathy. Employees that have empathy can identify and comprehend the feelings that consumers are going through. Employees may reply with regard and care, giving consumers a sense of being heard and cherished, by recognizing their sentiments. Customers are more likely to feel at ease and supported when they interact with empathic and emotionally intelligent staff members. Their overall opinion of the business is improved by this satisfying encounter. Employees that are compassionate and emotionally intelligent are better able to resolve disagreements with consumers. Instead of intensifying their disagreements, they might concentrate on creating win-win solutions.

The significance of clear and positive communication in avoiding misunderstandings:

The prevention of misconceptions, especially in professional contexts, depends greatly on clear and constructive communication. Positive and lucid communication reduces uncertainty and averts possible disputes by ensuring that the intended message is correctly received. Few misunderstandings may occur when communication is clear. The likelihood of the recipient misinterpreting the information being sent is decreased when the communication is clear and unambiguous. Different people may understand the same message differently as a result of ambiguous or unclear communication. Unambiguity is eliminated and specific information is provided through clear communication. Making assumptions about the intended message can happen when there is a lack of clarity in communication. Misunderstandings and inconsistent behaviour may follow from this. People are more likely to communicate their opinions and views when there is clear and constructive communication between them.

Strategies for maintaining a positive tone and language during interactions:

Take a minute to check in with your emotions before starting any interaction. Before speaking with people when you're angry, annoyed, or unhappy, take measures to calm yourself. You can react more favourably if you're conscious of your emotions. Use encouraging language that is upbeat and encouraging. As opposed to stating "That won't work," for instance, say "Let's explore other options," or "That's not my problem," say "I'll do my best to help you find a solution." To demonstrate that you respect the other person's time and opinions, swiftly respond to messages and questions. A pleasant impression is enhanced by a prompt reaction. Gratitude and appreciation for other people's contributions should be expressed. A pleasant environment is encouraged by recognizing their efforts.

The impact of personalized interactions on customer loyalty:

Customer

loyalty is significantly impacted by personalized encounters. Customers feel appreciated and respected when they receive personalized service. When companies remember customers' names, preferences, and past interactions, it demonstrates that the firm values each customer individually and creates a more satisfying experience overall. Customers are more deeply engaged as a result. Customers are more likely to interact with a business and show enhanced loyalty when messages and offers are tailored to their interests and prior actions. When a brand meets their particular demands, customers are more inclined to stick with it. Personalized interactions make it more difficult for other businesses to imitate the connection, enhancing client retention. Customer satisfaction levels increase as a result of personalized interactions that precisely address their problem concerns.

Customers who are happy with the product or service are more inclined to recommend it to others. Customers who have requested personalized messages receive content that is pertinent to them, such as news about new products, offers, and educational resources. The possibility that customers will interact with the information and do the necessary activities rises as a result of this focused strategy. On consumer data and insights, personalized interactions rely. Businesses may enhance their goods, services, and consumer experiences by studying this data and making wise decisions. Customers are more inclined to stick with a brand when they receive individualized service rather than those that provide generic interactions.

Importance of training and developing interpersonal skills in the business context:

In a commercial setting, training and interpersonal skill development are of the highest significance. These abilities are not only essential for professional development on an individual level, but they also have a direct bearing on the success and efficiency of the entire business. Effective communication within teams, with consumers, and with stakeholders depends on interpersonal skills including active listening, empathy, and clear communication. Customers will be more satisfied and loyal if employees have the interpersonal abilities to connect with them, understand their requirements, and deliver outstanding service. Interpersonal skills are prioritized in the workplace, which fosters a good environment. Higher morale and more engagement result from employees feeling heard, respected, and appreciated. Managing organizational transformation requires interpersonal skills. A workplace that values friendly interactions and interpersonal skills earns a solid reputation. Top personnel, clients, and business partners are drawn in by this favourable perception.

Recommendation of prioritizing interpersonal communication as a key driver of success in Business:

Prioritizing interpersonal communication helps businesses succeed and flourish in all facets of the enterprise, not just in terms of building stronger connections. Businesses may prosper in an environment that is more competitive and focused on the needs of the customer by making training investments, fostering a good culture, and appreciating the need for effective communication. Here are some recommendations for businesses to prioritize and invest in developing interpersonal communication:

- Prioritizing interpersonal communication may result in a host of advantages and support general growth and prosperity as a crucial factor in corporate success.
- A helpful organizational culture is developed when interpersonal communication is prioritized.
- Positive customer experiences fueled by efficient communication help to build a favourable brand reputation.
- Employees feel valued, heard, and appreciated, which results in improved morale and job satisfaction.
- Customers who are pleased spread the word about the company, bringing in new clients and enhancing its reputation.

CONCLUSION:

Interpersonal communication skills play a critical part in creating consumer happiness and loyalty, which cannot be understated. Businesses may build enduring relationships with their consumers by promoting active listening, empathy, transparent communication, and customized interactions. These abilities improve client relationships, foster trust, and foster steadfast commitment. Employees that are excellent in interpersonal communication also contribute to a productive workplace, enhanced teamwork, and overall organizational success. Businesses can expect to see sustainable development, a solid brand reputation, and a devoted client base as they acknowledge and invest in the power of interpersonal communication. These factors will help them reach new heights of success.

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The Impact of Interpersonal Relationships on Students' Academic and Non-Academic Development: Roles of Peers, Parents, and Instructors

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ABSTRACT

This study abstract focuses on the roles of peers, parents, and instructors in order to examine the complex connections between interpersonal interactions and their impact on student's academic and non-academic development. The study identifies significant outcomes impacted by various stakeholders and highlights areas where their effect could be restricted by examining current literature and empirical data. Peers have a substantial influence on kids' academic development and socioemotional growth, and this influence also extends to research behaviors, enthusiasm, and social behaviors. Both the good and negative effects of peer pressure are examined, demonstrating how they may help or hurt kids' development. The academic path and general development of students are significantly shaped by parental engagement, support, and communication. The abstract highlights the necessity for a well-balanced strategy that promotes autonomy while recognizing the possible risks of strict parental supervision. The role of teachers is examined, with a focus on the value of effective teaching methods and excellent teacher-student interactions in fostering academic success and emotional well-being. The abstract also discusses difficulties such as instructor prejudice and the effects it has on students' motivation and self-worth. While acknowledging the importance of these connections, the abstract also covers topics where peers, parents, and instructors may not have much of an impact because of individual variations, personal goals, and outside influences.

Keywords: *Interpersonal relationships, students, academic development, non-academic development, peers, parents, teachers, impact, outcomes.*

INTRODUCTION

The three key interpersonal relationships—parents, instructors, and peers—that profoundly affect teenagers' lives are examined in this research. The study attempts to investigate the distinctive effects of each connection on students' both professional and personal development, drawing conclusions from a thorough examination of the body of research and empirical evidence.The Chapter starts out by looking at the significant influence parents have on their children. In order to promote academic performance and general growth, it emphasizes the value of parental engagement, support, and communication. The abstract also highlights the necessity for a well-balanced strategy, one that promotes autonomy while taking into account the possible drawbacks of rigorous parental surveillance.

The next section of the Chapter looks at how instructors might affect students' educational experiences. In order to foster academic success and emotional well-being, it highlights the need for effective teaching strategies and fruitful teacher-student interactions. Additionally included in the study are the ramifications of instructor prejudice and how it affects students' motivation and self-worth.The Chapter also highlights the significance of peers in influencing teenagers' growth. It talks about the effects of peer relationships on academic development, socio-emotional development, research activities, excitement, and social behaviors. Peer pressure is studied from both good and negative angles, offering insightful information on how it may help or hurt kids' development. This study emphasizes the relevance of parents, teachers, and peers as the main social connections in teenagers' lives. A supportive and rewarding learning environment may be created for each individual by educators and policymakers by recognizing their unique responsibilities and potential impacts and developing individualized tactics to foster students' academic and non-academic growth.

Importance of Interpersonal Relationships

Interpersonal relationships are essential for human beings' overall well-being and personal growth. They play a crucial role in shaping various aspects of an individual's life, including emotional, psychological, and social development. Interpersonal relationships promote both mental and physical well-being in addition to offering emotional support and a sense of community. One's entire quality of life can be improved by cultivating and sustaining strong connections.An emotional sense of support and belonging is provided through interpersonal interactions. People may negotiate the difficulties of life and deal with stress and challenging circumstances by having supporting and loving connections with family, friends, or partners.

A sense of connection and belonging to a group or culture is developed through relationships with people. They foster a sense of social identity and help people feel like they are a part of something bigger than themselves. Improved psychological outcomes are associated with strong and healthy interpersonal interactions. They can improve psychological well-being in general and lessen emotions of isolation, despair, and worry. Self-esteem and confidence may be increased by having healthy connections. A better self-image and a stronger feeling of self-worth are developed when people feel accepted, respected, and acknowledged by others.Communication abilities are improved via interpersonal interaction in relationships. It requires engaging in active listening, empathetic communication, and effective speaking—all of which are useful in both personal and professional contexts.

Opportunities for personal development and self-awareness can be found in interpersonal relationships. Individuals discover their assets, liabilities, and potential improvement areas via interactions with others. Conflicts and disputes are possible in relationships. Better understanding and stronger links between relationships are fostered by learning to settle problems constructively. Especially throughout childhood and adolescence, interpersonal ties are essential to socialization. They provide knowledge of societal expectations, cultural values, and proper conduct in a certain setting. The educational outcomes and professional prospects of kids can be greatly influenced by positive teacher-student interactions and encouraging mentors. According to studies, people with strong social ties typically live longer and have superior physical health.

How do Interpersonal Relationships Assist Students' Outcomes?

Learning achievement, personal development, and overall well-being of students may all be strongly impacted by positive and encouraging connections with classmates, parents, and instructors. Parents, teachers, and peers may have a beneficial impact on student's academic progress, mental health, and personal growth by creating a friendly, encouraging, and inclusive atmosphere. This will put them on the road to long-term success. Interpersonal relationships that assist students' outcomes

- **Academic Support:** Teachers and peers can provide academic support and encouragement. Positive teacher-student relationships foster a conducive learning environment, leading to improved academic performance and motivation. Similarly, collaborative and supportive peer relationships can enhance learning through group discussions, study groups, and knowledge-sharing.

- **Emotional Well-being:** Interpersonal relationships offer emotional support and a sense of belonging. Students who feel connected and supported by their peers, parents, and teachers are better equipped to cope with stress, anxiety, and academic pressures, leading to improved mental well-being.
- **Motivation and Engagement:** Positive relationships can boost students' motivation and engagement in their studies. Feeling valued and supported by teachers and peers can inspire students to take an active interest in their education and participate more actively in classroom activities.
- **Communication Skills:** Interpersonal relationships provide a platform for students to practice and develop effective communication skills. Engaging in discussions, expressing ideas, and understanding others' perspectives help students become more articulate and better communicators.
- **Self-Efficacy and Self-Confidence**: Supportive relationships contribute to students' sense of self-efficacy and self-confidence. Encouragement and positive feedback from teachers, parents, and peers can build students' belief in their abilities, empowering them to tackle challenges and take on new opportunities.
- **Social Skills:** Interacting with peers and teachers helps students develop important social skills, such as empathy, cooperation, and conflict resolution. These skills are valuable for building positive relationships and navigating social situations throughout life.
- **Personal Development**: Interpersonal relationships contribute to students' personal growth and self-awareness. Feedback from teachers and peers, as well as experiences in various relationships, can help students identify their strengths and areas for improvement.
- **Sense of Responsibility:** Through relationships with teachers and peers, students can develop a sense of responsibility and accountability for their actions. This can lead to better time management, improved study habits, and a commitment to academic success.
- **Reduction of Risk Behaviors**: Positive relationships with parents, teachers, and peers are associated with a lower likelihood of engaging in risky behaviors, such as substance abuse or delinquency.
- **Long-Term Success**: The support and guidance provided by interpersonal relationships can have a lasting impact on students' future success, both academically and in their personal lives.

Interpersonal Relationships as a Lens through Which to Understand Educational Phenomena

The teaching and learning process is shaped by a variety of complex dynamics, which may be better understood by educators, researchers, and policymakers when education is seen from the perspective of interpersonal interactions. It may be quite insightful to evaluate the nature of the teacher-student interactions in order to understand how students engage, are motivated, and perform academically. Positive interactions between teachers and students help create a supportive learning environment that increases student engagement and improves learning outcomes. The way that peers interact sheds light on how social factors like peer pressure and group dynamics can affect students' behavior, academic success, and social and emotional development. Peer collaboration and support can improve educational experiences, but unfavorable peer dynamics might impede academic advancement. The degree of parental participation in a child's education provides important clues about the academic performance and general development of the children. Parents who are involved and supportive of their children can enhance results by influencing how they see school and learning.

The development of **Social and Emotional Learning** (SEL) depends on interpersonal connections. Educators may create efficient SEL programs that develop important life skills by looking at how kids interact with others, handle conflict, and communicate their emotions. The environment of the classroom as a whole is influenced by how well the students get along with one another. A supportive and welcoming learning atmosphere benefits students' well-being and feeling of community, which in turn improves their inspiration and overall learning experience. Teachers are better able to comprehend and manage issues of bullying and social exclusion among kids when they see interpersonal connections via this perspective. For a secure and encouraging learning environment, figuring out the underlying issues and creating plans to encourage a respectable and compassionate culture are essential.

Teacher-student Relationships in the Educational Ecology

Teacher-student relationships are a vital component of the educational ecology, encompassing the intricate network of interactions and influences within the educational setting. To build a supportive and productive learning environment, educators and policymakers may gain significant insights from an understanding of the dynamics of interactions between teachers and pupils within this ecological framework. Increased academic success and engagement are linked to good teacher-student interactions. The likelihood that students will be driven to study and actively engage in class activities increases when they feel encouraged, appreciated, and connected to their professors. Teachers may enhance students' self-esteem, emotional control, and interpersonal skills while also promoting their general well-being by treating them with kindness and respect. Students are more likely to take risks academically and voice their opinions without worrying about being judged when the environment is welcoming and supportive. For meaningful learning experiences, teachers and students must effectively communicate. Students' grasp of academic topics is supported, and growth possibilities are presented via constructive criticism and open discussion. Strong teacher-student connections help teachers better grasp the strengths, weaknesses, and learning preferences of specific students.

It is important to address the somewhat under-reported issue of how much variation there is in teacher-student relationships from student to student, class to class, and school to school before turning to the effects of interactions between individuals in the classroom and the role of teacher-student relationships in students' academic and non-academic outcomes. The answer to this query has important ramifications for the degree to which educational intervention attempting to improve teacher-student interactions should be directed. For instance, if teacher-student interactions significantly differ from class to class, whole-class intervention is necessary. If there is a significant difference between students, a more individualized approach to interactions is also recommended.

Impact of Relationships with Teachers, Parents, and Peers

The impact of relationships with teachers, parents, and peers on students is profound and far-reaching. These three key interpersonal relationships play a crucial role in shaping various aspects of a student's academic, social, and emotional development.

Relationships with Teachers

Academic success has been related to strong and encouraging teacher-student connections. Students are more likely to participate actively in their studies and display better levels of motivation and accomplishment when they perceive that their professors respect and support them. The classroom environment is more favorable and inclusive when there is good teacher-student interaction. An ideal learning atmosphere is created for all students when they feel free to express their thoughts, ask questions, and take academic risks. The social and emotional growth of kids is aided by teachers who show concern and respect. These connections can improve students' overall well-being, self-control, and self-worth. Better behavior control in the classroom frequently results from strong connections between teachers and students.

Relationships with Parents

Academic outcomes are positively impacted by parental participation in a child's schooling. Students often do better in class when parents take an active interest in and participate in their learning. Parents that are emotionally encouraging to their children might help them better handle stress and academic difficulties. Parents who encourage their children and recognize their accomplishments can boost motivation and foster a positive outlook on learning. Parental support encourages children to set higher standards for themselves and has an impact on their educational aspirations and future job choices.

Relationships with Peers

Essential social skills including communication, collaboration, and empathy are developed in pupils through peer interaction. These abilities are essential for developing wholesome connections and surviving social interactions throughout life. As children learn to handle disagreements, and peer pressure, and grasp other views, peer connections help pupils develop emotionally. Discussions, group projects, and peer feedback are all examples of collaborative interactions that foster knowledge sharing and comprehension. In addition to affecting students' self-concept and self-esteem, peer connections help pupils develop a feeling of social identity and belonging within their peer group.

Conclusion:

The study has advanced our understanding of the many roles that various persons play in influencing various aspects of students' academic life. In more recent thinking, a multifaceted framework known as "connective instruction" has also been proposed. This framework can help teachers more effectively incorporate relatedness into their daily pedagogical practices and classroom activities. When considered collectively, relationships-related research, philosophy, and practice attest to the value of interpersonal relationships for normal human functioning as well as practical strategies for enhancing these connections.The connections kids make with their educators, parents, and classmates have a significant influence on their academic success, social growth, and mental health. These connections provide an educational ecology that is encouraging and nurturing and is essential to kids' overall development and performance. Understanding the importance of these interpersonal interactions enables educators, parents, and legislators to put methods into place that promote gratifying and enriching relationships, producing an atmosphere that is supportive of a child's success.

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Exploring the Impact of Artificial Intelligence Integration on Relationship Satisfaction and Uncertainty

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ABSTRACT

This study investigates the effects of artificial intelligence (AI) integration on relationship satisfaction and uncertainty. It is critical to look at how these developments can impact close relationships as AI technologies grow more pervasive in many facets of everyday life, such as task management and communication. The survey included a broad group of couples who admitted to deploying chatbots or AI-powered products for tasks connected to their relationships. The study also revealed possible moderating factors including participant's technical familiarity, attachment types, and views about AI integration in interpersonal interactions. Participants' assessments of how AI affected their relationship dynamics were influenced by these factors. Understanding the influence of artificial intelligence (AI) on the dynamics of relationships is more important as human-machine interaction practices change. It is advised that further longitudinal research be conducted in order to examine the long-term effects of AI integration on relationship satisfaction and uncertainty.

Keywords:*Artificial Intelligence, Integration, Relationship Satisfaction, Uncertainty, Human-Machine Interaction, Chatbots, Task Management, Communication, Close Relationships*

Introduction:

Artificial intelligence can potentially play a role in relationship maintenance by assisting in communication, providing reminders, and automating certain tasks. AI-powered chatbots, for instance, might assist couples in organizing their time and activities or serve as a reminder for crucial anniversaries and occasions. Depending on the partnership, AI may have a different effect on relationship satisfaction. The support and convenience that AI products offer certain couples can increase their contentment. Some people, on the other side, could believe that AI ruins the intimate and emotional components of their relationship, which lowers levels of enjoyment. The introduction of AI into a relationship can cause ambiguity and doubt regarding the place of technology in their union. The purpose of the article is to investigate how AI integration affects the degree of relationship ambiguity that people feel. Uncertainty may be caused by worries about how AI affects emotional connection, how it affects relationship dynamics, and what it may mean for the future of the partnership. The goal of the study is to locate and examine possible moderating variables that affect the satisfaction/uncertainty of relationships and their link to AI integration. It aims to comprehend the factors that underlie people's favourable or unfavorable opinions about AI integration and how these opinions influence their actions and feelings in the context of interpersonal relationships.

The growing influence of AI technologies in various aspects of everyday life:

A key trend in recent years has been the expanding use of AI technology in many facets of daily life. A subfield of computer science called artificial intelligence is concerned with creating intelligent computers that can carry out activities that ordinarily call for human intellect. The integration of AI technologies into a wide range of fields and their fast advancement have had an influence on how people live, work, and engage with their environment. Virtual assistants with AI capabilities, like Siri, Alexa, and Google Assistant, have ingrained themselves into many people's everyday lives. These helpers are capable of doing things like setting reminders, responding to inquiries, operating smart home appliances, and even making tailored suggestions. AI is transforming healthcare by assisting with illness diagnosis, examining medical imagery, and forecasting patient outcomes. Applications that use AI to monitor patients' health problems can also make tailored therapy recommendations.

AI algorithms are also used to assess client preferences, forecast purchasing patterns, and provide tailored product suggestions. Other well-liked solutions for offering consumer support and help include chatbots and virtual shopping assistants. The development of autonomous drones and self-driving vehicles is a ground-breaking use of AI in the transportation industry that has the potential to revolutionize how people move and how commodities are transported. Machines can now comprehend, decipher, and produce human language thanks to AI technology. Speech recognition, machine translation, and sentiment analysis have all benefited from this development. To increase productivity, decrease mistakes, and improve safety, AI-powered robots and automation systems are being employed more and more in industrial operations.

The relationship between AI integration and relationship satisfaction:

Relationship Satisfaction and AI Integration: Some individuals might indicate higher relationship satisfaction as a result of the comfort and assistance provided by AI-powered products. AI may assist with time management, reminders, and activity coordination, lowering stress and increasing relationship efficiency. However, if some people believe that AI is displacing or weakening human connection, they may feel less relationship happiness. They could believe that AI falls short in its ability to assist and intimately connect with them on the same level as human connection.

- **Uncertainty and AI Integration:** The use of AI could reduce uncertainty by bringing regularity and structure to relationship maintenance. A sense of control and stability in the relationship might result from using AI-powered reminders and task management tools. Integration of AI can increase uncertainty for certain people. Feelings of concern over the relationship's use of AI might result from worries about privacy, data security, and the possibility of AI misreading emotions or intentions.
- **Moderating Factors:** People who are more comfortable with technology and AI may be more likely to see improvements in relationship satisfaction and less uncertainty. They could view AI as a useful tool rather than as a danger to their relationship. How AI integration affects relationship happiness and uncertainty may depend on attachment patterns. While people with anxious or avoidant attachment types could respond more strongly to how integrating AI will affect their relationships, those with secure attachment patterns may find it easier to adjust. Positive views regarding the use of AI in interpersonal interactions may make people more receptive to its advantages, which might improve relationship satisfaction and lessen uncertainty.

The effects of AI on relationship dynamics, satisfaction, and uncertainty:

The effects of AI on relationship dynamics, satisfaction, and uncertainty are influenced by how AI technologies are integrated into the context of intimate relationships.

- **Relationship Dynamics:** Communication between partners can be facilitated by chatbots and virtual assistants powered by AI. They could facilitate regular encounters by helping to plan events, remind people, and organize tasks. Applications for artificial intelligence are made to be a friend and a support system. In some circumstances, they could provide solace and engagement, even if they cannot take the place of genuine emotional ties. Changes in how couples communicate might result from using AI in maintaining relationships. For instance, the way they divide up work and communicate may change as they depend increasingly on AI for some activities.
- **Relationship Satisfaction:** Integration of AI can facilitate and improve the management of everyday tasks and obligations, which for some people results in improved relationship satisfaction. By preventing forgetfulness and missed meetings, AI technology might lessen sources of conflict in romantic relationships. The apparent effort couples put out to keep the relationship going may have an impact on relationship satisfaction. It may cause feelings of neglect and unhappiness if one spouse believes the other depends too heavily on AI.
- **Uncertainty:** Reminders and organizing tools enabled by AI may reduce uncertainty by fostering predictability and confidence in the upkeep of relationships. If AI systems are used to evaluate intimate data, the application of AI in relationship dynamics may give rise to concerns about data security and privacy. Uncertainty regarding AI's role in close relationshipsmay grow as a result of its failure to completely grasp and address complex emotional demands.
- **Challenges and Risks:** Artificial intelligence (AI) systems may misread feelings or intentions, resulting in misunderstandings and even conflicts. Over-reliance on AI for emotional support or decision-making may result in a decline in real human relationships, which will exacerbate relationship unease and uncertainty.

Recommendations for individuals and professionals involved in relationship counselling or technology development:

For Individuals:

- The effects of AI integration may differ depending on the particulars of each interaction. Avoid overly depending on technology for emotional support or decision-making by customizing the usage of AI to your shared requirements and preferences.
- To keep a healthy balance between human connections and technology in your relationship, establish explicit boundaries about the usage of AI. Make sure AI technologies enhance your relationship dynamics rather than taking the place of or weakening true human ties.
- Develop mutual trust in your connection as well as in the AI systems you are using. By choosing AI solutions with robust security safeguards and open data handling methods, you may address concerns about privacy and data.
- Monitor the relationship dynamics, satisfaction, and uncertainty on a regular basis in light of the integration of AI. To guarantee the greatest results, be willing to modify your strategy as necessary.

For Professionals Involved in Relationship Counseling:

- Keep up with the changing role of AI in maintaining relationships to better grasp how it may affect couples seeking counselling.
- During counselling sessions, ask clients about the role that AI technologies have had in their interpersonal dynamics.
- Examine the effects of AI use on communication styles, uncertainty, and relationship satisfaction.
- Encourage partners to communicate openly about their integration of AI experiences. As they consider how AI may affect their relationship, assist them in expressing their thoughts and feelings.
- Be aware of potential difficulties with AI integration, such as misunderstandings brought on by AI errors or excessive dependence on technology for emotional support. Make tailored suggestions to couples on how to incorporate AI into their union in a way that fits with their individual requirements and ideals.

CONCLUSION:

Technology and intimate relationships connect in an elaborate manner, which has been made clear by research on the effects of artificial intelligence integration on relationship satisfaction and uncertainty. The study's conclusions showed that various factors, including personality variations, attitudes toward technology, and the context in which AI is used, impact the effects of AI on relationship dynamics, satisfaction, and uncertainty. The study found that humans' perceptions and experiences of AI integration are moderated by characteristics including technical knowledge, attachment patterns, and views toward AI. Whether AI improves or complicates relationship dynamics depends in large part on these aspects. To leverage the benefits of AI integration while keeping genuine human relationships, couples can benefit from open conversation, trust-building, and maintaining a balanced approach.

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- April 2014 JOURNAL OF MARITAL AND FAMILY THERAPY 229
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The Creation of a Prognostic Health Monitoring System and a Safety and Failure Analysis of the Electrical Power train for Electric Vehicles

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1. ABSTRACT

Designing a prognostic health monitoring system for electrical powertrain components is one of the primary goals of the EU project HEMIS in order to improve the safety and maintainability of electric vehicles. Based on a generic design that tries to capture common properties of a wide range of electric cars, this paper summarises some of the preliminary work done in the areas of safety and failure analysis

Keywords: *powertrain, electric vehicle, electric car, failure analysis, HEMIS.*

INTRODUCTION

Due to the relative youth of the new technologies involved, moving towards mass manufacturing of hybrid and electric vehicles brings significant hurdles to the auto industry. The electrical powertrain, which consists of the electric traction machine and its related power electronics controller, is the most notable of these. Fully electric vehicles (FEVs) are characterised by the fact that their only source of traction is its electrical powertrain. Therefore, creating a Prognostic Health Monitoring System (PHMS) for the electric powertrain is one of the key goals of the EC project HEMIS in order to improve the safety and maintainability of FEVs. To do this, a generic electric vehicle architecture has been created and examined to look into pertinent safety and reliability issues. This has been accomplished by defining and analysing a generic electric vehicle architecture in order to look at pertinent safety and reliability issues and afterwards determine what is needed for the PHMS.

1. Electric vehicle general structure

The RAMS (Reliability, Availability, Maintainability, and Safety) analysis tasks in the HEMIS project need an input from the underlying architecture. As the intended audience for The architecture that is defined must be generic, expressing the general qualities of electric vehicles that are pertinent to the HEMIS PHMS, as opposed to any individual vehicle, as the HEMIS PHMS is a large class of electric vehicles. The suggested generic electric vehicle architecture must therefore strike a balance between the need to make the analysis general (and hence high level) and the need to take into account enough specifics to make the RAMS analysis feasible. During the RAMS analysis processes, it is predicted that the architecture may need to be further enhanced.

This research concentrates on system components that are significant for the PHMS and the electrical powertrain components that this system seeks to monitor because it is not practical to address the full vehicle in the HEMIS project. To define the vehicle architecture at a level appropriate for study, some presumptions on the nature of the vehicle were necessary. First off, it is presumptive that a near-future, high-end passenger vehicle will be the HEMIS PHMS' intended use. Previous EU research initiatives, such as [1] through [3], suggest that the following features can be expected to be included in such vehicles, and in-vehicle data network divided into a number of "functional domains"; x connections between cars and infrastructure Systems for Advanced Driver Assistance (ADAS).

Although alternative powertrain vehicles have a wide range of physical and electrical architectures, the HEMIS project's primary focus is on fully electric cars (FEVs) as defined in the context of the European Green Cars Initiative [4], which includes: cars that are electrically propelled and offer a sizable driving range using only battery power; x includes cars with range extenders; x including compact, light-weight passenger and light-duty vehicles.

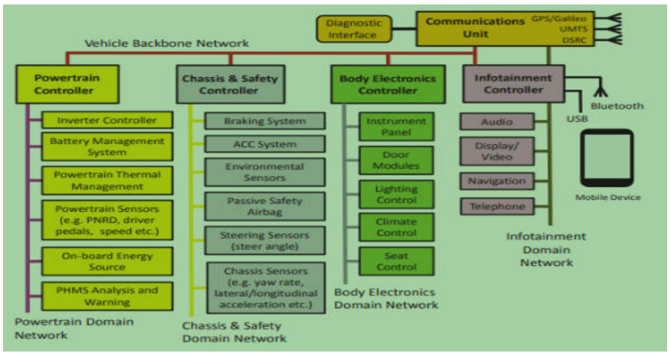

Fig. 1: HEMIS generic FEV architecture: network view.[27]

Thus, in addition to vehicles that are entirely powered by batteries, the FEV idea also include series hybrid architectures and vehicles that use alternative energy sources like fuel cells. As a result, the initial assumptions made about the electrical powertrain for HEMIS are that: x traction power is only provided by electrical machines, and not mechanically from any on-board source such as an internal combustion engine (ICE); x the electrical machine may be operated as a traction motor, or as a generator under braking conditions; and x the electrical machine may be operated as a generator under braking conditions. Being the most popular option, a high voltage traction battery provides electrical energy storage; Energy is assumed to come from the following sources: x the electricity grid (by conductive or inductive charging, the latter of which may be accomplished by wireless power transfer, during which the vehicle may be active but temporarily stationary above a source coil embedded in the road, or possibly even while in motion as in [5]); x energy recovery during regenerative braking; x possibly from an on-board energy source (which could be an ICE or turbine connected to a generator); A HEMIS PHMS that is focused on the electrical gearbox components (i.e., the electrical machine(s) and their related power electronics and control systems) is also presumptively installed in the vehicle. Based on [3], the presumptive network architecture is shown.

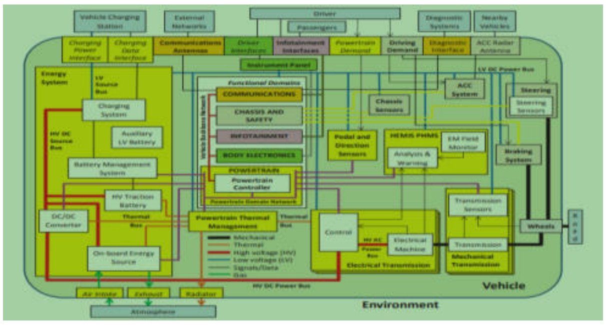

Fig. 2: Functional picture of the HEMIS generic FEV architecture.[27]

2. Main functions of vehicle

The distribution of the vehicle systems throughout the five functional domains of the powertrain, chassis and safety, body electronics, infotainment, and communications is assumed in Figures 1-2. All domains are connected to a Vehicle Backbone Network, which allows for inter-domain communication, while each domain has its own network for intra-domain communication. Each domain has a domain controller, which serves as a back-up domain system in the event that the associated systems fail and serves as a gateway to the Vehicle Backbone Network. Although the Powertrain Domain is the one that HEMIS is most interested in, some Chassis and Safety Domain systems may also interact with Powertrain Domain systems in a meaningful way. Additionally, the Body Electronics Domain is interesting due to its function in informing and alerting drivers. However, the importance of the Infotainment and Communication domains for PHMS operation is smaller.

The architectural description was used to specify the high level functionality of the systems. The Energy System in the Powertrain Domain offers resources for getting, producing, and storing energy as well as for supplying energy to the Electrical Transmission. The HV Traction Battery, DC/DC Converter, On-Board Energy Source, Control, and Electrical Machine are just a few of the important powertrain sub-systems that the Powertrain Thermal Management system controls for maximum performance.

The Pedal and Direction Sensors, which keep an eye on the accelerator pedal and PNRD (Park, Neutral, Reverse, and Drive) selection lever, transmit driver demand to the powertrain. Torque delivery to the Wheels via the Mechanical Transmission is the primary purpose of the electrical powertrain (the Electrical Transmission of Figure 2). It is anticipated that the Electrical Transmission, under the direction of the Powertrain Controller, implements more complex tasks of the electrical powertrain, such as idle creep, hillhold, and torque vectoring. Regenerative braking, which essentially provides energy harvesting when the accelerator pedal is released if the machine's rotor is still turning, is also taken into consideration, however it is presumed to be Category A as specified in [6].

The Braking System of the Chassis and Safety Domain is the major source of braking. This system is also expected to include a variety of improved braking features, such as electric parking brakes, electronic stability control, and brake aid of Category A, which has been required since 2011 [9]. These features have all been required since 2007 and include anti-lock braking, brake assist of Category A, and electronic stability control. An Adaptive Cruise Control (ACC) system, as well as the Steering Sensors and Chassis Sensors, are additional systems from the Chassis and Safety domain that communicate with the electrical powertrain. The Chassis Sensors have parameters like longitudinal acceleration, which are needed as an input to the hill-hold function, which is carried out by the Powertrain Controller and Electrical Transmission. The ACC system also features a speed control function.

Hazard analysis of vehicles

A preliminary hazard analysis (PHA) is conducted by going over a system's high level functionality and operational environment. This makes it easy to recognise the dangers that could arise if the system's objective is not accomplished. The use of guidewords is suggested because the PHA is designed to be systematic and repeatable. The PHA makes a distinction between system failures and hazards, and the system under study must be taken into account without any safeguards or mitigations. Furthermore, for this kind of analysis, implementation specifics are irrelevant.

The HEMIS PHA was built on the foundation of the general architecture described in section 2. The goal of this investigation was to pinpoint risks related to vehicle handling and stopping distance, as well as risks related to acceleration and deceleration (i.e., unavailable, un-demanded, excessive, insufficient and reversed). The high level functions described in section 3 were evaluated to find functional flaws that might lead to dangers. The Powertrain Domain, Chassis and Safety Domain, and Electrical Transmission and Energy Systems were the main areas of analysis for these functional domains.

The process of identifying hazards was divided into two phases: the first phase focused on functional system failure-related risks, while the second phase focused on non-functional hazards that are inherent to the unique technologies used in the vehicle. The latter featured high voltage electrical power networks, traction batteries, and on-board energy production systems like fuel cells. Fire, explosion, exposure to dangerous compounds, and exposure to high voltages are a few of the potential risks associated with these. The PHA's goal is to convert system risks into design restrictions or functional safety requirements. After being found, each risk was evaluated in terms of Using qualitative classifications outlined , assess their possible effects ("severity"), likelihood of exposure to the danger ("exposure"), and chances for the driver to have some control over the result ("controllability"). The resulting hazards were then determined and categorised in accordance with the Automotive Integrity Levels (ASILs) of using a risk graph. The individual systems and functions that may result in the possible dangers were also identified using fault tree analysis (FTA) and failure mode and effects analysis (FMEA). The targeted, deductive nature of FTA may discover failures that the larger, inductive FMEA methodology could miss, making the FMEA and FTA methodologies complementary. On the other hand, the extensive coverage offered by FMEA may reveal pertinent problems that are outside the purview of the more constrained FTA analyses.

3. The design of electrical transmission

To enable more thorough study of the components that are supposed to be monitored by the PHMS, the Electrical Transmission's design was further improved, as shown in Figure

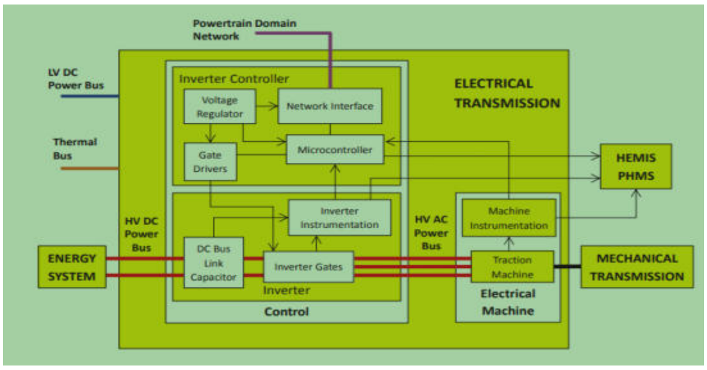

Fig.3: Information about the architecture of electrical transmission.27]

Three different types of traction machines were taken into consideration based on surveys of already available vehicles (like [11]) and conversations with vehicle and machine manufacturers. These featured switching reluctance machines, permanent magnet synchronous machines, and squirrel cage induction machines. The main parts of the three different types of machines—the rotor, stator, bearings, windings, etc.—are fundamentally the same. The implementation of the rotor magnetic field source is where they diverge most. A steel cage made up of rotor bars and rotor end rings forms the magnetic field of the rotor in the squirrel cage induction machine. Permanent magnets, primarily made of rare-earth elements, serve as the rotor magnetic field sources for the permanent magnetic machine. Salient rotor poles made of soft magnetic material that protrude from the rotor core in the switching reluctance machine provide the rotor magnetic field. As a result, while the failure types do differ slightly from one another, the failure behaviours as a whole are relatively similar.

The underlying design of the power electronics and controller utilised to power these devices is also similar. The failure behaviours are, thus, once more extremely similar for the Different circuit topologies are needed to drive the various machine kinds. FMEA and FTA were used to investigate potential functional failure mechanisms of the generic electrical powertrain utilising functions specified in accordance with the architecture shown in Fig. 3. Additionally, an overview of how electrical powertrain issues relate to the vehicle-level functional safety threats was developed using Ishikawa diagrams [12], offering a detailed breakdown of all potential reasons that could result in the bad outcome. This method offers a graphic picture of the connections between all of the possible reasons, making it easier to pinpoint the problem's underlying causes. In order to ensure that functional safety targets are met, the FMEA approach provides a mechanism for identifying and prioritising those failure modes that would call for remedial action.

4. Faults in transmission

Since these technologies are still in their relative infancy, specific information about problems in car traction machines and related power electronics converters is not generally available. There is, however, some information about comparable equipment used in other applications. At voltages below 1 kV RMS, electrical machine connection faults are reportedly relatively rare [13], but at higher voltages, they are more frequent due to increased dielectric stresses and strains on conductors. According to reports, hybrid and electric car traction battery voltages range from 120 V [14] to 650 V [15], which suggests that connection failures in traction machines now utilised in automotive applications may be improbable. However, it is generally acknowledged that bearing-related failures are the most frequent reason for electrical machine failure, with stator-related faults and other rotor-related faults making up the next two most important fault types. Table 10—which is based on the surveys mentioned in [16] and [17]—breaks down these categories into more detailed component flaws. Both surveys' findings are fairly similar, with 41% of defects being attributed to bearings, 35-36% to stators, and 9-10% to rotors. Stator ground insulation issues, which account for 22-23% of machine failures [16]–[17], are the main cause. These results, however, are heavily influenced by larger, higher voltage machines with higher degrees of vibration and dielectric stress, which could not accurately represent the properties of car traction motors. Additionally, it is said in [13] that larger machine bearings tend to be more dependable than those of smaller machines. According to a review of small (75 kW), low-voltage machines (often squirrel cage IM), bearing faults were to blame for 95% of the failures, whereas stator and rotor issues only accounted for 2% and 1% of the failures, respectively [18].

However, it is stated in [19] that because induction motors used for automotive traction applications experience more frequent, rapid temperature rises than comparable machines used for industrial applications, electrical issues may be far more common in the latter. In squirrel cage induction machines, these temperature variations could hasten the deterioration of insulation and result in mechanical strains that could lead to cracks forming at the intersections of the rotor bars and end rings. As a result, while the results of [18] would seem to indicate that bearing problems are the primary cause of machine failures in automotive traction applications, insulation and rotor-related faults may also play a substantial role in electrical machine failures. Failures in the converter were claimed to be caused by defects in capacitors (30%), PCBs (26%), semiconductors (21%) and solder (13%), according to a survey based on 200 items from 80 businesses [20]. Another industry-based survey's findings [21] indicate that 40% of semiconductors, 26% of capacitors, and 24% of gate drivers have problems. These findings imply that power semiconductors and DC link capacitors are likely to be responsible for a sizeable share (perhaps between 50 and 60 percent) of potential inverter failures.

5. Possible phms inputs

The Inverter and Electrical Machine sensors, as well as other vehicle metrics that may be relevant to their performance, will be monitored by the HEMIS PHMS in order to evaluate the health of these important electrical powertrain components. The remaining useful life may be predicted as well as flaws and degradation could be found using this information. This would improve dependability, availability, maintainability, and safety by warning the driver of potential issues and the need for repair.

Fault Indicators	Fault Types							
	Bearing and seals	Air-gap eccentricity	Rotor Bars	Winding short circuit	Insulation	Rotor Shaft	Rotor Core	Stator Core
Current	×	×	×	×	×			
Vibration	×	×	×	×		×	×	×
Temperature	×			×	×		×	×
Partial discharge				×	×			
Gaseous emission				×	×			
Air-gap torque				×				
Power				×				
Magnetic flux	×	×		×				
Acoustic emission	×							

Table 1: Possible signs of induction motor issues.[27]

Based on the reviews described in [22] and [23], Table 1 below provides an overview of the physical features used to track the signs of typical induction machine defects. Automotive traction machine failures are thought to most frequently be caused by issues with bearings, insulation, and rotor components (see section 6). As a result, the findings in Table 1 imply that temperature, vibration, and current may be helpful HEMIS PHMS indicators. Without the requirement for extra sensors (which might be more expensive and less reliable) or access to the machine, stator current signature monitoring may also be able to provide information on machine vibration characteristics. Additionally, the stator current is frequently already being watched for other purposes, such as safeguarding the machine against harmful fault currents and keeping an eye on the efficiency of inverters. Damaged bearings, fractured rotor bars, and air-gap eccentricity are a few vibration-related faults that might be identified by their effects on the stator current signature [22]–[23]. The large fluctuations in operating circumstances that arise during driving, however, may necessitate the use of more advanced signal processing techniques for automotive applications. It has been demonstrated that approaches based on short-time Fourier Transform and Wavelet Transform methods are appropriate for a range of load circumstances [23]. Based on tracking the stator current vector, methods for identifying IGBT failures in a PWM voltage source inverter drive for an induction machine are detailed in [24]. According to these methods, the damaged semiconductor may be located, and data clustering algorithms provide a reliable assessment that is not reliant on rotor speed. Due to the changeable speed and load conditions, the latter is especially interesting for FEV applications.

Drive capacitor failures brought on by ageing are often tracked in terms of the capacitor's ESR (equivalent series resistance) through Fourier studies of current or voltage data [25]. According to [26], when loads are reasonably constant, ripple voltage and ripple current are good indicators of capacitor ageing; if not, the ratio of ripple voltage to ripple current is used. An alternative method based on system modeling is proposed to estimate the ripple voltage from the converter input current in the absence of ripple monitoring. Alternative real-time condition monitoring is also suggested in [26], where the capacitance and ESR values are estimated.

6. CONCLUSION

According to ISO standards, a generic electric vehicle architecture has been proposed and utilised as the foundation for safety assessments 26262, FMEA, and FTA) to look into the specifications for a prognostic health monitoring system (PHMS) to watch over the electrical powertrain parts. The failure mechanisms related to the electrical machine and its related power electronics have also been examined in further detail utilizing Ishikawa diagrams, FMEA, and FTA techniques. Opportunities for electrical powertrain component condition monitoring have also been briefly addressed. The large fluctuations in operating circumstances that arise during driving, however, may necessitate the use of more advanced signal processing techniques for automotive applications. The breadth and accuracy of condition monitoring for electrical powertrain components are thus expected to be improved, as well as the accompanying forecasting capabilities, by merging information from a variety of sensors and analysing them using a variety of processing approaches.

Therefore, future work will focus on choosing the parameters that the HEMIS PHMS should monitor and developing appropriate analysis algorithms for eventual implementation and prototype presentation.

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SOLAR TREE: New Proposed Model for Harnessing Solar Energy and its Scope in India

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ABSTRACT

This review paper consists of study of a new design solar model which can overcome the drawbacks of conventional method of collecting solar light. In present work we study a solar tree model which structure is based on the pattern of natural tree. As in natural trees leaves and branches are arranged in a manner so that they can capture more sunlight for their living. And by arranging this way they avoid shading from each other. This special arrangement is called phyllotaxy which is directly related to the Fibonacci number and Golden ratio. In a similar way if solar panels are being arranged by using specific pattern they will be oriented in different directions. As sun moves through different locations in the sky throughout the day, each panel gets good share of sunlight at different instant of time and boost up the overall power of solar tree.

Keywords- solar photovoltaic; three-dimensional; phyllotaxis

Introduction

At the present time people are being aware of the importance of use of renewable energy sources in which solar energy resource is playing a crucial role. Solar power dominates fossil fuels greatly in two manners: (a) Solar power is renewable form of energy and it is never going to run out. (b) It is eco-friendly. Among all the energy sources available, solar energy is the most promising.

Solar power can fulfill the world's energy need either directly or indirectly. But solar energy must be utilized properly. However extracting power from sun efficiently is a major challenge. Several techniques are being devised for extracting power from sun efficiently. The P-V cells available in solid silicon crystalline forms are being used for conversion of insolation to electricity. Other form like amorphous or thin film cells are also available but most efficient is the solid crystalline PV cells for direct absorption of sunlight. The other applications of solar energy are water and building heating etc. However these uses are less efficient as compared to PV technology. Solar PV technologies convert solar energy into usable energy forms by directly absorbing solar photons-particles of light that act as individual units of energy-and either converting parts of energy into electricity as in a PV cell or storing part of the energy in chemical reactions. The main focus of this work is on the PV cells.

Generally in solar power generation system PV panels are erected on a hut like fixed structure in open space under the sun and for large power generation these structures require large area of land surface in acres. Land is already a burning crisis in most of the countries and it would be uncountable loss if land is used for other purposes than agriculture. Along with most of the agriculture areas are in need of electricity but are far away from the conventional power plants. Hence, using vast land, for capturing solar power would never be cost effective and viable for human being.

The above stated problem motivated us to go through and study new models which can utilize minimum land for maximum solar power absorption by creating maximum solar surface termed as a solar tree. From here comes the idea of solar tree design in which solar panels are arranged along the branches of solar tree stem such that at each node there is only one solar panel. This technique of arranging solar panels is termed as spiraling phyllotaxis which is usually followed by natural trees.

This paper is organized as follows. In section 2, we present basis of solar tree design. In section 3, we discuss how performance analysis of solar tree can be done. In section 4 we present different modifications to be done in solar tree design and its future scope.

1. Basis of solar tree design

Design of solar tree model is bio-inspired so that solar panels can absorb more sunlight similar to the leaves of a natural tree. Hence there is a need to know about some terms which are the basis of solar tree design and plays an important role in growth of natural plants.

Phyllotaxy is the arrangement of leaves on a tree. Phyllotaxy shows the apical meristems growth of a plant. This is defined by meristems consist of organogenic cells that are established during plant embryogenesis and are found in plant segments where growth takes place. Apical means at the top-peak or summit of a structure. **(Barabe, et al., 1997)**

The basic phyllotactic patterns in the plant kingdom are (a) opposite phyllotaxis (b) whorled phyllotaxis (c) alternate phyllotaxis

Alternate phyllotaxis pattern is used in our solar tree model. Hence there is only one solar panel at each node. The spiral patterns, natural trees follow, include **Fibonacci numbers**. As spiral pattern of oak tree, almond tree, elm tree, poplar tree, beech tree etc. can be given as respectively 2/5, 5/13, 1/2, 3/8 and 1/3. All these numbers 1, 2, 3, 5, 8, 13…. form the **Fibonacci sequence**. The formula of Fibonacci sequence is

$$F_{n+1} = F_n + F_{n-1} \qquad (2.1)$$

This Fibonacci pattern is the basis of design of our solar tree model. **(Grigas, 2013)**

2.1 Proposed material and methodology for solar tree design

For the design of solar tree materials to be used are listed as below:

(a) a PVC rod as a trunk of tree
(b) Al sheets as branches of tree
(c) solar panels as leaves of tree
(d) a base structure made of Al for holding solar tree model

Solar tree model can be designed by copying a fibonacci pattern of any tree suppose oak tree which is 2/5 (spiral phyllotaxy). In this pattern spiral takes two spirals around the main trunk to cover all the 5 branches and 6th branch is placed at the same position as of first branch from the main trunk. This can be understood with the help of Fig.2.1.

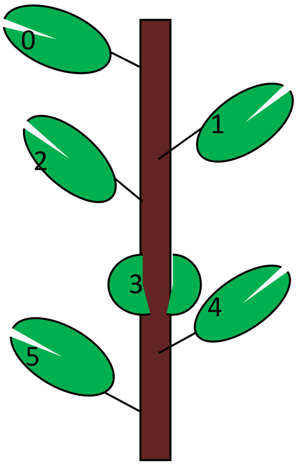

Fig.2.1 2/5 Phyllotaxis

As pattern is 2/5, hence angle between each branch can be calculated as follows:

$$\frac{2}{5} \times 360^{\circ} = 144^{\circ}$$

If we consider first branch from the top of main trunk as a reference then next branch is placed at an angle of 144° in anticlockwise direction (216° in clockwise direction). Similarly other branches are placed such that angle between successive branches remains 144° in anticlockwise direction. As the pattern is spiral phyllotaxy, at each node there is only one branch. Position of panels of solar tree will depend upon latitude of the site where solar tree is to be installed as maximum solar exposure by a solar panel can be done when its tilt angle becomes equal to latitude of site.

Depending on a location if tilt angle of first panel is 29° then other panels can be oriented in following ways

Table 2.1 Orientation and tilt angle of different panel

	Tree Solar						Conventional Panel
	From Top to Bottom of Main Trunk						
	1st panel	2nd panel	3rd panel	4th panel	5th panel	6th panel	
Tilt angle	29°	**7**°	43°	79°	65°	29°	29°
Orientation	South	North-East	West-South	South-East	North-West	South	South

1.3.1. Design layout of solar tree model

Design specifications of solar tree model can be given with the help of Fig.2.4

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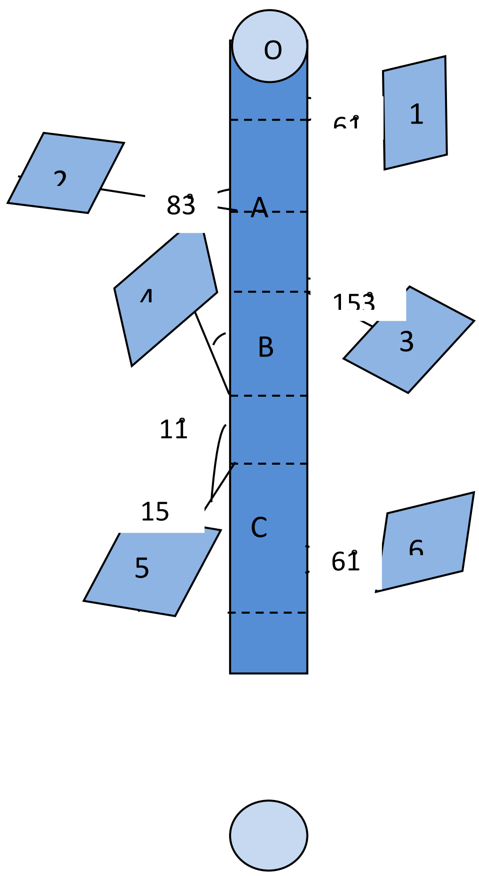

Fig.2.4 Structure of solar tree model

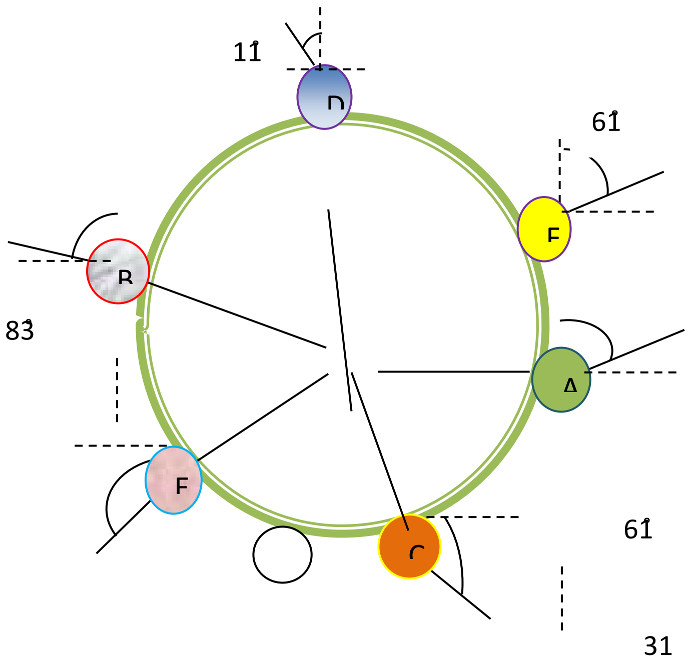

Fig.2.5 Position of different branches from top-view of solar tree

Calculation of circular distances between different points in Fig.2.5 can be done using following formula:

$$\text{arc} = \text{angle}(\text{made by arc at the centre of circle in radian}) * \text{radius}$$

2. **Analysis of solar tree performance**

To analyze the performance of solar tree model a conventional panel of same rating can be used so that parameters of both models are compared under sunlight. We can compare power values and irradiation level of different duration in a day as well as of different days on both models. By using instruments like solar power meter, multi-meter, rheostat as load, wires, connecting leads and probes voltage and current parameters of both models and irradiation level at both models can be calculated. And by using these parameters power values (P= V*I) for both model can be calculated.

3. **Modifications in solar tree design and its scope in India**

As in proposed model of solar tree different panels are oriented in different directions, we can use mppt techniques at each panel so that each panel can receive maximum amount of sunlight in every direction. Using this solar tree model will become more efficient. As we use 6 panels in our solar tree model according to 2/5 pattern, it is one-stage model. We can increase number of stages in solar tree model to increase amount of power generation. As we increase height of solar tree to increase number of panels, to avoid shading effects we can use blocking and bypass diode across each panel.

The state and national highways are big sources for Solar Power Tree (SPT) plantations. Two sides of single road high ways and the three sides of double road highways including island in between can be utilized for solar power trees. A simple calculation shows that if the National Highway is used for plantation of solar power trees from Kolkata to Asansol which is around 300 km in length it would be possible to produce 110 MW by installing solar power trees of 2KW capacity through the road sides at a certain interval (say 15 meter between two trees). This would actually require 660 Acres of land for the same power generation at a single place by the existing method of laying out solar panels in a conventional way i.e. over the roofs of low height fixed structures. The village roads and the big boundary walls of paddy lands can provide sufficient space for planting solar power trees that can supply enough power for electrification of villages and irrigation activities.

4. CONCLUSION

On comparing it can be concluded that Fibonacci tree design will overcome drawback of the flat panel model due to its specific design. Electricity will drop in the flat-panel array when shade fell on it but the tree design will keep making electricity as the Fibonacci pattern helps some solar panels to collect sunlight even if others are in shade. Fibonacci pattern helps branches and trees to avoid shading from each other. Bad weather like snow doesn't hurt it as panels are not flat. Hopefully if this new method of solar power tree plantation is adopted widely it would be possible to produce sufficient energy and to satisfy the demand of power for the world keeping the best ecological balance and preserving the nature as it is. A design like this may work better in urban areas where space and direct sunlight can be hard to find.

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Finite element analysis evaluated axial load distribution in a plane-piled raft foundation under medium-stiff clay.

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ABSTRACT

For the analysis of the stacked raft foundation that is described in this work, the nonlinear finite element method was utilized. A three-dimensional nonlinear finite-element analysis can be utilized to make predictions regarding the behavior of axial load distribution. Each and every one of the piles experiences a nonlinear change in their axial stress as time goes on. It is not only difficult but also very expensive to measure the axial load distribution in a pile field.

Keywords- raft foundation, axial load, finite-element

Krauthammer and Western (1988)

focus on the relationship between shear transfer capabilities across pavement joints and the effects on the behavior of the pavement. The approach of the present study is to develop a numerical model that could accurately represent the mechanism for shear transfer across reinforced concrete pavement joints and implement it in an existing finite element code. The tool is then used for the analysis of various pavements for which experimental data are available; the model is further refined until the numerical results are in good agreement with the experimental information.

Important papers which talk on piled raft foundations are Clancy and Randolph (1993)

Prakoso and Kulhawy (2001), Lin and Zheng(2006), Sanctis and Mandolini (2006), Shukla et.al.(2010), Al-Mosawi et.al (2011),El-Garhy et.al (2013) , Raut et.al (2015).

Based on literature review it has been found that not much work has been done on piled raft foundation by finite element method specially three dimensional nonlinear finite element method to predict the axial load distribution in a pile in piled raft foundation.

3. FINITE ELEMENT ANALYSIS

For finite element discretization one fourth of piled raft with equivalent area of raft taken from a single pile with equivalent area of raft from pile forest model. The bottom degrees of freedom are completely fixed. On the x-axis plane and the plane parallel to it z translation are fixed. Similarly on the z-axis plane and plane parallel to it the x translations are fixed.

The soil, pile and raft have been discredited as eight noded brick elements. The material behavior of pile and raft has been considered as linear elastic medium while the soil has been idealized as nonlinear material by Extended Drucker-Prager yield criterion. The total number of nodes is 1275 and the total number of elements is 800.

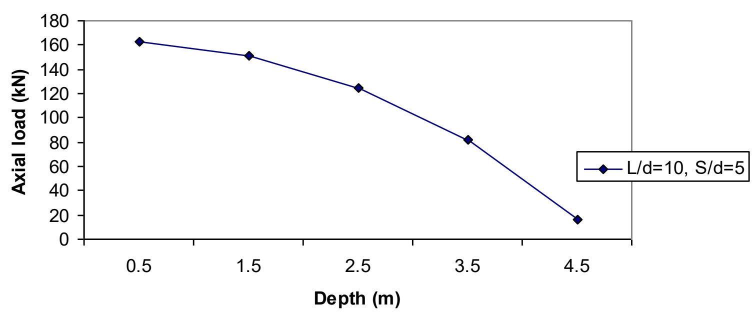

Fig.1. Axial load distribution in pile

4. RESULTS AND DISCUSSIONS

Fig.1 shows the axial load distribution for a single pile of length to diameter ratio of 10 for spacing to diameter ratio 5. The axial load is maximum in the top portion and then it decreases with depth. The variation of axial load distribution is nonlinear with depth.Fig.2 shows the axial load distribution for a single pile of length to diameter ratio 20 and spacing to diameter ratio of 5. The axial load is maximum in the top portion and minimum at the bottom portion. The axial load distribution is nonlinear. When compared with the axial load distribution of pile of length to diameter ratio 10 it is found that at any depth, the axial load is greater for pile of length to diameter ratio 20. Thus the total load taken by pile of length to diameter ratio 20 is greater than the total load taken by pile of length to diameter ratio of 10.

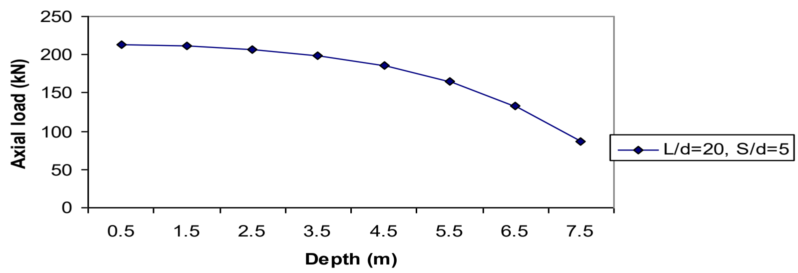

Fig.2 Axial load distribution in pile

Fig.3 shows the axial load distribution of pile of length to diameter ratio of 30. The variation of axial load distribution is nonlinear. At any depth the axial load distribution in a pile of length to diameter ratio 30 is greater than the axial load distribution of pile of length to diameter 10 and 20.

Fig.4 shows the variation of axial load distribution in a pile of length to diameter ratio 40. The axial load distribution is maximum in the top portion and minimum at the bottom portion. The variation of axial load distribution is nonlinear. At any depth the axial load distribution is greater in pile of length to diameter ratio 40 than the piles of length to diameter ratio of 10,20 and 30.ig.5 shows the axial load distribution of pile of length to diameter ratio of 50. Behaviour is similar as for piles of length to diameter ratio of 10, 20,30 and 40. At any depth the axial load distribution is greater than the piles of length to diameter ratio of 10,20,30 and 40.

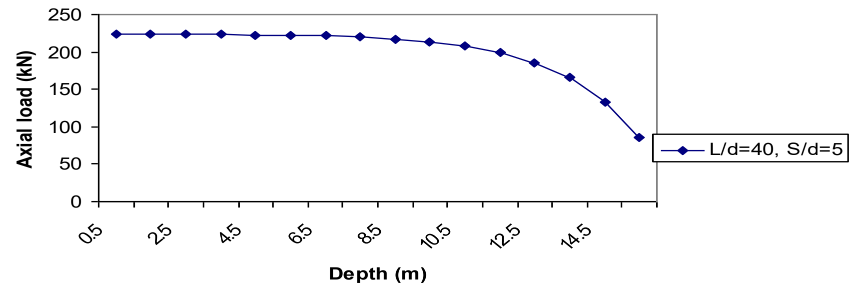

Fig.4 Axial load distribution in pile

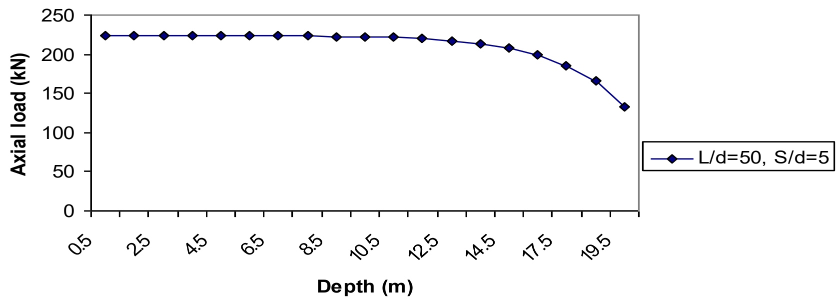

Fig.5 Axial load distribution in pile

5. CONCLUSIONS

The amount of deflection, also known as settlement, reduces in a way that is not linear with height. The level of environmental pressure is lowest at the base and gradually increases as one climbs higher. The horizontal settling is nearly identical all throughout, which contributes to the pavement's rigidity. Both the nodal deflection and the element stress are nonlinear and depth dependent. The axial load distribution in piles of varying length-to-diameter ratios can be predicted using a three-dimensional nonlinear finite element analysis. The axial load distribution for piles with length-to-diameter ratios of

10, 20, 30, 40, and 50 is highest at the top and lowest at the bottom. Every pile experiences some degree of nonlinear axial load fluctuation. The axial load distribution of piles in the field is difficult to measure and can be quite expensive. This problem can be solved by using nonlinear finite element analysis.

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On Strength and Durability of Bamboo and Other Building Materials in Civil Engineering Structures

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ABSTRACT

lifespan. There is a wide range of diversity in the traits of these creatures. The first step in developing a successful usage of bamboo in engineering is selecting the proper species of bamboo. Therefore, it is crucial to properly identify the various species of bamboo before employing it. Flooring, ceiling, walls, windows, doors, fences, home roofs, trusses, rafters, and purlins are just few of the many building applications that make substantial use of it. It is also used as a scaffolding material for tall buildings, bridges, and water transportation facilities. Sustainable development, which prioritises care for the environment, culture, and traditions in addition to technological progress and economic viability, can benefit from this bamboo research as well.

Keywords: bamboo, reinforcement, Water absorption, bonding strength.

1. INTRODUCTION

Since the beginning of the Industrial Revolution, new types of industrial materials have been developed to fulfil the ever-increasing demands of the industrialised world's population. Cast iron and, later, steel, were developed and employed extensively in mass production as a symbol of industrialization beginning in the middle of the nineteenth century. These days, they're in everything from the tools used in the construction industry to the knives used in the kitchen. Aluminium, another industrial material that has been mass produced and utilised in industry for less than a century, has already largely replaced steel in many applications due to its ability to provide the same level of strength at a fraction of the weight. Bamboo has several benefits over steel, cement, and plastic, including strength, flexibility, and light weight, but it also has limitations in processing and connection due to its tube structure, which is not ideal for compressive or shear loads. Finally, they located bamboo, a material that may be utilised in place of expensive reinforcing bars in concrete. Using the current distribution system, commercial quantities of bamboo can be obtained. It has a short rotation period and is a renewable resource. It takes bamboo around a year to reach maturity. The plant needs at least another year, preferably two or three, to reach its full potential. Bamboo is a sustainable resource that is abundant in rural parts of underdeveloped countries and simple to work with. Most species of bamboo are found in tropical and subtropical regions, however there are a few that can survive in colder climates.

2. LITERATURE REVIEW

Fujji et al. [1993] investigated the chemistry of the immature culm of a mosobamboo (Phyllostachys pubescens Mazel). The results indicated that the contents of cellulose, hemicellulose and lignin in immature bamboo increased while proceeding downward of the culm. The increase of cellulose in the lower position was also accompanied by an increase in crystallinity.
Amada et al. (1997) investigated the mechanical and physical properties of Bamboo. They conducted a thorough investigation into the structure and purposes of the nodes, which they found to strengthen the Bamboo Culm. They also commented on the advantage Bamboo has over other natural buildingmaterials with its fast growth rate.
Mardjono (1998) provided research with the effort to give some sort of organization of a system to building with Bamboo between cultures, species, and countries having varying designs. The objective of their research was to improve the functions of Bamboo buildings by this organization to provide privacy, safety, comfort, durability, and accessibility. Overall Bamboo used as a structural material suffers from an incredible disadvantage due to inadequate applied scientific research. They do feel that Bamboo productsshould be brought to the level of acknowledged and received building materials. The results of their research will be published as a thesis and guide for designing Bamboo structures to be dispersed to peoplein developing countries.

A study reported in International Standard Organization (ISO) (1999) fashioned lab manual for determining the physical and mechanical properties ofBamboo. The purpose for publishing this manual is first of all so that these methods are available all over the world. Research is done in so many places, very precise, yet is stuck in the laboratories. With this document, the methods are made available. Secondly, this document gives a practical step by step explanation of how to perform each test specifically following the International Standard Complement Document "Determination of Physical and Mechanical Properties of Bamboo." Another complement document is Bamboo Structural Design (1999).
Janseen (2000) conducted her study on building with Bamboo. This book covered a wide variety of aspects of Bamboo going back to the structure of the plant and its natural habitat. It gives calculations to show why it"s economically competitive, mechanical properties, its many uses, its natural durability, and the preservation of the Bamboo. In much more detail, it discusses the joints and building with pure Bamboo. In relation to this project, her book does touch on Bamboo used as reinforcement in concrete. Listed in her book are several things that are more of a hassle than steel reinforcement. Of those, the bonding between the Bamboo and concrete is considered the biggest problem due to absorption of water and smooth wall**.**

Power (2004) tells of a study conducted by the U.K. Department of International Development in response to a devastating earthquake that killed 40,000 peoplein Iran. The engineers were looking for cheapearthquake-proof housing to take the place of mud brick. They constructed a prototype Bamboo reinforced concrete house and used an earthquake simulator to find that the house stood sound during a
7.8 (on the Richter scale) earthquake.

They found no cracking in the concrete, the Bamboo to be extremely resilient to earthquakes, and the cost to be split in half compared to mud-and-brick construction

The American Bamboo Society (2005) provided a very intricate collection of specialized terms followed by their definitions relating to Bamboo. It also has a glossary of questions and answers common to someone new to the topic. These questions ranged from identifying Bamboo, preserving Bamboo, finding help with your Bamboo, to other topics not as closing connected to the research of this project.

Atul agarwal and Damodar maity (2009) they studied axial compression and bending test was performed on Plain, Steel & Bamboo reinforced members. As explained in there experimental program, For example, a total of 12 columns (150x150x1000mm) were casted using design mix (M20) as per IS code. These columns included of the Bamboo Culm

Amada and Untao (2001) mention that bamboo is the most effective material in construction by the superior character of bamboo such as being physically powerful, tough, and a low-cost material. Normally, the Culm of bamboo with outer surface layer withstand strongly to any loading with stronger fracture resistance than the node. It

suggests that the fibers in the node do not contribute any fracture resistance. The tensile strength of bamboo fibers almost corresponds to that of steel. The main discovery is that the fracture properties of bamboo depend upon the origin of fracture. In the nodes, it is found that the average fracture toughness is lower than the minimum value of the entire Culm, suggesting that the fibers in the node do not contribute any fracture resistance

Seinfeld (2001) researched the remarkable current uses of Bamboo around the world. In the United States, it is almost completely used as decoration. A discussion is presented on the astonishing feature Bamboo brings to the table as mentioned in other articles. Another special feature about Bamboo is that harvesting Bamboo does not harm the plant, producing more of its timbers. Bamboo buildings are definitely a prospect of the future in the US; however in Asia, the Pacific islands, and South & Central America, they are quite traditional.

The main prevention of Bamboo structures in America are building codes. There are not standardized codes for buildings of Bamboo though there are attempts towards them. Bamboo is also still being looked at as a way to clean environmental pollution. It is a consumer of Nitrogen, which could soon be part of a huge effort to prevent air pollution. designs for construction of bamboo scaffolds. The commonly used bamboo types are Kao Jue and Mao Jue. They should be 3 to 5 years old and air-dried in vertical positions under indoor condition for at least 3 months before use. The nominal length of both Kao Jue and Mao Jue is 6 m. All bamboo members should be free from visual defects, and meet the following requirements on the cross-sectional dimensions. This section provides detailed standards of design and construction of some typical types of single bamboo scaffold, including double-layered, truss-out and signboard bamboo scaffolds. When the recommended standards given in this section are not followed or when other types of bamboo scaffold not covered in this section are used, they should be designed by a design engineer. For a bamboo scaffold for demolition.

CONCRETE MIX PROPORTIONS

The same mix designs can be used as would normally be used with steel reinforced concrete. Concrete slump should be as low as workability will allow. Excess water causes swelling of the bamboo. High early-strength cement is preferred to
Minimize cracks caused by swelling of bamboo when seasoned bamboo cannot be waterproofed.

SIMILARITIES WITH STEELREINFORCED CONCRETE

Bamboo reinforced concrete design is similar to steel reinforcing design. Bamboo reinforcement can be assumed to have the mechanical properties. hen design handbooks are available for steel reinforced concrete, the equations and design procedures can be used to design bamboo reinforced concrete if the above mechanical properties are substituted for the reinforcement. Due to the low modulus ofelasticity of bamboo, flexural members will nearlyalways develop some cracking under normal service loads. If cracking cannot be tolerated, steel reinforced designs or designs based on unreinforced sections are required. Experience has shown that split bamboo
works, irrespective of its size, the design engineer should also ensure the bamboo scaffold is capable to withstand the increased wind load acting on the plasticsheeting.

Steel Brackets Scaffolds
Steel brackets are essential to the overall stability of a bamboo scaffold. The details of a steel bracket for thesupport of posts of a bamboo scaffold for constructionsite. All steel brackets should be securely mounted onto the structural elements of a building with high quality anchor bolts and comply with the following requirements. The horizontal spacing between the steel brackets should not be larger than 1.3 m;and the concrete strength of the structuralelement to which the steel bracket is fixed should be not less than 25 N/mm2. All anchor bolts should be installed strictly in accordance with the manufacturer's recommendations. There may be occasions that a post of a bamboo scaffold does not rest on the steel bracket; the design engineer should ensure that the loading from the misaligned post can be effectively transferred to the steel bracket

3.1.1Guidelines for Bamboo Scaffolds

Performance
Design Engineer
Drawings and Specifications
Engineering Justifications

Performs better than whole culms when used as reinforcing. Better bond develops between bamboo and concrete when the reinforcement is-split inaddition to providing more compact reinforcement layers.

4.CONCLUSIONS

- Bamboo strengthening concrete. Bamboo can replace steel in basic urban poor dwellings near bamboo farms.

- The main and distribution reinforcement now use bamboo reinforcement like steel reinforcement did. Bamboo sticks can be adapted to reinforce reinforced concrete beams.
- Bamboo can replace steel reinforment due to its high tensile strength and low cost.
- Like steel reinforcement, bamboo is used for main and distribution reinforcement. Bamboo is far less elastic than steel.

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The Mechanical Properties And Durability Of Concrete Deteriorate When Exposed To High Temperatures

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ABSTRACT

Concrete batch mix composition, heating rate, and environmental conditions. Thermal, mechanical, and deformation qualities of concrete affect how a structural member reacts to fire. . Concrete composition and temperature affect these qualities. A 150x150x150 mm cube was heated to 600°C at 5 °C/min to determine mechanical property degradation and compared to other research and codes. Pore pressures were determined using 150 x 150 x 150 mm blocks heated to 600°C at 5°C/min and 25°C/min. Experimental evidence of complicated, temperature-dependent moisture transport. Which greatly affected pore pressure and temperature developments?

Tension and other important factors must be tested at elevated temperatures to build well-founded models and improve proposed correlations. General, reasonable models and linkages match experimental evidence.

Key Words- compressive strength, High Temperature, concrete mix, mechanical behaviour

INTRODUCTION

Background of high strength concrete

Concrete fire behaviour depends on temperature-dependent material features. Fire-exposed concrete members have large temperature gradients because thermal diffusivity is poor compared to steel. With significant thermal inertia, the core region may take a long time to heat up. Hence, while concrete loses compressive and flexural strength fast beyond a critical temperature, which is equal to the equivalent temperature for steel strength loss, structural efficacy is not impaired until the bulk of the material reaches the same temperature. Thermal study of the structural part is needed.

Engineers worry about accidental fires in concrete structures because they cost lives and property. Stress affects concrete differently. Micro-cracking at the mortar-aggregate interface causes conditions (transition zone) High-rise buildings and infrastructure, which use concrete structural components, must include structural fire safety. Fire resistance is the length of time a structural member resists structural integrity, stability, and temperature transmission. Concrete has the best fire resistance. Cement and aggregates chemically react to make concrete, which is inert, has low thermal conductivity, high heat capacity, and slower strength deterioration with temperature. . Fire resistant design rarely uses room-temperature concrete qualities. So, the fire safety practitioner must know how to extend the technical literature's limited property data based on a priori considerations. .

Significance of research

The structural safety of such structures after exposure to high temperature. The important factor that the effect on strength be well understood. The spatial and temporal variations in exposures, including the cooling phase of the fire. Progress has been made on modelling the thermo-mechanical behaviour but the treatment of detailed behaviours, including hygral effects and spalling, remains a challenge. , the provisions for concrete strength at elevated temperatures in current major codes and authoritative guides, such as the Euro code and CEB model code, are unconstructive when applied to HSC. In fact, these provisions were developed based on NSC data and didn't make the distinction between HSC and NSC the difference between HSC and NSC in its provisions for concrete strength at elevated temperature. However it is found slightly conservative for HSC at temperatures higher than 350°C. Thus the study proposes a strength-temperature relationship for HSC. The project provides initial findings of an ongoing study on the behaviour of high strength concrete under at elevated temperature.

Modes of failure

Spalling- The fire performance of a concrete structural member is spalling. This property is unique to concrete and can be a governing factor in determining the fire resistance of an RC structural member. Spalling is defined as the breaking up of layers (pieces) of concrete from the surface of a concrete member when it is exposed to high and rapidly rising temperatures such as those encountered. In fires. These actions lead to the development of fractures and expulsion of chunks of material from the surface layers. More specifically, the main prerequisites for spalling have been established as: moisture content of at least 2%, and steep temperature gradients within the material. It is sometimes argued that high-strength concrete is more prone to spalling, due to its lower porosity and hence the increased likelihood of high pressure developing within the concrete structure. This process is often assumed to occur only at high temperatures, yet it has also been observed in the early stages of a fire and at temperatures as low as 200°C. The mechanism leading to spalling is generally thought to involve high thermal stresses resulting from rapid heating and/or large build-ups of pressure within the porous concrete, which the structure of the concrete is not able to dissipate, due to moisture evaporation.

Cracking-Thermal expansion and dehydration of the concrete due to heating may lead to the formation of fissures in the concrete rather than, or in addition to, explosive spalling. Transient strain occurs during the first time heating of concrete, but it does not occur upon repeated heating. Exposure of concrete to high temperature induces complex changes in the moisture content and chemical composition of the cement paste. Moreover, there exists a mismatch in the thermal expansion between the cement Paste and the aggregate. Therefore, factors such as changes in chemical composition of concrete and mismatches in thermal expansion lead to internal stresses and micro cracking in The concrete constituents (aggregate and cement paste) and results in transient strain in the concrete. . It was found that the penetration depth is related to the temperature of the fire, and that generally the cracks extended quite deep into the concrete member. Major damage was confined to the surface near to the fire origin, but the nature of cracking and discoloration of the concrete pointed to the concrete around the reinforcement reaching 700°C. Cracks which extended more than 30 mm into the depth of the structure were attributed to a short heating/cooling cycle due to the fire being extinguished.

EXPERIMENTAL PROGRAM

Testing report on various trial mixes

Testing report for cube Compressive strength of different trial mixes.

Trial Mix Batch Six cubes (15 cm x 15 cm x 15 cm) were casted and tested for Compressive strength.

TABLE 1.MIX PROPORTION Batch Report of Batch-I

Material	Proportions
Cement	553 kg/m^3
Coarse aggregate	1141 kg/m^3
Fine aggregate	740 kg/m^3
w/c ratio	0.31
HRWR	450 ml per 50 kg of cement
Silica fume	7%

TABLE 2 Cube Compression Testing

S.NO	Date of Testing	No. of Days	Cube-I	Cube-I
B-I	22-06-2014	28	37	36
B-I	22-06-2014	36	41	43
B-I	22-06-2014	45	41	43
B-I	25-06-2014	60	44	46
B-I	25-06-2014	28	37	36

TABLE 3 MIX PROPORTION Batch-II

TABLE 4.Cube Compression Testing Report of Batch-II

Material	Proportions
Cement	475 kg/m^3
Coarse aggregate	1042.5kg/m^3
Fine aggregate	719 kg/m^3
w/c ratio	0.31
HRWR	500 ml per 50 kg
Silica fume	10%

S.NO	Date of Testing	No. of Days	Cube-I	Cube-I
B-I	22-06-2014	30	38	36
B-I	25-06-2014	45	40	38
B-I	25-06-2014	60	44	46

B-III six beams (15 cm x 15 cm x 15 cm) were casted

TABLE 5.MIX PROPORTION Batch-II I TABLE 6 Cube Compression Testing Report of Batch-III

Material	Proportions
Cement	500 kg/m^3
Coarse aggregate	1060 kg/m^3
Fine aggregate	680 kg/m^3
w/c ratio	0.32
HRWR	450 ml per 50 kg of cement
Silica fume	500 kg/m^3

S.NO	Date of Testing	No. of Days	Cube-I	Cube-I
B-I	04-07-2014	36	38	36
B-I	11-07-2014	45	43	40
B-I	26-07-2014	60	44	45

Trial Mix Batch-IV

Six cubes (15 cm x 15 cm x 15 cm) were casted

Table 7.Mix proportions Batch B-IV

Material	Proportions
Cement	450 kg/m^3
Coarse aggregate	1030 kg/m^3
Fine aggregate	750 kg/m^3
w/c ratio	0.33
HRWR	450 ml per 50 kg of cement
Silica fume	10 %

TABLE 8 Cube Compression test Report of Batch-IV

S.NO	Date of Testing	No. of Days	Cube-I	Cube-I
B-I	04-07-2014	7	42 MPa	39MPa
B-I	11-07-2014	21	39 MPa	34 MPa
B-I	26-07-2014	28	42 MPa	43 MPa

STANDARDIZED MIX

Different mixes are tried and variation of cube Tensile strength is measured with mix proportions and finally mix with maximum cube compressive strength is taken as standard mix. After standardization of mix beams and cylinders were casted.

In all 90 cylinders & 30 beams were cast in the form of different batches. To derive inference they were subjected to various temperature ranges and conditions of gradual cooling and sudden quenching. All the batches cast in this semester were having the same mix proportions (mentioned in the table below). This mix was derived on the basis of various trial mixes done in the previous semester. But problem of variation in atmospheric temperature was critical as temperature changes drastically in summer (in this situation water readily evaporated from the mix resulting in improper hydration of cement), and alternatively there comes the variation in the cube Tensile strength as calculated at different environment concreting conditions.

Testing report for modulus of rupture of standardized mix beam specimens subjected to elevated temperatures

OBSERVATION

TABLE 9.Beam tested at room temperature

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B-01	28-08-14	36	13.33Mpa	13.45Mpa	13.36Mpa

TABLE10. Beams tested after exposing them to 300 ̊C for the duration of 2 hours.

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B02	28-08-14	36	15.55Mpa	14.3 Mpa	16.67Mpa

TABLE11.Beams tested after exposing them to 300 ̊C for the duration of 3 hours.

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B03	29-08-14	42	14.53MPa	14.01Mpa	13.44Mpa

Specimens subjected to heating for 2, 4, 8 hours duration and tested for flexural strength

TABLE 12. Beam tested at room temperature

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B(1)	06-09-14	42	13.38MPa	12.34Mpa	13.39Mpa

TABLE 13. Beams tested after exposing them to 600 ̊C for the duration of 2 hour

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B(2)	06-09-14	42	13.45MPa	14.01MPa	14.45Mpa

TABLE 14.Beams tested after exposing them to 800 ̊C for the duration of 3 Hours.

S.No.	Date of testing	No. of days	beam-I	beam-II	beam-III
B(3)	07-09-14	42	12.32MPa	13.33MPa	13.01Mpa

CONCLUSION

High-strength concrete with dense structure is less heat-resistant than regular strength concrete. Ordinary concrete's compressive strength decreases independently of its room temperature strength. . Concrete degradation depends on the concrete mix, including moisture content, and climatic characteristics such maximum fire temperature and fire duration. Concrete heating conditions need systematic study. Comparing these small-scale behaviours to total building performance in genuine fires is more difficult. Despite concrete structure mechanical behaviour has been well modelled, spalling behaviour prediction remains difficult. Predicting structural interactions, which may cause failures, is also lacking. The additional decrease in the strength of the concrete heated to temperature caused by its sudden cooling will be the most important for temperature which are not very high and range for instance between600°C -800°C.

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Dynamic Environments for Mobile Robot Navigation

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ABSTRACT

Recently, human-populated service robots have grown popular. Hospitals, offices, retail stores, and museums use various systems. Many multi-robot systems have been created for tasks that are better done by a team of robots. Surface cleaning, delivery, and exploring uncharted territory are these tasks. Mobile robot teams must coordinate their movements to avoid congestion and collisions. Robots should navigate quickly. Consequently, these criteria demand advanced path planning methods. Existing path planning methods for single robot systems cannot be easily applied to multirobot systems because the joint configuration space is usually vast and grows exponentially with the number of robots. Several multi-robot path planning approaches are decoupled, planning robot pathways separately. They then examine if the paths would bring the robots too near. Recalculating pathways avoids these problems. Most disconnected methods prioritize robotics. Recalculating robot pathways follows these priorities. The pathways of higher-priority robots are fixed while computing their paths. This greatly reduces the search space. Most prioritized decoupling methods employ fixed priority (order of the robots). However, the order in which robot pathways are recomputed affects whether a solution can be found and how efficient it is for the multi-robot system. In the first half of this thesis, we explore all priority schemes for a robot order that solves the path planning problem. We use task specification-derived constraints between robot priorities to search. Our hill-climbing strategy improves an acceptable priority system. Any prioritized path planning methodology can be found and optimized using our search method. Our approach solves complex path planning challenges in simulation and real-robot studies. This thesis's second section examines robots in human surroundings. If they respond to people's actions without interfering, these systems can improve. Human movements are unknown, unlike multi-robot path planning systems. So, robots must use sensors to detect people, identify them, and understand their intentions to better predict their behavior. This thesis uses the EM algorithm to learn normal human motion patterns from sensor data. Furthermore, we describe how the learned patterns can be used to predict future movements of the people. Afterward, we explain how this knowledge can be integrated into the path planning process of a mobile robot. Finally, we introduce a method which automatically derives Hidden Markov Models (HMMs) from the learned motion models. These HMMs can be used by a mobile robot to predict the positions of multiple persons even when they are outside its field of view. To update the HMMs based on laser-range data and vision information we apply Joint Probabilistic Data Association Filters. In practice, the robot becomes uncertain about the positions of people if it does not observe them for a long period of time. We therefore propose a decision-theoretic approach to determine observation actions that are carried out while the robot is executing its tasks.

INTRODUCTION

It is hoped that one day humans and service robots can live side by side and collaborate on a variety of projects. There has been a significant advancement made in the field of service robots over the course of the past few years. There are already a number of mobile robots available on the market that has been built specifically for use in settings that also include people. These robots, for instance, have been put to service in a variety of settings, including medical facilities, office buildings, retail establishments, and museums. The current generation of robotic systems is already capable of carrying out a wide variety of tasks, including but not limited to distribution, education, providing tele-presence, cleaning, and entertainment. Furthermore, there are prototypes of autonomous wheelchairs and intelligent service robots which are designed to assist people in their homes1. In this depicts four examples of existing robotic systems. First assume a cleaning robot which is designed to clean large surfaces, for example in supermarkets or airports. Secondly, we talk about a robot has been developed within the EU project Web FAIR [2004]. The goal of this paper is to build an interactive tele-presence system which provides individual access to exhibitions and trade-fairs by the Internet. Again an entertainment robots [Sony, 2003] and another one depicts one of the robots installed at Swiss EXPO 2002 [Swiss Federal Institute of Technology Lausanne, 2002], which guided the visitors through a part of the exhibition.

Multi-robot systems are becoming increasingly common as a result of the realization that certain jobs can be completed more effectively by a group of robots rather than by a single robot working alone. For example, some applications for multi-robot systems include surface cleaning, distribution jobs, the exploration of uncharted terrain 2, and robotic soccer (a scene from the film 4-Legged). When multiple teams of mobile robots are working in the same environment, it is necessary to coordinate their movements in order to prevent bottlenecks, congestion, and even collisions. At the same time, the robots should be able to complete the navigation tasks in the shortest period of time possible. So, in order to satisfy these requirements, advanced methodologies for route planning are required.

It is not possible to immediately translate the path planning techniques used for single-robot systems to multi-robot systems, as described for example in the book written by Latombe (1991). The difficulty of planning the paths for mobile robot teams is substantially more complicated than the problem of planning the paths for individual robots. This is because the search space of a composite planning problem is often very expansive. The reason for this is because of the following: To be more specific, the size of the joint state space of the robots increases at an exponential rate as the number of robots increases.

The following are some of the existing solutions to the issue of motion planning for many robots: The scenario on the left depicts a standstill between two robots, which is a condition that might arise when there is little space in a corridor. The picture on the right shows a congested scene with multiple robots. In the second scenario, robot 1 would be better off taking a detour and selecting the path that goes via the top corridor rather than continuing straight ahead. These two instances show that it is necessary to coordinate the movements of a team of mobile robots whenever they are placed in the same location.

Robot systems can be roughly divided into two categories:

Centralized approaches combine the configuration spaces of the individual robots into one composite configuration space which is then searched for a solution for the whole composite system.

Decoupled approaches in contrast first compute separate paths for the individual robots independently. Then they try to solve existing conflicts based on the independently computed paths. Conflicts are situations in which robots would get too close to each other if the paths were executed.

There are two important criteria to evaluate path planning methods:

1. Completeness: Is the path planning system able to compute a solution to any multi-robot path planning problem for which a solution exists?
2. Optimality: Is the solution as efficient as possible considering the whole team of robots?

While the general centralized approach, which performs an unconstrained search in the composite configuration space, is able to find the optimal solution to any planning problem for which a solution exists, its time complexity is exponential in the dimension of the composite configuration space. Therefore, it can typically not be applied to real world systems since those systems have to act under serious time constraints. In practice it is necessary to use heuristics for the exploration of the huge joint state space or to constrain the configuration space. As a consequence, practical centralized approaches cannot ensure completeness and optimality.
Many decoupled methods use a priority scheme for the robots. This means that a unique priority is assigned to each robot. The robots are then processed in the order implied by these priorities. During path planning for one robot the paths of the robots with higher priority are considered. This way the size of the search space is reduced to make the search tractable. Since all decoupled methods strongly restrict the search space they are generally incomplete and may also generate sub-optimal paths for the robots.

The order in which prioritized approaches compute the paths of the robots has a serious influence on whether a solution can be found and on the quality of the solution. No single prioritization will be sufficient for all possible multi-robot motion problems. In the first part of this thesis we present an approach to prioritized decoupled path planning that performs a hill-climbing search in the space of priority schemes. To find solvable priority schemes3 even for large teams of robots, constraints derived from the task specification are used to guide the search. Extensive experiments on real robots and in simulation runs will show that our approach enables decoupled path planning methods to find efficient solutions even for complex multi-robot problems.
In the second part of this work we focus on robotic systems operating in environments populated by humans. Such systems can improve their service if they react appropriately to the activities of the people in their surrounding and do not interfere with them. In contrast to path planning for a team of mobile robots the intentions and future trajectories of people are not accessible. Therefore, it is necessary that the robots can locate and track people using their sensors. Furthermore, the robots need to be able to identify and potentially learn intentions of people so that they can make better predictions about their future actions. In the past few years various approaches have been presented to track the positions of people and to predict their short-term motions. All these approaches assume that motion models of the people are given. A lot of research has already been focused on the problem of learning and recognizing behaviors or plans of humans. Additionally, systems have been developed to detect atypical behaviors or unusual events.
In this paper we present an approach that, in contrast to the previous approaches, enables a mobile robot

• To learn typical motion patterns of people from sensor data,
• To adapt its navigation behavior by predicting trajectories of people, and
• To utilize the learned motion patterns to maintain a belief about where the people are. Such capabilities can be useful in various kinds of situations. For example, they allow a robot to reliably predict the trajectory of a person so that it avoids blocking the path of that person. Furthermore, a home care robot can more robustly keep track of the person it is providing service to and this way increase the time it stays in the vicinity of the person, for example to support interactions [Chatila et al., 2002]. Thus, the knowledge about motion patterns of a person is quite useful for various tasks such as collision avoidance, strategic positioning, and verbal assistance.

The remainder of this thesis is organized as follows: In the following chapter we consider the problem of planning the paths for teams of robots. We present our approach to prioritized decoupled path planning that searches in the space of priority schemes. After this we focus on environments populated by humans.
Hidden Markov Models (HMMs) from the learned motion patterns. These HMMs are used to estimate the positions of multiple persons and are updated based on observations made by a mobile robot.

Multi-Robot Path Planning
Path planning is one of the fundamental problems in mobile robotics. As stated by Latombe [1991], the capability of effectively planning its motions is "eminently necessary since, by definition, a robot accomplishes tasks by moving in the real world."
The problem of coordinating multiple mobile robots has received considerable attention in the robotics literature. Whenever several robots are deployed in the same environment there is the need for coordinating their movements. Trajectories for the individual robots have to be computed such that collisions between the robots and static obstacles as well as between the robots among themselves are avoided. Especially in the context of multi-robot systems different undesirable situations can occur, such as congestions or deadlocks. As an example, consider the situation with three robots positions are depicted next. The starting positions of the robots are indicated by large circles whereas the small dots correspond to the goal locations. The lines are the individual optimal paths for the robots. Assuming that the corridors are too narrow to allow two robots to pass by, no path can be found for robot 1; if robot 3 enters the corridor before robot 1 has left it. In that case robot 3 blocks the way of robot 1 such that it cannot reach its designated target point G1. This example shows that there is the need of coordinating the motions whenever teams of robots are operating in the same environment.
The existing methods for solving the problem of motion planning for multiple robots can roughly be divided into two major categories [Latombe, 1991]: the centralized and the decoupled techniques. In the centralized approach the configuration spaces of the individual robots are combined into one composite configuration space which is then searched for a path for the whole composite system [Schwartz and Scharir, 1983, Tournassoud, 1986, Barraquand and Latombe, 1990, Barraquand et al., 1992, McHenry, 1998]. Because the size of the joint configuration space grows exponentially with the number of robots, this approach, in general, suffers intrinsic scaling limitations. The major alternative are decoupled approaches [Erdmann and Lozano-P´erez, 1987, O'Donnell and Lozano-P´erez, 1989, Liu et al., 1989, Buckley, 1989, Warren, 1990, Chu and EiMaraghy, 1992, Chai et al., 1995, Souccar and Roderic, 1996, Azarm and Schmidt, 1996, Ferrari et al., 1998, Leroy et al., 1999]. Decoupled path planning systems first compute an individual path for each robot independently. Subsequently, they apply heuristics for resolving conflicts between the paths of different robots. Conflicts are situations in which the robots attempt to occupy the same location at the same time or in which they would get too close to each other.
A centralized path planning method which searches in the unconstrained composite configuration space is able to find the optimal solution to any planning problem for which a solution exists. Its time complexity, however, is exponential in the number of robots [Reif, 1979, Schwartz et al., 1987]. Practical centralized approaches therefore either use heuristics to explore the huge joint state space, or constrain the configuration space to make the search feasible. As a result, they are typical neither complete nor optimal. Which means that they may fail to find a solution even if there is one and that the solution they generate may not be the optimal one?

As explained before decoupled planners first determine the paths of the individual robots independently and then employ different strategies to resolve possible conflicts. To deal with the still large search space it is common practice to assign priorities to the individual robots [Erdmann and Lozano-P´erez, 1987, Buckley, 1989, Warren, 1990, Azarm and Schmidt, 1996, Ferrari et al., 1998]. The replanning step is then performed in accordance with these priorities. Thus, in the case of conflicts, prioritized approaches try to compute a new collision-free path for each robot given the paths of the robots with higher priority. Priority schemes provide an effective mechanism for resolving conflicts that is computationally extremely efficient. Since they strongly restrict the search space, all decoupled techniques are also incomplete and generate potentially sub-optimal solutions.
For decoupled methods the order in which prioritized approaches compute the paths are planned has a serious influence on whether at all a solution can be found and on how long the resulting paths are. To illustrate this, let us consider two examples. First is a situation in which no solution can be found if robot 3 has a higher priority than robot 1. Since then the path of robot 3 is planned without considering robot 1, it will enter the corridor containing its target location (marked G3) before robot 1 has left this corridor. Because the corridors are too narrow to allow two robots to pass by, robot 3 will block the way of robot 1 so that it cannot reach its target point G1. However, if we change the priorities and plan the trajectory of robot 1 before that of robot 3, then robot 3 considers the trajectory of robot 1 during path planning and thus will wait in the hallway until robot 1 has left the corridor.

CONCLUSION

The main focus was on mobile robots that could collaborate with both humans and other robots in the same workspace. When we think about the issue of route planning for groups of mobile robots, we make the assumption that there is a centralized system somewhere that can compute routes that are safe from collisions for each robot. However, due to the fact that this joint state space expands at a rate that is exponentially proportional to the number of robots, it is often not possible to search for the optimal path inside the composite state space of all robots. So, in order to make the search more manageable, we are taking into consideration prioritized techniques, which give each robot its own distinct priority. The pathways of the robots are successively computed in the order specified by the priority system, while also taking into account the paths of the robots with higher priorities. This is done in order to ensure that all possible paths are considered. We demonstrated through a variety of studies that the order in which the courses of the robots are planned has a significant impact on both the likelihood that a solution can be discovered at all and the length of the paths that are produced as a result of the planning process. As a result, we created a method that is capable of carrying out a hill-climbing search within the space of priority schemes. The planning of the routes that the robots will take is done in parallel with the search for the best possible priority scheme. The restrictions that are derived from the task specification are utilized to direct the search in order to develop solutions that are workable even for huge groups of robots.
We demonstrated that our methodology supports prioritized path planning approaches by conducting extensive tests on real robots as well as by simulating the results of those experiments.

- To significantly expand the number of planning problems that can be solved.
- To develop effective solutions even for situations involving multiple robots that is complicated in nature.

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Effect Of Curing Temperatures And Additional Activators On Chloride Ingress And Its Induced Mineralogical Alteration Of Ground Granulated Blast Furnace Slag Activated By Ca $(OH)_2$

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ABSTRACT

The impact of additional activators (sodium sulfate, sodium nitrite, and calcium nitrite) and curing temperature (20 and 35 °C) on chloride binding and ingress resistance of ground granulated blast furnace slag activated by $Ca(OH)_2$ was studied using X-ray diffraction, scanning electron microscopy, thermogravimetric and thermodynamic modeling. The outcomes of the study indicated that the difference in the chloride binding capacity at low chloride concentrations was primarily affected by the types of the AFm phase. The solid solution formed between Friedel's salt and various types of AFm phases resulted in a decrease in the chloride binding capacity. At a curing temperature of 35 °C, the chloride binding capacity reduced due to the leaching of calcium ions and carbonation induced by the coarse pore structure. It was found that the chloride ingress resistance was significantly related to the leaching of calcium and carbonation, and the denser calcite layer formed at the exposure layer had a positive impact on the chloride ingress resistance.

INTRODUCTION

In recent years, the widespread use of cement as a binder for concrete is limited due to sustainability issues [1]. A frequent concern with durability, which further causes structural deterioration and failure of concrete, is the chloride-induced corrosion of steel reinforcements. The rising demand for cement and concrete has facilitated the development of eco-friendly alternatives to OPC such as alkali-activated materials (AAMs) in recent years. There has been significant research on the use of industrial waste and by-products including fly ash, silica fume, metakaolin, and ground granulated blast furnace slag (GGBFS) in alkali activation systems. Among these, alkali-activated slag (AAS) is the most commonly utilized AAM . The AAS has a low carbon footprint, low heat of hydration, good chemical resistance, and high early mechanical properties. Recent studies have also demonstrated that AAS has the ability to bind chlorides than OPC. The commonly used activators for AAS are water glass and NaOH. However, the use of these activators can cause quick setting and toxicity to the environment. Water glass can cause skin and eye irritation if it comes into contact with the skin or eyes. Further, the production of sodium silicate can generate waste by-products, such as salt cake, which can be harmful to the environment if not disposed of properly. The NaOH is a strong alkaline substance that can cause burns and tissue damage if it comes into contact with the skin, eyes, or respiratory system. $Ca(OH)_2$ is a more economical activator; furthermore, it can help initiate slag hydration in slag cement binders. Several previous studies have investigated the activating behavior of $Ca(OH)_2$, which showed

$Ca(OH)_2$ have a similar activating efficacy to those of other activators commonly used in AAS binders . However, the pH of $Ca(OH)_2$ activation is approximately 12.5, lower than the alkalinity (pH > 13.0) required promoting slag dissolution [18]. Consequently, the initial dissolution rate of slag will be lower than that of systems using other alkali solution and thus lead to lower mechanical properties. According to previous research, changing the curing conditions, such as increasing the curing temperature or adding an appropriate amount of additional activators, can promote the reaction of slag [24]. Snellings et al. found that elevated curing temperature resulted in a decrease in the ettringite at the later ages of slag reaction. Osio-Norgaard et al. observed the crossover effect at a curing temperature greater than 40 °C. This phenomenon made the pore structure coarser. Evidently, changing the reaction environment will directly affect the pore structure, pore solution composition, and hydrates assemblage, and this will have a subsequent impact on the chloride resistance of cementitious materials. Based on previous studies, a detailed impact of additional activators and curing temperature on the chloride resistance is discussed below: Activators with different cations (Na^+, K^+, Mg^{2+}, etc.) have the most significant impact on the pH and ion concentrations in the pore solution. The addition of alkali metals (Na^+, K^+) will result in an increase in the pH value, and this may further accelerate the initial dissolution of slag. Accordingly, a higher number of hydration products are generated, and the porosity can be considerably reduced [26,27]. This means that the resistance to chloride ingress could be improved. For Mg^{2+}, although the pH of the initial pore solution is lower than that of other alkali activators , it is believed that in AAS, a hydrotalcite-like phase can be formed with a moderate MgO content when Al reacts with Mg. This phase may lead to a similar chloride binding capacity with AFm as that induced by the layered double hydroxide (LDH) structure with exchangeable interlayer spaces. Several studies have demonstrated the ability of the hydrotalcite-like phase to uptake chlorides .However, a major challenge is that the quantity of this phase depends on the investigated system, and the exchangeable sequence of the anions could be ranked as $CO_3^{2-} > SO_4^{2-} > OH^- > F^- > Cl^- > Br^- > NO_3^- > I^-$. Thus, for a higher alkali content, hydrotalcites may preferentially react with CO_3^{2-} or SO_4^{2-} before chloride exchange occurs [12,32,33]. Chen et al. discussed the potential of nitrate- or nitrite-intercalated hydrotalcite to enhance corrosion control. Although they highlighted the considerable potential of postponing corrosion initiation, chloride ingress may be enhanced due to the pore coarsening effect caused by an alteration in the pore structure. For activators with different anions, the most evident impact is the change in the AFm phase's ability to bind chloride. Chlorides can be chemically bound in the AFm phase in the form of Friedel's salts ($3CaO \cdot Al_2O_3 \cdot CaCl_2 \cdot 10H_2O$) and Kuzel's salts ($3CaO \cdot Al_2O_3 \cdot 0.5CaSO_4 \cdot 0.5CaCl_2 \cdot 11H_2O$) mainly due to the phase change caused by ion exchange. The added anions, such as CO_3^{2-}, SO_4^{2-}, OH^-, NO_3^-, and NO_2^-, in the interlayer of the AFm-like phase can change the structure, and this may further affect the polymorphs of Friedel's salt produced by AAS. The AAS contains a high number SO_4^{2-} ions and possesses a relatively stronger chloride binding capacity due to the decomposition of ettringite (AFt) . In addition, according to the chloride concentration, the pH value and the anion type in the solution, various solid solutions of Friedel's salt may be formed. However, Kuzel's salts seem to be unstable in the presence of carbonate. When additional activators are applied to achieve a high pH environment, the most apparent negative impact is the increase in the leaching of calcium ions. Leaching may cause decalcification of C-(A)-S-H, and it may lead to a decrease in the physical bindings of chlorides in the C-(A)-S-H diffuse layer due to the higher competition with hydroxyl ions resulting from additional activators, indicating a decrease in the chloride binding capacity.

From the point of view of curing temperature, in general, 20 °C, which is a typical laboratory condition, is used as the reference temperature. Heat curing helps increase the reactivity required to reduce porosities and the average pore size of AAMs irrespective of the precursor. This may further result in an increase in the chloride binding capacity. Osio-Norgaard et al. investigated the impact of curing temperature in the range 20–38 °C on the chloride ingress resistance of a slag blended system, and they found that a higher curing temperature could result in an increase in the chloride binding capacity. They stated that the enhancement phenomenon is attributed to the accelerated reaction degree of slag. They also found that the pore structure became coarser at a curing temperature of 38 °C and aggravated chloride ingress. For AAS, although few studies have studied the impact of a higher curing temperature on the chloride binding capacity, numerous studies have analyzed the impact on the engineering properties. Although a curing temperature greater than 20 °C can promote slag dissolution at an early stage, which further leads to the development of more rapid hydration products like (C-A-S-H gel), the thick shell of this hydration products surrounding the slag inhibits further slag hydration. Moreover, thermal cracks may occur and increase the porosity, which may result in a decrease in the chloride ingress resistance .

Similar findings were observed in a previous study. Additional activators such as calcium nitrite ($Ca(NO_2)_2$ and sodium sulfate (Na_2SO_4), along with a high curing temperature (35 °C), promote slag hydration and make the pores finer at an early stage. However, at the later age, the porosity of samples to which activators have been added is larger than that of the specimens without additional activators, especially at a curing temperature of 35 °C, which suggests that the refinements in porosity are decelerated. Furthermore, in the $Ca(OH)_2$ activation, wherein calcium was added in the pore solution, additional $Ca(NO_2)_2$ could not effectively promote the slag reaction at early ages at ambient temperature, although the mechanical properties of this sample were significantly improved at later stages and were even comparable to those of the control group. However, at a high curing temperature, $Ca(NO_2)_2$ exhibits a finer porosity and higher reaction degree. This preliminary study showed that the reaction environment is crucial for the hydration process as well as to improve the long-term durability of slag activated by $Ca(OH)_2$. However, there is a lack of detailed characterization for the coupling effects of additional activators and high curing temperature on the chloride resistance. Thus, although the external reaction conditions are changed to improve the early performance, the comprehensive effect should be balanced against the potential negative impact on the long-term performance or durability.

A majority of the results in the corresponding literature cover the chloride ingress resistance and binding capacity of the AAS system. There is a lack of information on the impact of additional activators and curing temperature on the durability performance in the slag activated by $Ca(OH)_2$ system in chloride-bearing environment. Therefore, the objective of this investigation was to study the chloride ingress and its induced mineralogical alteration of slag activated by $Ca(OH)_2$ at various reaction environments. The findings of this study will offer insights into the mechanisms of the chloride binding capacity and the chloride ingress resistance of slag activated by $Ca(OH)_2$ system that is exposed to sodium chloride, which could help broaden the practical applications of $Ca(OH)_2$ system.

Materials and sample preparation

The chemical composition of the slag and calcium hydroxide investigated in this study has been described in previous studies [48] and are provided in Table S1. The particle size distribution of the materials used in this study is given in Fig. S1. A $Ca(OH)_2$/slag ratio of 0.2/0.8 and water/binder (slag + $Ca(OH)_2$) ratio of 0.55 was used for mortars and pastes based on previous research.

Properties before exposure to NaCl

Fig. 1 shows the compressive strength of the mortars at specified ages. At three days, the incorporation of additional activators helped improved the strength development, irrespective of the curing temperature. The Na_2SO_4 sample exhibited the highest strength, which is 7.9 MPa at 20 °C. The strength of the respective samples improved as the curing temperature increased, but the impact of additional activators was not as significant as that at 20 °C.

CONCLUSION

The impact of additional activators (Na_2SO_4, $NaNO_2$, and $Ca(NO_2)_2$ and curing temperature (20 and 35 °C) on the chloride ingress resistance upon NaCl exposure of $Ca(OH)_2$-activated GGBFS was studied quantitatively based on a combination of XRD, SEM-EDS,TGA and thermodynamic modeling. Although Na_2SO_4 and a high curing temperature have a positive impact on the properties of slag activated by $Ca(OH)_2$ at an early stage.

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Concrete In Wastewater Applications Is Attacked By Biochemicals: A Review Of Current Practices

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ABSTRACT

A significant financial demand exists worldwide due to the costs of providing and maintaining infrastructure for wastewater and drinking water. Indication of inadequate durability is the disproportionately high cost of maintenance. There stays an absence of agreement on debasement components, the exhibition of different concrete sorts, the job of microorganisms in the erosion cycle related with wastewater applications and testing techniques. This paper provides a literature review that outlines the various research strategies used to address this issue. The outcomes of these various approaches are contrasted, and the various strategies that were utilized are compiled and discussed. A combined approach that takes into account the interaction between biological and chemical processes is proposed to be a crucial step in gaining a better understanding of the associated deterioration mechanism. A performance-based approach to specifying concrete in these harsh service conditions can be established if this is possible.

INTRODUCTION

High-quality water and wastewater infrastructure necessitates significant international investment in concrete and, as a result, long service lives. To provide adequate infrastructure for wastewater and drinking water, for instance, it is estimated that annual investments of up to $21 billion are required in the United States alone [1]. Additionally, it is anticipated that the annual operating and maintenance costs of wastewater infrastructure and drinking water infrastructure will exceed $25 billion and $31 billion, respectively. In light of this, it is surprising to learn that the corrosion of water and wastewater infrastructure has been a topic of debate for decades, with little agreement on how to design and specify this infrastructure so that it can best meet the harsh environmental demands it will face in service [2–7]. The deterioration of concrete in pipelines and sewer systems has been the primary focus of most studies to date [5,8,9]. However, very little in-depth research has been done on how corrosion affects the essential treatment facilities that process our wastewater. Substantial lines in sewer frameworks will generally be an "off-the-rack" item with minimal in-put by the specifier into specification of blend plan. As a result, the manufacturer's mix design, which is influenced by local factors, is largely responsible for the product's performance. Although the engineer may specify the concrete in treatment plants, little has changed in professional practice regarding the design of concrete mixes as a result of a lack of in-depth research into the deterioration of these structures.

Numerous concrete structures connected to the treatment of water and wastewater has been found to be corroded, according to the evidence that is currently available. The alarming fact is that after less than a decade in operation, some of these facilities are significantly deteriorating (Fig. 1). In this context, it is evident that current design practices based on prescriptive approaches to concrete specification may not be appropriate for dealing with the aggressive nature of wastewater or, in some instances, the drinking water purification treatment processes [10]. Currently, construction practice is not being influenced by existing research findings. The absence of generally cited sturdiness plan formulae represents that the disintegration systems related with this basic infrastructural application are not yet broadly acknowledged or comprehended. By looking at key parameters like the nature of the attack, the environment, and the physical effects of the attack on the concrete, this paper will help close this gap. This will make it easier to implement a performance-based design approach and increase comprehension of the degradation mechanism.

Characterizing the wastewater environment

The disintegration of sewer frameworks has for some time been a subject under significant examination and during the 1940s a complete scien-tific assessment was embraced trying to comprehend the consumption cycle [11]. Flow research has kept on zeroing in on the decay of substantial sewer lines and contextual analyses have occurred all through the world, including exhaustive.

In the latter, the condition of the sewer systems in four Lebanon cities was evaluated, and the following factors were identified as contributing factors to corrosion: Biological Oxygen Demand (BOD) levels, a high concentration of sulfate and dissolved sulfide, high temperatures, a high concentration of H2S gas, high turbulence, long detention times, low dissolved oxygen levels, low water velocity, and low wastewater pH are some of the other criteria that have been outlined in several publications [4,5,12–14].

The aforementioned contributing factors can be found in wastewater treatment plants as well as in sewer piping. Events of substantial corruption in these designs have been kept in a restricted style in air circulation tanks [15], in septic tanks and siphoning stations [16] and the underside of substantial pieces and in essential influent channels [17]. The corrosion that has been observed just above the waterline is mentioned in both of the last two sources. This is significant in that earlier exploratory examination [5,18] into understanding debasement of cement in sew-err pipes has demonstrated that ideal consumption levels likewise happen simply over the waterline. Work completed into deciding profundity favorable to files of sulfate entrance into concrete noticed that center examples were taken from the walls encompassing the winding siphon of a sewage treatment plant as well as the substantial walls of a clarifier which has been harmed by sulfates starting from the sewage waters [19].

According to the available evidence, bacterial manifestations belonging to the genus "Thiobacillus" are a major cause of the deterioration of concrete sewer pipelines [5,11]. The result of their metab-olism brings about sulfuric corrosive being shaped which goes after the cementitious grid of the substantial causing loss of solidarity and attachment. However, the role of thiobacillus is only one component of a much more extensive and intricate corrosion process. Sulfate-reducing bacteria transform sulfates into sulfides like hydrogen sulfide (H2S) gas in the often anaerobic conditions of raw sewage influent. This disperses into the atmosphere under favorable conditions, where it is further reduced to elemental sulfur or partially reduced sulfur compounds in the presence of oxygen. In return, they supply the catalyst that the aerobic Thiobacillus bacteria require to begin producing sulfuric acid; In a subsequent section, a more in-depth explanation of the corrosion process is provided.

Both corroding sewers and wastewater treatment plants contain sulfuric acid, which has been shown to be a corrosive agent [20,21]. A combined acid–sulfate reaction with the hydrogen ion, which results in a dissolution effect, and the corrosive role played by the sulfate ion constitute an attack by sulfuric acid [2,22].

When sulfuric corrosive responds with a concrete network, the first step includes a response between the corrosive and the calcium hydroxide ($Ca(OH)2$) framing calcium sulfate as indicated by the accompanying condition:

$CaOH2$ and $H2SO4$! Gypsum ($CaSO4$ $2H2O$) is formed when this is hydrated to form gypsum, which appears as a white, mushy substance with no cohesive properties and "the consistency of cottage cheese" on the surface of concrete pipes [23]. In the proceeding with assault, the gypsum would respond with the calcium alu-minate hydrate ($C3A$) to shape ettringite, an extensive item:

$26H2O$ + $3CaSO4$ + $2H2O$ + $3CaO$ According to Skalny et al., "$CaO3$," "$Al2O3$," "$CaSO4$", and "$32H2O$," 22], the gypsum can migrate into these deeper sections of concrete and the ettringite can be found there as long as the pH is high enough for it to form. Davis et al.'s evidence includes However, their investigation of the piping revealed that very little ettringite was found in the corroding front and that the thermodynamics of the conversion to gypsum may be so rapid that ettringite is merely a short-lived intermediate.

According to the preceding evidence, corrosion in concrete sewers and wastewater treatment facilities appear to have a distinct relationship. The environment, the nature of the attack, and the concrete's physical consequences are all common variables. Mehta and Burrows [24] have discussed the need for a paradigm shift in concrete design, moving away from the conventional prescriptive strategy in favor of a performance-based design. However, a thorough understanding of the deterioration mechanism is essential for this strategy's success. In light of this, wastewater infrastructures must be prepared for the harsh environments they will operate in, as well as the current state of research on sulfate and sulfuric acid corrosion in wastewater environment. Consider sulfate attack, sulfuric acid attack, and how they relate to determining the resistance of current concrete specifications to attacks like biogenic sulfuric acid (BSA) corrosion when evaluating the available scientific research. As was to be expected, there are a lot of contradictory data on the subject, as one practicing engineer eloquently explains in his publication [6]. When mixed with Portland cement, it has been demonstrated that cements containing additions of ground granulated blast-furnace slag (GGBS) have an inherent ability to resist sulfates [25,26]. GGBS is being utilized in expanding amounts in substantial practice today alongside other optional cementitious materials (SCMs, for example, crushed fuel debris (PFA). These SCMs are advantageous because they are byproducts of other industrial processes and, as a result, can assist in reducing the construction project's carbon footprint due to the high $CO2$ emissions they produce. Concretes made with these binders are stronger and denser over time, but they also have lower early age strengths and need special attention when curing [27–29].

In evaluating exploratory test techniques recently utilized by
specialists many differentiating suppositions exist [4,30], including the proposed deficiency of sulfate testing as a technique to examine bio-sensible erosion in a wastewater climate while others stipu-late synchronous natural and synthetic sulfuric corrosive testing as
the main genuine philosophy [4]. The support of the sulfate particle in sulfuric corrosive ($H2SO4$) consumption and that of remaining sulfates pres-ent in wastewater (found in effluent from food and refreshment ventures [31]) can't be overlooked notwithstanding. A useful understanding of the aggressive nature of the environment that sewers and wastewater treatment plants are exposed to can

also be gained by reviewing experimental test methods that are carried out in situ and simulated. This makes it possible to investigate the roles played by both sulfate-reducing and sulfur-oxidizing bacteria because it helps to define the environmental conditions that are favorable to the onset of biogenic sulfuric acid corrosion.

Sulfate-reducing bacteria

Sulfate-reducing anaerobic bacteria like Desulfovibrio convert sulfates found in raw sewage in the sewer system into sulfides [4] to start the bacterial processes. Anaerobic conditions can only develop in the slime layer on the pipe walls above the water line in partially filled sewers. Dissolved oxygen levels close to zero and sufficient concentrations of carbon and sulfate in the wastewater themselves is some of the essential environmental conditions required for these bacteria to function and grow [32]. They use the wastewater's sulfates to get the oxygen they need and then release sulfur ions when this happens [33]. The oxidation of organic compounds and H2 provides the bacteria with the energy necessary for the reduction of sulfate, according to research conducted to quantify the microbial-induced deterioration of concrete [14]. Ayoub et al.'s evaluation of Lebanon's sewer system [8] asserts that the bacteria convert sulfate to sulfide when they obtain oxygen from the wastewater's dissolved oxygen and nitrates. However, they claim that areas with dissolved oxygen levels greater than zero did not exhibit corrosion in Lebanon's garments. If sulfate-reducing bacteria, as they suggest, need dissolved oxygen to start the corrosion cycle, why is there no corrosion where dissolved oxygen is present? Their own hunt of existing writing recommended that sulfide develop couldn't happen with disintegrated oxy-gen levels more prominent than 0.5 mg/l while Hewayde et al. [33] established a limit of 0.1 mg/l at which corrosion is prevented.

The final cycle in the underlying phase of substantial weakening in-
volves the sulfur particles delivered by the microbes. Hydrogen sulfide (H2S), an essential component of the corrosion process, is produced when these react with the dissolved hydrogen in the wastewater [33]. Although the hydrogen sulfide initially forms as a dissolving liquid, this poorly soluble compound must leave the wastewater and enter a gaseous phase in order to contribute to the deterioration of concrete. The typical pH of sewage is marginally acidic and in the reach pH 5-6 however when this starts to bring down related to fierce water (frequently found in sewer pipes or connected with some wastewater treatment processes), the H2S escapes and gathers in the environment over the water le-vel [4,16,33]. A meager layer of dampness exists on the outer layer of the substantial line presented to the environment and it is into here the hydrogen sulfide is gas is broken down. The alkalinity of the concrete, which can range from 11 to 13, accounts for the high pH of the condensate layer. In addition to that, it drives the gas's dissolution. Hydrogen sulfide is broken down into HS— or S2— ions at high pH, which attract more H2S into the moisture layer [14]. Research has likewise shown that the concentration of H2S in the dampness film increments as the pH of the mortar covering of the substantial line diminishes [13]. The H2S reacts with oxygen to form elemental sulfur or partially oxidized sulfur species [4,9,14,21], which are sometimes visible in the corrosion products that are deposited on the surface of concrete [18].

Sulfur-oxidizing bacteria

In a wastewater environment, perhaps the most important link in the chain of events that leads to concrete corrosion is the formation of sulfur. Parker [11] discovered five strains of the species Thiobacillus on the surface of concrete during microbiological experiments carried out in 1945 to determine the cause of the corrosion in sewer pipes. These strains oxidize sulfur, or some form of sulfur that has been partially reduced, to form sulfuric acid. Thiobacillus thiooxidans, Thiobacillus intermedius, Thiobacillus pero- metabolis, Thiobacillus novellus, Thiobacillus thioparus, Thiobacillus neapolitanus, and Thiobacillus versutus, all of which are known to oxi- dize and grow with reduced inorganic sulfur compounds [14,34], are some of the strains of Thiobacillus that Thiobacillus ferrooxidans, an iron-oxidizing bacteria, has also been found to be involved in the production of sulfuric acid in sewage treatment plants and pyritic ground [35,36].

Microbes of the class Thiobacillus don't join themselves to
the outer layer of cement for any reason. Roberts and co. 14] state that the pH of the concrete needs to be reduced to 9 and that the Thiobacillus bacteria can only colonize the concrete if there is sufficient moisture, nutrients, and oxygen. The involvement of the hydrogen sulfide dissociation process, as previously mentioned, is one of several hypotheses for the concrete's pH dropping to around 9. Anyway the most generally accepted the-ory is that the pH will be brought due down with the impacts of carbonation [13,14,23]. In-situ tests in a sewage system with high hydrogen sulfide concentrations (>600 ppm) led to the development of an alternative theory for determining the conditions necessary for bacterial colonization [7]. The creators guarantee that the for the most part acknowledged job of carbonation in bringing down the pH of a substantial's surface doesn't hold for their tests. Instead, they say that the bacteria in the thin moisture layer themselves oxidize the hydrogen sulfide gas to make sulfuric acid, which lowers the pH of the gas. They also say that the bacteria will grow in the layer even if the concrete has a pH of 11 to 13. However, Parker's experimental observations revealed that Thiobacillus concretivorus—the strain of Thiobacillus found to attack concrete—did not directly convert the hydrogen sulfide into sulfuric acid but rather only free sulfur or other forms of utilisable sulfur compounds like thiosulfate [38]. Waksman and Joffe [39] and Nica et al. [] used the strain T. thiooxidans to characterize 38] also stated that the sulfur-oxidizing organism does not directly utilize hydrogen sulfide or other sulfides.

In perceiving the extensive variety of Thiobacillus strains that take
part in sulfuric corrosive creation, it should be noticed that not all flourish in an indistinguishable climate. T. thiooxidans, for example, falls under the category of "acid-preferring" acidophilic sulfur-oxidizing microorganisms (ASOM), while T. intermedius, for example, falls under the category of "neutral-preferring" neutrophilic sulfur-oxidizing microorganisms (NSOM) [14,38]. As the concrete's pH decreases from approximately 8 to approximately 6, it is hypothesized that the production of sulfuric acid by various strains of neutrophilic bacteria colonizes the surface [23]. Additionally, it was discovered that microbial succession occurs on the surface and that NSOM do not penetrate the corroding concrete while ASOM do.

Parker [11] noticed that the bacteria he was cultivating could survive up to a pH of about 6.5, below which none could grow. The acidophilic sulfur-oxidizing bacteria colonize these slightly acidic pH values, further lowering the concrete surface's pH to as low as 2, where the strain T. thioox- idans thrives [18,40]. According to Barbosa et al., the optimal temperature at which the acid was produced in the greatest quantities after 50 days was 30 °C. 15] noted in their research that "sulfide oxidation" by the strain T. dentrificans was inhibited at 15.6 °C and decreased at low temperatures. Parker [11] also discovered that up to a nitrogen concentration of 50 ppm, above which there appeared to be a slight inhibition, the rate of acid production in his bacteria increased.

erties including versatile modulus, strength, stress unwinding, and creep. It has been extended to predict compressive strength gains at early ages using the same ultrasonic measurements that can be used as a setting indicator [12] [18]. Because they frequently change throughout the course of the physical measurement, these mechanical properties are significantly more challenging to measure in general at earlier ages than later in the hydration process. It is particularly difficult to measure relaxation and creep in tension, but progress is being made [19]. Conventional creep loading has typically been utilized in compression [20]. One key to a fundamental materials science-based prediction of early-age cracking is an understanding of how these mechanical properties develop because they control the resistance half of the load/resistance paradigm [20,21].

WARM IMPACTS

Accepting legitimate relieving and hence disregarding vanishing, one of the two significant reasons for early-age breaking is warm impacts, the other being autogenous shrinkage. A concrete will typically first heat up and expand due to heat produced during early-age cement hydration, which varies depending on the exposure to the environment. The concrete may crack if the subsequent cooling is too quick, especially if it is strained locally or globally. Quantitative characterization of the concrete's thermophysical properties, its heat of hydration, and its interaction with the environment are all crucial for comprehending the role that these thermal effects play in early-age cracking.

The hydration of Portland cement significantly alters the volume fractions and spatial arrangement of solids, liquids, and gases (air voids and empty capillary pores) within the three-dimensional microstructure, so it would be expected that the thermophysical properties of cement paste such as heat capacity, thermal conductivity, and coefficient of thermal expansion.

Some authors have also attributed the initial reduction to the growth of fungi, departing from the previously accepted role that the species Thiobacillus plays in lowering the surface pH of concrete from approximately 8 to 4 [5,41]. Mori and co. [5] discovered an unidentified green fungus that could lower the pH to levels suitable for T. thiooxi- dans colonization and growth and grew at high pH levels. Gu and co. [41] go one step further in their explanation by identifying the fungus as Fusarium. They guarantee that this affects the substantial that that of the neutro-philic microbes T. intermedius. According to the findings of their investigation, the latter was able to penetrate the material while the fungus Fusarium was able to etch the concrete's surface. Additionally, they assert that fungi produce a wide range of acids, including acetic, oxalic, and glucuronic acids. Independently of Mori et al., a second set of experiments [42] was carried out with mortar that contained T. intermedius-inoculated bacteria. 5]. It was hypothesized that the bacteria's production of sulfuric acid was responsible for the deterioration of the concrete in these tests; However, the authors observed little gypsum and little change in the culture medium's sulfate ion concentration. They came to the conclusion that carbonic and organic acids, including acetic acid, which are all metabolites produced by bacteria, were the primary cause of the concrete's deterioration.

The function of biogenic corrosion caused by sulfuric acid 4.1 Attack mechanisms Only a small amount of research has been done to evaluate the performance of concrete mixes in a biological environment [4], which is surprising given that several researchers have claimed that biogenic sulfuric acid corrosion in wastewater systems is more severe than chemical attack with sulfuric acid and sulfate [43,44]. This fills in an important knowledge gap that hinders the creation of a material-based performance specification. While research has shown that gypsum, ettringite, and even thaumasite are the end products of corrosion, the order in which they form, their quantities, and their specific effects on the cement matrix are the subject of debate.

The destructive idea of a sulfuric corrosive assault has been well doc-umented from both in situ perceptions and synthetic testing on concrete [4,5,22,30,45-47]. The aggressive chemical reactions that result from the combination of the hydrogen ion's dissolution effect and the sulfate ion's distinct effect pose a threat to the cement matrix's stability. However, the mechanisms behind chemical and biological sulfuric acid attacks are the subject of debate, and resistance to the former does not always translate into resistance to the latter [4,9,48]. The involvement of the bacteria that produce sulfuric acid, Thiobacillus, where Monteny et al. [4] assert that the moist conditions in the gypsum corrosion front provide the bacteria with an excellent breeding ground. After that, they migrate into the concrete, producing acid much closer to the front of the corrosion, despite the fact that Yamanka et al. 7] They argue that this is the acid itself moving inward. However, the weak penetration of sulfuric acid during a chemical attack restricts the effects of corrosion to the surface [49]. For the attack to continue, the acid must negotiate its way through this layer of corrosion. It is by and large expected that this outcomes in less serious conse-quences comparative with an organic assault, as the eroded surface goes about as a boundary for additional entrance. In order to measure microscopic biological activity using chemical testing, it may be necessary to brush loosely adhering particles on a regular basis [4,50].

Types of sulfuric acid attacks

In 1945, C.D. Parker said that a sulfuric acid attack on concrete sewers made a white putty-like deposit that was moist, flaky, and easy to get off the surface [11,37]. As previously stated in Equation (), a reaction between the hydration products in the cement matrix and the sulfuric acid produced the calcium sulfate (gypsum) [22]. 1). Gypsum formation is one of the primary corrosion mechanisms involved in the deterioration of the cement matrix that results in a loss of cohesion in cementitious calcium compounds, as demonstrated by experimental and in situ analysis of mortar and concrete [5,23,33,51]. Gypsum crystal growth at the aggregate-paste interface was blamed, however, for the weakening of the concrete foundations of an Italian building that were exposed to sewage waters [52]. However, the accumulation of gypsum can also slow an attack by acting as a barrier against further penetration [4,53]. However, it has also been claimed that the rougher surface area results in a greater surface area that can be attacked [18].

Some researchers have discussed the relative resistance of various binder combinations to sulfuric acid attack. According to BRE Digest 363 [54], experiments exposing 100 mm Portland cement concrete cubes to an H2SO4 solution for five months with a binder of 35% ordinary Portland cement (OPC)/65% GGBS demonstrated superior performance to binders of 100% sulfate resisting Portland cement (SRPC) or 75% OPC/25% PFA [47]. Lower porosity, lower levels of calcium hydroxide, or both have been blamed for the improved acidic performance of concrete [4,45,48], while Saricimen et al. 16] found that neither SRPC nor OPC differed in their ability to resist attack in a flowing H2SO4 solution containing 3 percent, which is supported by [7]. Monteny and co. 43] suggest that a refined pore structure will increase the cement matrix's capillary action and enable the aggressive solution to penetrate the concrete further.

De Be- lie et al. conducted experiments to evaluate commercially available piping [9] exposed non-standard cylindrical specimens of concrete to a 0.5% H2SO4 solution in alternating wet and dry cycles using high sulfate resisting cements CEM I and CEM III. They came to the conclusion that the limestone aggregate, which served as a sacrificial medium to slow the rate of acid attack, was more important than the cement type in protecting against attack. The sulfate opposing ce-ments likewise performed better compared to the impact heater slag concretes, a perception comparatively upheld by other trial results

[29] (directing trials with 60% GGBS chambers in a 1% H2SO4 for 168 days). However, research by Monteny et al. [] refutes this. 4], who experimented with solutions containing 1–5% H2SO4. However, it is noteworthy that the limestone aggregate's significance has been emphasized [25,29].

Cement hydration (primary ettringite) and the effects of an external sulfate attack (secondary ettringite) are examples of the formation of ettringite, a crystalline compound. Calcium aluminates, such as C3A, and gypsum are involved in some of the reactions that lead to its formation; however, an external sulfate attack on the calcium aluminate hydrocarbons and monosulfate hydrate phases may also be involved [4,54]. Skalny et al. claim that [22] Under the attack of sulfuric acid, only a small amount of ettringite will form in the concrete's deeper sections as long as the pH is high enough to keep the concrete stable and enough gypsum can move into the concrete during the initial stages of the attack. This appraisal agrees with different scientists who have additionally expressed ettringite's failure to make due in an acidic climate [44] and, surprisingly, in basic conditions with pH's essentially as high as 10.6 [49]. Monteny et al., on the other hand, [4] emphasize the significance of etchingite and its more devastating effects in their evaluations.

its formation from an attack by sulfuric acid was also documented by others evaluating the influence of fungi on concrete corrosion [42] and simulated biogenic sulfuric acid corrosion [5].

It is interesting to note that it is generally accepted that the mix design and the binder combinations used determine the presence of important compounds like gypsum and ettringite. However, the concept of utilizing this material design to regulate the presence of these explosive compounds is still in its infancy.

Influence of the sulfate ion Because an attack by sulfuric acid is a combined acid–sulfate reaction, many researchers think it's wise to test concrete susceptibility in standard sulfate testing solutions like sodium sulfate (Na2SO4), magnesium sulfate (MgSO4), or a mix of the two. However, based on differences in chemical and biological tests [4], the validity of this method for assessing attack in a wastewater environment has been questioned.

Sulfate solutions based on sodium and magnesium have significantly different effects on concrete. With the previous, calcium hydroxide essentially goes through disintegration to gypsum and sub-sequent ettringite. The solution will only begin to attack the C–S–H phase when there is insufficient calcium for the reaction to continue [22,51]. Magnesium solutions adhere to all phases of the cement matrix simultaneously, preferring calcium hydroxide over the calcium–silicate–hydrate (C– S–H) phase for the production of their reactive calcium. Gypsum, ettringite, a magnesium silicate–silicate–hydrate with no cohesive properties, and brucite, the mineral form of magnesium hydroxide, are the products of a magnesium sulfate reaction [55].

Ettringite can be primarily linked to the reaction between the AFm monosulfate phase and the sulfate ions migrating into the concrete in sodium sulfate. At low convergences of sulfate solutions (<1000 mg SO2 —/l) ettringite will be the essential driver of crumbling [4] while at higher focuses (>8000 mg SO2 —/l) gypsum will overwhelm in a sulfate assault [56]. Therefore, it is essential to employ a sulfate concentration that accurately reflects the corrosion mechanism in the intended environment. The deterioration mechanism in magnesium sulfate solutions is primarily caused by disintegration and loss of cohesion, which results in the formation of gypsum and magnesium hydroxide [4,22]. Ettringite is destabilized as a result of magnesium hydroxide's saturated solution pH of approximately 10.5. Consequently, the conditions favorable to the formation of etchingite following a magnesium sulfate attack are significantly enhanced [57]. Skalny and co. While research on slag cements [58] attributed etchringite formation as substantially contributing to the damage caused by MgSO4 solutions, 22] do note that a limited amount may form when the pH remains high enough in the concrete for a sufficient amount of time.

LITERATURE REVIEW

According to **Gollop and Taylor's analysis** [51,58], Al2O3 levels decrease as the resistance of GGBS concretes to sulfate attack increases. Other researchers [16,29] noted that exposure to sodium sulfate had fewer negative effects when C3A levels were lower. Gollop and Taylor, on the other hand, ignored the effects of the aggregate-paste interface in their analysis of a sulfate/sulfuric acid attack because they used cement pastes [49,59–61]. Their addition of increasing concentrations of GGBS led to an increase in resistance to attack by sodium sulfate solutions up to a level of 92 percent, but when they were exposed to magnesium sulfate, their results were the opposite. In an appraisal of 150 mm 75 mm rein-constrained substantial chamber examples presented to a 2.1% SO2 — sulfatearrangement, **Al-Amoudi** [61] demonstrated that for a 60% GGBS supplant ment level, crumbling in the blended magnesium/sodium based arrangement was considered significant. It was determined that GGBS mixes performed poorly in comparison to other cement replacement materials like fly ash (20 percent replacement) and silica fume (10 percent replacement). Osborne [29] arrived at similar conclusions regarding the effects of magnesium and sodium sulfate solutions and the use of high percentages of GGBS as a cement replacement when evaluating the results of a study by the BRE [25,46]. The TEG one-year review [62] also noted that limestone cement and high-quality carbonate aggregate with a 70% GGBS replacement level protect against conventional sulfate attack.

Vincke et al. simulated the biological corrosion process over 17 days in a wet/dry attack cycle [After an incubation period in an H2S environment, 21] exposed 2 5 cm specimens of concrete to a biological sulfur solution containing Thiobacilli bacteria. The specimens made with CEM I Portland cement and CEM III blast-furnace slag cement were examined for weight loss after 51 days and three cycles. According to the findings, both mixes performed similarly. De Belie and others [9] used a method that was almost identical to the one described above [21]. They used specimens with a diameter of 80 mm and a depth of 15 mm, and they went through a fourth cycle that lasted 17 days. The sulfate ion concentration of their solution increased from 2 g/l to 4 g/l during their experiments, which the authors cite as evidence for the sulfur-oxidizing bacteria's production of sulfuric acid. Their experiments came to the conclusion that Portland cement formed more effectively than CEM III blast-furnace slag cement. In this instance, they hypothesize that because CEM III has a larger surface area than Portland cement, bacteria can colonize the cement's surface more quickly.Other approaches to modeling biological corrosion in the wastewater environment have been discovered through additional research. According to **Monteny et al.,** researchers in Hamburg created a simulation chamber. 4], which enabled the modification of the corrosion process to eight times the in situ level by optimizing the corrosive environment. At 30 °C, test blocks measuring 60 x 11 x 7 cm were sprayed with Thiobacilli bacteria and immersed in 10 cm of water. The chamber was filled with 10 ppm of H2S gas that served as the bacteria's substrate. The quantity of microorganisms on the outer layer of the examples was counted furthermore, it was observed that the pace of consumption was reliant upon the degrees of T. thiooxidans identified. Exploratory work was likewise completed into the consumption system engaged with the crumbling of cement developing a reenacted sewer pipe 20 m long and a breadth of 15 cm [5]. The first half of mortar bars measuring 4 x 4 x 16 cm were placed in sewage and subjected to H2S gas at a concentration of no more than 300 ppm as test specimens. Indistinguishable mortar bars were set half sub-mersed into a sewage medium, an autotrophic basal development cul-ture medium without thiosulfate and refined water. These were inoculated with T. thiooxidans every two weeks. Bars in the sewage and autotrophic basal media had corrosion just above the waterline. While the sewage samples had the highest rate of corrosion, those in water remained unaffected. The creators reasoned that in light of these outcomes the microorganisms required a sup-employ of dampness and supplements to start the consumption cycle while the erosion items not set in stone to be cheat total and optional ettringite. Similarly as with the issue of sulfuric corrosive at-tack, the chance of limiting the arrangement of erosion items through fitting blend configuration isn't created.

CONCLUSION

The study of the effects of sulfate/sulfuric acid on concrete revealed three distinct research foci. They are: Studies of the biological processes that cause the infrastructure in wastewater to corrode, with a focus on the role that sulfate-reducing and sulfur-oxidizing bacteria play. Sulfates and sulfuric acid's chemical effects on concrete mixes have been the subject of research. Methodologies for research carried out in a laboratory, particularly those that take into account the biological effect of concrete. Even though chemical tests may be helpful in determining the kinds of damage that can occur, they do not fully represent the effects that microbial agents have on concrete. Full-scale laboratory analysis has been done by some researchers [4,63], but it is important to note that the equipment needed to accurately mimic in situ conditions is always complicated, cumbersome, and custom-built. The realization of the resources necessary for such research remains a barrier to addressing this issue. It is impractical to use such intricate research equipment for routine performance-based specification. Even though there is a lot of data on the topics of biogenic concrete corrosion caused by sulfate, sulfuric acid, and other chemicals, little has been done to develop a mathematical model of corrosion that is accepted and includes agreed-upon parameters of significance. This is a significant knowledge gap and a technical obstacle to the use of material design to combat biochemical attack-induced corrosion. This has significant repercussions for public expenditures in this sector and continues to influence the design of durable concrete wastewater infrastructure. The need to think about how biological and chemical processes interact might be the key to making more progress and allowing practitioners to use concrete mix design to get the service lives they want. Acknowledgments The authors are indebted to Enterprise Ireland Innovation Partnership Project IP/2008/540 and Ecocem Ireland for their financial support.

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Hybrid Fibre Composite Ferro cement Bending Performance and Tensile Properties Literature Review

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ABSTRACT

Reinforced with hybrid fibres Both bending and tensile tests were performed on the ferro cement. The purpose of this research is to develop hybrid composites, which are composites that combine the beneficial qualities of more than one type of reinforcing material. A significant amount of investigation was put into a number of different hybrid composites. When all of these investigations are taken together and compared, the results for bending and tensile strength are inconsistent. Incorporating hybrid fibre into Ferro cement is extremely desirable because doing so boosts the material's tensile strength capability, improves its ductility, and provides strain hardening properties. Maintaining a cost of building that is fair in developing nations where raw resources are in short supply and demand is high. This is the primary reason why adding materials of a smaller particle size does not result in an increase in the packing density. Specifically, applications that involve safety structural elements and have a need for ultra-high performance would profit tremendously from an increase in packing density coupled by an improvement in toughness. This would be the case even if the density of the packing were to remain the same.

Keywords- Ferro cement, Hybridization, Bending Properties, Tensile strengt

1. Introduction -Reinforced concrete is the most often used construction material on Earth, but the fundamental difference between them is the use of wire meshes and a concrete binder that contains larger aggregate sizes. Constructed from hydraulic cement mortar and wire mesh that is close together, ferrocement has a very thin wall and is often used in construction. Metal or other suitable materials can be used to create the mesh. Because of its versatility, ferrocement has become a popular choice for complex architectural structures such as domes, curved building parts, water tanks, and even boats. Ferrocement can be used to build and repair structures. An entirely new type of material is created, one that is distinct from typical reinforced concrete in terms of its properties (strength, deformation, and potential applications). Thin panels or sections can be made with only a thin mortar layer covering the uppermost layers of reinforcement. Compared to ferrocement materials, conventional reinforced concrete materials are more commonly used as load-bearing elements because of a lack of extensive inquiry into the ferrocement materials and their usage as structural elements. The durability and corrosion issues of ferrocement are critical to its success. For the purposes of this definition, a hybrid fibre is one made up of both micro and macro synthetic fibres.It can be divided into the following combinations:.It is based on the fibre constitutive response, in which one of the fibres is stronger and stiffer, providing a stiffer and reasonable first-crack strength and also ultimate strength. As a result, the second type of fibre, which is more pliable, improves the post-cracking toughness and strain capacity. Combinations based on different aspect ratios are also possible. In the case of fiber-reinforced concrete, short fibre bridges tiny fractures restrict their expansion and also postpone the coalescence. Fracture toughness is improved in composites with long fibres because macro fractures are prevented from propagating.Hybridization is the blending of various fibre kinds. By mixing the fibres, the qualities of the concrete mix can be improved on a number of levels. This composite material outperforms plain and mono fibre in terms of behavioural efficacy. The addition of discontinuous fibres has been recommended by previous studies to boost tensile strength. By using hybrid fibres, the researchers hope to boost ferrocement's overall structural performance. The requirements of a hybrid fibre ferrocement can only be determined by conducting a thorough material investigation. As a first step, to classify the composite's behaviour, a test series employing a method designed for classifying high performance materials is required. There must be strain hardening qualities in the stress-strain connection before this can occur. An analysis of the strain capacity of a material can also be made using the tensile strength test, which evaluates the material's tensile strength as well as its composition. Hybrid fibre reinforced ferrocement

2.Material description- According to Naaman (2000), the definition of ferrocement has been expanded to include the stipulation that "the fineness of the mortar matrix and its composition should be suitable with the mesh and armature system it is supposed to encase." There is a possibility that the matrix will have discontinuous fibres. This definition was intended to emphasise the compatibility of the matrix with the reinforcement that is used to build a composite, as well as to present the opportunity to use discontinuous fibres or micro fibres to improve the mechanical performance of ferrocement as hybrid composites, should this become necessary. The form of hybrid reinforcement known as fibrous ferrocement has wire mesh as the primary reinforcement and mono fibre as the secondary reinforcement.

Since the publication of Naaman's study in 2000, there have been ongoing efforts to develop ferrocement as a high performance material or, as Naaman prefers to refer to it, a strain hardening material (Naaman 2007). Due to the interaction of fibres with wire mesh, ferrocement composites benefit from an increase in their structural qualities when fibre is used (Shannag and Bin Ziyyad 2007). Both mono (meaning only one kind) and hybrid (meaning both types) variants of the fibres can be utilised. Mechanical behaviour

By enhancing the mortar mixtures with the use of additives and fly ash as a partial replacement for cement, structural standards for ferrocement have been improved. This has led to an increase in the use of ferrocement (Arif et al. 2001). Altering the type of reinforcement used and the proportion of it used has also contributed to the improvement of ferrocement's characteristics.

3.Improvements in fe Classification of high performance cementations composites

Today, several different types of cement-based composites are used in practical building applications, including the fabrication of structural parts. Because of this, it is essential to categorise the materials used in the construction of structures according to their performance. Because of material models and the material parameters that they relate to, structural engineering and materials engineering are now recognised as having a link between them. This reflects the behaviour of a material through its physical requirements, which direct its structural and mechanical behaviours. These behaviours include: (Stang and Li 2004). Compression strength, tensile strain behaviour, flexural response, toughness, and energy absorption are the features of cement-based composites that are significant for the classification of a material's performance. Other properties include flexural response. Because of the risk of failure caused by crashes in the compression zone, compressive strength is an essential property in the design of concrete (known as brittle failure). However, because FRCCs exhibit behaviour that is either quasi-brittle or strain-hardening, compression strength is not a relevant design criterion for these materials.

Figure 2.13 illustrates the various categories of errors that can occur. When the cement paste has reached a point where it is solidified, brittle failure behaviour can develop. At the first crack, which is no longer able to resist any stress, linear stress–strain behaviour is followed by an abrupt reduction of stress (curve A). On the other hand, failure in fibre concrete and a few other fibre-reinforced cementitious materials can be described as quasi-brittle. This results in a linear stress–strain behaviour, which is then followed by a softening behaviour, as demonstrated by curve B. Strain-hardening materials, on the other hand, are defined by their capacity to withstand stress in a manner that is linearly inconsistent with their elastic behaviour. Almost immediately after achieving the first crack load, an increase in strain will take place due to the increasing levels of loading. This will result in substantial deformation (curve C).

When compared to brittle or quasi-brittle materials, the maximum strain value of a strain hardening material is often higher (Li 1997). A transition from quasi-brittle to strain hardening failure is only possible under conditions of'steady-state' cracking, which arises under two conditions: (1) the stress at the crack must equal the first crack peak; and (2) the crack opening displacement must be less than the fibre slip caused by the bridging stress. Cement structural specifications have been made to ensure that a transition from quasi-brittle to strain hardening failure is possible. roCement structural specifications have been made to ensure that a transition

According to EI Debs and Naaman, the addition of polyvinyl alcohol mono discontinuous fibre to ferrocement with only one layer of steel mesh but with various wire spacing results in better overall performance in terms of cracking behaviour, yield, and maximum strength than conventional ferrocement does. In another set of experiments, it was found that increasing the number of steel mesh layers from two to four in conjunction with a volume percentage of steel fibres in ferrocement ranging from 1.5 to 2 percent led to an increase in the strength of the material.

4.Application

The advantages of flexibility in the fresh casting stage and high ductility in the hard stage have made ECCs attractive for structural applications (Li 2008), including either on their own or in the form of a composite (hybrid) to support other structural materials. This includes applications where the ECCs are used to support other structural materials (Naaman 2007). It has been demonstrated that the one-of-a-kind characteristics of ECCs as strain hardening cementitious composites (SHCCs) are capable of protecting structural elements constructed of RC from the damaging effects of an aggressive environment by narrowing the cracks that form in these elements (Maalej and Li 1995). Li et al. conducted research on the use of ECCs in concrete structures with the intention of repairing or retrofitting them (2000). According to the findings of the investigation, the use of ECCs is not limited to structures that are already in existence; rather, they are also suitable for protecting structures that have specific requirements, such as high impact resistance, crack width control, an aggressive environment, and a large damage tolerance.

Fischer (2010) had great success utilising stand-alone PVA–ECC panels in modular houses by employing them as floor slabs. The panel slabs that were put through their paces in the testing process had advantageous qualities such as relatively high flexural stiffness, ductility, maximum strength failure, and low cost.

The environmental benefits are in addition to the advantages brought about by the mechanical and economic aspects. This slab system is more appealing and sustainable thanks to the utilisation of waste materials as filler in the mixing matrix of the ECC floor slab. These waste materials may include FA or slag.

According to Li et al. 2004b, it is possible to create green ECCs for sustainable infrastructure in a variety of applications, such as pipelines, cement boards, electrical shafts, pavements, and as overlay systems in bridge decks (Zhanga and Li 2002).

Material description

Because it offers the lowest coststrength ratio of all construction materials, concrete continues to be the most commonly utilised material. The issue with concrete is that it has a low tensile strength and behaves in a brittle manner. This causes failure and collapse fast after the first crack appears in the material. This issue, number 37, inspired researchers to study ways to improve the properties of concrete. Steel fiber-reinforced concrete, also known as SFRC, is a type of hybrid-reinforced cementitious material that was first developed in the early 1960s. The addition of steel fibre led to a considerable improvement in the tensile splitting strength, flexural strength, initial cracking strength, toughness, and impact resistance of the material. In addition to this, there was a decrease in fracture width, deflection, shrinkage, and creep (Tejchman and Kozicki 2010). ACI Committee 544 contains a set of guidelines that can be used for the design and specification of material properties (2002). As was mentioned before, the ASTM Standard (2011a) categorised FRC based on the type of fibre it was made of, including steel, glass, synthetic, and natural fibre.

The behaviour and qualities of mechanical systems

Flexural testing was used to undertake experimental investigations of steel fiber-reinforced beams with changing fibre content (Altun, Haktanir, and Ari 2007). The fibre content ranged from 0 to 60 kg/m3 of the beam's volume. Compression, elastic modulus, and toughness were some of the qualities that were mentioned. The findings showed that the increase in the fibre content did not cause a substantial decrease in the compressive strength, and the results showed that a capacity of good flexural strength could be attained by utilising 30 kg/m3 (1.25 percent volume fraction)

Shear testing were carried out on SFRC beams utilising a variety of stirrup configurations and fibre contents. Lim and Oh (1999) conducted an experiment, the results of which suggested that further shear reinforcement is not necessary in SFRC. However, other experiments revealed that a fibre volume percentage of 1.5 percent was sufficient to obtain excellent shear strength capacities (Juárez et al. 2007).

In order to investigate the tension stiffening and cracking behaviour of SFRC specimens with conventional longitudinal reinforcement, standard uniaxial tension tests are often carried out on these samples. There was reported to be an increase in the post-load yielding capacity, in addition to the development of various fracture forming behaviours. This was in comparison to the standard RC (Deluce and Vecchio 2013). Take note that the percentage of fibres present in the mixing matrix has a major impact on the FRC's capacity for withstanding tensile stress (Sujivorakul 2012). During tensile testing, synthetic FRC showed a crack behaviour that was comparable to that of natural FRC (Wang, Li and Backer 1990).

5.Durability of the material and its applications

The application of a material in building is based, from a structural point of view, on the mechanical performance of the material as well as its durability. According to Li and Stang (2004), cementitious materials have a strong correlation between their structural level durability and their ductility. Corrosion can occur on steel rebars if there is not enough concrete covering them or if the permeability of the cracks that form around them is enhanced. The addition of fibre to concrete increases its resistance to cracking and narrows the cracks that do appear. When compared to conventional RC, there is an observed decrease in the permeability of concrete as well as an increase in the overall impact on the environment (Banthia and Bhargava 2007; Bentur, Diamond, and Berke 1997).

A durability performance evaluation of FRC in a hostile environment employing fractured fiber-reinforced shotcrete revealed difficulties with the material's durability as a result of sulphate and salt solution attack (Kaufmann 2014). According to the results of the test, environmental conditions very comparable to those seen in tunnel construction are present. It was demonstrated that steel fibres in cracks corrode, which leads to a loss of the structure's potential for residual strength. On the other hand, 39 uncracked samples demonstrated a higher level of resistance behaviour during a specified time period. In addition to this, it was found that polymer fibre had a greater level of durability in these kinds of conditions.

There are a number of different application possibilities made possible by the production of FRC using shotcrete or pre-casting procedures. Pipeline trench applications, sewage channel applications, tunnel lining applications, railroad track beam uses for high-speed trains, and precast concrete fence panel applications are some of the places that FRCs are put to use (Banthia et al. 2012). These are the broad applications of fibre reinforced concrete; constructions that are subjected to blast or impact loading are good examples of more particular applications of matrix-modified FRC. Bindiganavile, Banthia, and Aarup (2002), for instance, investigated the influence of impact load response on ultra-high-strength compact steel fibre reinforced concrete. The matrix was experimentally investigated under drop-weight impact load, and it contained Portland cement, SF (24 percent by weight of cement), and 6 percent steel fibre volume fraction (quasi-static loading). The material demonstrated three times the strength and energy absorption of regular FRC thanks to its unique composition. This demonstrates that as a result of the material's great resistance to impact, it is appropriate for use in strategically significant structures such as those associated with high-security or the military.

CONCLUSIONS

Numerical modelling considered microscopic and structural levels. This phase of the inquiry yields the following conclusions:

• The FEM model that simulated the RVE (micro structural model) to compute the elastic modulus partially confirmed the experimental data. The FE simulation showed that elastic modulus values moderately increased over time. The values obtained were within 4% of the experimental results.

• The numerical model used to the HFF panel during flexure yielded excellent results compared to experimental data using elastic modules from the nanoindentation test. • The finite element modelling of the HFF–OWC slab showed good composite action and no horizontal shear transfer-induced slab fracturing.

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Air Pollution: Causes, Effects, and Solution

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Abstract- Environmental pollution is a growing concern worldwide as it poses a significant threat to the health and well-being of humans, animals, and the planet. The causes of environmental pollution are diverse and include industrial activities, transportation, agricultural practices, and waste disposal. The effects of pollution can be devastating, ranging from respiratory illnesses to climate change. To combat this issue, several remedies have been proposed, including reducing emissions through the use of clean energy sources, implementing stricter regulations on industries and transportation, promoting sustainable agriculture practices, and encouraging the adoption of eco-friendly waste management strategies. While progress has been made in addressing environmental pollution, it remains a complex and urgent issue that requires immediate action from individuals, businesses, and governments alike.

Keywords: Pollution, Environment, causes, effects, remedies.

1. INTRODUCTION

Pollution can be defined as any human activity that has a negative impact on the quality of the natural environment. Although environmental pollution is not a new phenomenon, it is still the world's most pressing issue and one of the leading environmental causes of disease and death. Most of the time, middle- and low-income nations pollute the environment more than developed nations do, possibly due to poverty, inadequate legislation, or ignorance of pollution types. It's possible that humans deal with pollution on a daily basis without realizing it, or that our fast-paced lives have made us immune to it.

Air, land, and water pollution are all caused by deforestation, bush burning, dumping of agricultural and household waste in water bodies, the use of chemicals to harvest aquatic animals, and improper disposal of electronic waste. Particularly so, as human population density rises, so do human activities and their effects on the environment. Not only do the effects affect humans, but also other aquatic and terrestrial animals, including microorganisms, which, due to their abundance and diversity, tend to keep their biochemical function, which is important for the ecosystem's survival, going on.

The reasons for ecological contamination are not restricted to industrialization, urbanization,populace development, investigation, and mining, yet in addition trans-boundary development of contamination from created to non-industrial nations or the other way around. Pollution has remained a global problem in part because of trans-boundary pollution.In addition, harmful substances like gaseous pollutants, toxic metals, and particulate matter (PM) are introduced into the atmosphere, resulting in environmental pollution; sewage, effluents from industries, runoff from farms, and electronic waste into water bodies; and activities that pollute the soil, such as mining, deforestation, landfills, and illegal waste disposal.

Air pollution, in particular, has alarming consequences, with a disproportionate impact on low-income earners, children, the elderly, and other vulnerable groups in developing nations.The information on the causes and outcomes of natural contamination is fundamental,in any case, the expense of inaction in colossal. Different physical and synthetic methodologies have been applied to free the climate of contamination, however a large portion of them make extra environmental issues and are costly.

2. MAJOR TYPES OF POLLUTION

Air Pollution

The presence of toxic chemical compounds in the atmosphere at concentrations that could be harmful to humans, animals, vegetation, and buildings is known as air pollution. In general, air pollution refers to the presence of chemical compounds in the air that were not originally present but have altered its quality. Through global warming and ozone layer depletion, air pollution also impacts the quality of life on Earth.Sulphur oxides (especially SO_2), nitrogen oxides (including NO and NO_2), volatile organic compounds (VOCs), and carbon monoxide (CO) are typical gaseous pollutants. Primary and secondary pollutants are the two types of gaseous pollutants. Examples of primary pollutants include carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). On the other hand, secondary pollutants are gases and particulates that also form in the atmosphere, largely as a result of the primary pollutants. The breakdown of ammonium nitrate aerosols, sulfuric acids, and hydrocarbons, for instance, results in the production of ozone (O_3), atmospheric sulfur, and nitrogen oxide gases, respectively.

The chemical composition of air pollutants, such as their oxidizing capacity, solubility, concentration, and susceptibility, as well as the susceptibility of the affected person or thing, determine the extent of damage. Because they are soluble in water, SO_2 gases can harm the skin and upper airways of humans; Due to their lower solubility, O_3 and NO_2 can penetrate the lungs further. CO is a colorless, odorless, highly soluble, non-irritating gas with a higher affinity for hemoglobin than oxygen. As a result, it easily enters the bloodstream to form carboxy-haemoglobin, which has negative effects.

Wind can carry large dust-like particles that settle on buildings, structures, and people's eyes. Emissions from incomplete combustion of organic materials frequently contain a number of harmful pollutants, including persistent organic pollutants (POPs) and polyaromatic hydrocarbons (PAHs), which are known to be harmful to health.

Soil Pollution

Industrial and domestic wastes are the primary contributors to soil contamination, along with earthquakes, erosion, and other natural disasters that typically cause soil damage. Heavy metals, hydrocarbons, and both organic and inorganic solvents are examples of soil pollutants. Soil pollution is primarily caused by open land disposal, waste burning, and inadequate landfills.

Soil pollution is also aided by fossil fuels from petrochemical, petroleum, and power-generating facilities. Soil contamination is frequently the result of petroleum exploration, refining, and distribution via road transport. Due in part to the toxic nature of the additives used in their production and the direct effects that plastics have on animals and plants, land pollution caused by plastics is beginning to receive global attention. The sight of plastic litter on land is unpleasant, as is the possibility that it will seep into the soil, preventing plants from absorbing nutrients and entangling terrestrial animals.

In addition to affecting human health, soil pollution may also alter plant metabolism, resulting in lower crop yields. It is also possible for pollutants to enter the food chain through plant absorption.

Water Pollution

Man-made and natural sources both contribute to water pollution. Natural ores found in underground water sources may contain toxic metals that leach into water bodies and cause pollution. These ores are linked to high levels of arsenic and lead contamination in groundwater sources.Pesticides, hydrocarbons, POPs, and heavy metals are examples of chemicals that can have negative health effects like cancer, hormonal imbalance, impaired reproduction, and severe damage to the liver and kidneys. Eutrophication, the growth of plants and occasionally algae as a result of nutrients in the water, can increase pollution by reducing oxygen levels.

Examples of high arsenic and lead pollution of groundwater sources are connected to such metals. The elevated concentrations of the elements that are causing water pollution may be the result of the geological formations found in various regions, which play a significant role in determining the water bodies' elemental compositions. Domestic waste, insecticides and herbicides, food processing waste, pollutants from livestock operations, volatile organic compounds (VOCs), heavy metals from electronic waste, chemical waste, and medical waste are all examples of anthropogenic sources of contamination.

Airborne toxins like PM additionally bring other natural poisons into surface water. Typhoid, stomachaches, vomiting, and other health issues can be brought on by these pollutants.

3. CAUSES OF ENVIRONMENTAL POLLUTION

Mining And Exploration

Air, water, and land quality are all impacted in varying degrees by mining and exploration processes. The phase and scope of the work being done at the site determine the degree of pollution. The excavation of the mine site by itself may result in the loss of habitat, the formation of sinkholes, and the production of waste. Other harmful elements like lead (Pb) could explode during the mining of gold ore, a valuable material, and pollute the soil and water.

Vandals have taken to illegally bursting oil pipelines and siphoning oil for refining in illegal refineries in the majority of oil-producing states in Africa. In most cases, security agencies burn down these illegal refineries with the intention of stopping bunkering. However, this burning process generates enormous quantities of toxic metals, organic pollutants, carbon compounds, and sulfur compounds, all of which have negative effects on aquatic and terrestrial life. Due to the presence of greenhouse gases, acid rain, heat waves, and the death of fish and other aquatic animals in surface waters are just a few examples.

Agricultural Activities

Any nation's economic development is fueled by agriculture, which also provides for the people's daily needs. Even though agriculture plays an important role, agricultural activities still cause pollution, which poses a number of health and environmental risks. Certain farming practices that have a tendency to harm,contaminate, and degrade the environment and ecosystem may be the cause of agricultural pollution. The burning of waste materials from agricultural activities like clearing land, applying more fertilizer to plants than they need, and using pest control chemicals that aren't biodegradable are all ways that farming contributes to pollution. The introduction of particular chemical substances into the food web, the production of PM and smoke, and the destabilization of habitats are all outcomes of these processes. Besides, nitrates from horticultural cycles are known substance contaminations in groundwater springs.

The environment is also polluted by the raising of terrestrial or aquatic animals, in addition to the pollution caused by farmland cultivation. Unused animal feed or excrement, for instance, may have unpleasant odors that could be harmful to health.

Urbanization And Industrialization

The rapid expansion of urbanization, modernization, and industrialization all likely contribute to environmental pollution worldwide, with a greater impact in developing nations. Due to indifference to water conservation and water wastage, water resources are beginning to dwindle, and as the population grows, there is a risk that this trend will continue or even worsen.

Additionally, pollution contaminates water bodies, rendering them unusable for drinking. Furthermore, industrialization results in an overwhelming amount of waste being dumped into land and water bodies. Large quantities of wastewater, heavy metals, toxic sludge, solvents, and other pollutants enter streams and rivers as a result of rapid urbanization and industrialization.

Air pollution is a major concern due to the exponential growth of automobiles and motor vehicles as a result of urbanization. Lastly, industrialization encourages extensive habitat destruction through the construction of roads, houses, and the cutting down of trees for their lumber, all of which contribute to the devastation of ecosystems and the extinction of some animal and plant species.

Environmental degradation is one of the results of uncontrolled urbanization in non-industrial countries. This happens very quickly, which causes a slew of other issues like polluted air and water, increased difficulties with waste disposal, and fertile farmlands.

Burning Of Fossil Fuels

Before they are burned, fossil fuels may release harmful pollutants into the air. At the point when petroleum derivatives are consumed, various air toxins are discharged, which cause natural contamination and concomitant annihilation of the biological system. We burn gas, oil, and coal to meet our energy needs, and these fuel the current climate crisis. The burning of fossil fuels releases a wide range of primary and secondary pollutants into the air, including SO_2, CO_2, CO, hydrocarbons, organic compounds, chemicals, and nitrogen oxides (NOx). The major greenhouse gases, such as carbon dioxide, methane (CH_4), nitro-oxide, and fluoridated gases, are present in emissions from fossil fuels. As a result, these activities' air pollution not only threatens air quality but also contributes to climate change and global warming.

Particulate Matter

PM contributes significantly to the atmosphere. PM can come from either natural or human-made sources. There are various regular sources that infuse a large number of lots of PM into the climate. Volcanic eruptions, dust and wind storms, forest fires, salt spray, rock debris, reactions between gaseous emissions, and soil erosion are just a few examples.

Plastics

The extent to which plastics have contributed to environmental pollution is becoming increasingly apparent to the general public. Polypropylene, polyethylene, polystyrene, poly-amides, and polyesters are examples of plastics that can be found in nature. Due to their durability and affordability, plastic bags are primarily utilized for food shopping and storage in the majority of developing nations.

EFFECTS OF ENVIRONMENTAL POLLUTION

The impacts of natural contamination are to date underreported in most creating countries that endure contamination the most. This is partly due to a lack of awareness of the potentially harmful effects that pollution could have on health and the environment, as well as poor, unreliable database management systems.

Effects On the Environment

The environment is made up of land, water, the atmosphere, and the biosphere. It stores all pollutants. Damage to trees, the death of wildlife species, soil infertility that results in poor plant yield, destruction of roofing sheets, impacts on historical monuments and buildings, and discoloration of vehicles and automobiles are among the effects on the land. Other effects include littering the land surfaces with wastes, which has a repulsive odor and a negative impact on the appearance of the land.

Soil's chemical properties are altered, and important cat-ionic nutrients like magnesium, potassium, and calcium are lost, which lowers the pH of the soil. All of these things either directly or indirectly cause a lack of food for humans and other animals; Death and starvation are possible outcomes.

Changes in a water body's chemical, microbiological, and physical properties are typically the results of pollution. For instance, the sun's increased heat raises the water's temperature; Oil covers the water's surface in exploration areas, preventing sunlight and oxygen; increases in water salinity as a result of drilling with NaCl; an increase in the quantity of harmful metals; eutrophication, and the bio-network is destroyed, water quality and quantity are reduced, biodiversity is diminished, nutrient levels become too high, and plant growth is stunted. Due to the introduction of sulfur- and nitrogen-containing compounds and other anaerobic processes as a result of pollution, water bodies become noxious, repulsive, and abandoned.

Air in the atmosphere is known to carry a variety of pollutants and deposit them on land and water. Haze forms when sunlight strikes certain pollutants like PM and gases, making it difficult to see colors and shapes clearly. MP’s effects on aquatic and soil environments are being studied. However, there is a possibility that MP’s contain hazardous additives and chemicals that can enter the soil ecosystem and accumulate in soil invertebrates.

Effects On Animal Health

Wildlife and marine organisms both suffer sub-lethal health effects from oil spills that occur during exploration, refinement, and transportation on land, through pipelines, and/or marine vessels.

When these organisms breathe in or ingest petroleum products containing harmful substances, their digestive, respiratory, and circulatory systems suffer. Oil slicks pose a threat to seabirds and other marine mammals because they can clog their skin or feathers, preventing them from moving quickly enough to find food or escape predators, resulting in death.The difficulties of plastics in the climate have turned into a subject of talk in late times. It harms ecosystems, reduces biodiversity, and, ultimately, has the potential to affect the lives of most marine animals, including birds, fish, crabs, turtles, and others.

The genetic diversity and biodiversity of the natural population are affected by pollution. According to research, the ribosomal sequences in fish genomes that live in polluted environments are extremely complex. In response to changes in the environment, there is a systematic increase in the number of copies of the ribosomal DNA. This is because these sequences are primarily responsible for maintaining genome integrity.

Effects On Microorganisms

Zooplankton and other microscopic communities found in flowing water ecosystems are crucial to the nutrient cycle and energy transfer in aquatic food webs.

As a consequence of this, the biotic responses of microscopic organisms to the conditions of their environment made it possible to accurately assess environmental degradation in aquatic ecosystems.

However, the effectiveness of zooplankton biodiversity has been diminished as a result of pollution's significant influence on its geographic distribution.

Effects On Human Health

The majority of human illnesses have been linked to environmental pollution due to its detrimental effects on health. More evidence is being found in recent studies linking pollution to a number of serious health conditions. The number of studies examining the health effects of air pollution exposure is rising at an alarming rate. The World Health Organization's report made it abundantly clear that fires used for cooking and heating caused 3.8 million deaths in the indoor air.

It has been discovered that some recalcitrant pollutants, like POPs and PAHs, bind with particulate matter (PM), particularly $PM_{2.5}$, causing a variety of cardiopulmonary diseases, respiratory diseases, cancer, and effects on humans that are not related to cancer.

Because they reach the population, they are intended for by breathing, settling in drinking water, or being exposed to food, airborne pollutants tend to travel further and cause more harm.

Although epidemiological studies are pointing the finger at a number of women's health issues as the result of pollution, particularly air pollution, several other health problems associated with pollution may not have been discovered. Uterine fibro-ids may result from exposure to $PM_{2.5}$ and O_3 due to specific genetic or epigenetic abnormalities, according to the literature.

4. REMEDIES

There have been suggestions made for a variety of remediation strategies, including biological, chemical, and physical ones. However, the most important thing is to figure out how to stop pollution in its tracks so that the environment that has already been affected can be fixed quickly and easily. The physio-chemical properties of the pollutants that have built up in the environment that needs to be cleaned are unaffected by physical methods of soil reclamation.

Chemical methods, on the other hand, break down the pollutants that have built up and change their physio-chemical properties to make them less harmful to the environment. Importantly, biological techniques based on the biological activity of higher plants and microorganisms can break down pollutants that have built up over time and further lead to their mineralization, immobilization, or removal.

Understanding and reducing the use of plastics, cleaning up oceans and beaches, replacing materials, and comprehending the effects on the health of humans and animals are just a few of the areas that have been suggested for future research and development in recent studies.

5. CONCLUSION

An overview of pollution, its causes and effects, and strategies for reducing pollution have been presented in this paper. Air pollution seems to be the most studied type of pollution and has received more attention. This could be because air pollution is linked to an increased rate of morbidity and premature death. While pollution affects both developed and developing nations, poverty, ineffective legislation, and a lack of awareness are to blame for the majority of the latter's problems.In countries with middle and low incomes, polluted areas disproportionately affect vulnerable populations.

In order to make it possible to remediate an environment that has already been impacted, it is necessary to raise awareness of the dangers posed by pollution and to mobilize all resources to prevent activities that contribute to environmental pollution. The use of microorganisms in biological remediation techniques has been deemed environmentally friendly, cost-effective, and long-lasting for human and environmental safety.

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To Increase Performance in Construction use of Carbon Fiber

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ABSTRACT

Over the past few decades our research and technical skills has increased a lot. Even today we are innovating and developing the new trends in technology in-pursuit of a safe and sustained future as the innovation leads to invention. Throughout this evolution, engineers are in constant research for new and better building materials and carbon fiber is one of these materials, which is used with some other fibers and a specific polymer to form a high performance composite mixture .The aim of this research paper is to study the benefits of using carbon fiber in different types of industry & this paper also over comes the drawbacks of using other building materials. The amazing properties of carbon fiber such as high tensile strength, high stiffness, low weight & high resistance to chemical and temperature makes it one of the most popular materials in construction industry due to these properties It has enormous applications in military, medical science, construction, automobile, aircraft industry etc. It actually works as a robust building material. It produces the structure that possesses both flexibility and durability. It is incredibly strong that's why it can also withstand earthquakes. It is more flexible in wind than the regular structures. It is also listed in the top 20 engineering achievements of 20th century.It isde finitely the next generation building materialasitc an replace steel in the many structures and can reduce its construction and maintenance cost.

Keywords: Carbon fiber ,building material ,steel ,polymer ,tensile strength, stiffness.

INTRODUCTION

HISTORY

In the 18thcentury, Thomas Edison carbonized cotton and bamboo to make filaments for his early in candescent light bulbs.
In the late 1950s-ryan made high tensile carbon fiber and in early 1960s first and commercial and practical use of carbon fiber is made in aircraft which makes them lighter and faster due to the light weight and high stiffness of carbon fiber. During 1970's experimental work to find alternative raw materials led to the introduction of carbon fibers made from petroleum pitch derived from oil processing. Unfortunately they have only limited compression strength and were not widely accepted. The 20th century saw a tremendous increase in the demand for carbon fiber. Threats to peace increased the demand for carbon fiber for defense purposes, mid-century.
By the beginning of 21st century, new applications and new market sent the production of carbon fibers on an upswing.
Despite a global downturn in2008-2009, world wide demand for carbon fiber increased upto45, 000 metric-tons in 2010. According to the global market forecasts, the annual growth rate of carbon fiber is expected to be around 17%by2017.

METHODOLOGY

What Is Carbon Fiber?

Carbon fiber is a composite mixture of fiber such as aramid, aluminum or glass fibers bound together by a polymer which is most often epoxy or may be polyester, nylon etc.

The raw material used to make carbon fiber is the precursor. About 90% of the carbon fibers produced are made from polyacrylo-nitrile (pan). The remaining 10%are made from rayon. All these materials are organic polymers having long strings bound together by carbon atoms. During the manufacturing of carbon fiber variety of liquids and gases are used and the process is part mechanical and part chemical. Each fiber is 5-10 microns in diameter. Carbon fibers are 2 times stiffer than steel and has high tensile strength. In fact the carbon fiber might be the strongest material.
Carbon fiber is mostly used where the combination of high strength and light weight is required.5steps of production of carbon fiber are shown in the figure.

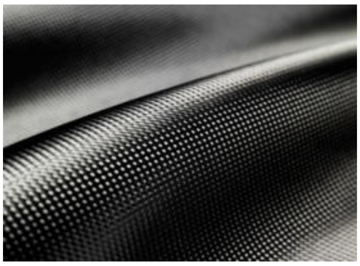

Fig.1 CarbonFiber

PROPERTIES OF CARBONFIBER

Carbon Fiber Has High Specific Strength

Strength of a material is the ratio of force per unit area atthe failure to the density. Any material which is strongand light such as aluminum, titanium, carbon, glass etc.has always high specific strength. The strength to weightratio of carbon fiber is much more than that of steel, aluminum,or glass fiber.Table showing the specific strength of various materials.The unitsare in KN.m/Kg.

CarbonFiberIsElectrically Conductive

This property of carbon fiber is both useful and bitharmful too. In construction of ships, this property comesinto play. Carbon fiber's conductivity can increase thegalvanic corrosion in electrical fittings but proper andcareful installation can reduce this problem. Carbon fiberdust is also harmful, which can cause short circuit in electrical appliances.

Fatigue Resistance Is Good

Carbon fiber has a good resistance to fatigue. Carbon fibers when placed perpendicular to the direction of applied stress produced the most favorable condition of increased resistance to bending and to flexural fatigue. Resistance to fatigue greatly depends upon the orientation of fibers. Damage in tensile fatigue will lead to the reduction in stiffness with large no. of stress cycles.

Carbon Fiber Has High Tensile Strength

Tensile strength is the maximum stress that amaterial can with stand safely while being stretched before failing. Carbon fiber does notlosses its shape and dimensions on stretching. Itis highly flexible and after stretching it regain sits shape almost completely.

Low Coefficient Of Thermal Expansion

This is a measure of how much a material expands orcontracts under the application of temperature when itgoes up and down. As compared to steel, aluminum orglass, ithas comparatively low thermal expansion, whichmakes it ideal for applications where small movement can be critical.Table showing the thermal expansion ofvarious materials. The unitsare in inch.

High Corrosion Resisitant

Carbon fiber is chemically inert and stable. It does not corrode easily by the environmental factors such as temperature, humidity, moistureetc. although epoxypolymer used in carbon fiber is sensitive to light and needs protection.

Carbon Fiber Is Very Rigid

Rigidity or stiffness of any material is measured by its young modulus; it measures how much amaterial deflects under stress. Reinforced carbon fiber plastic is 4 times stiffer than glass and around 20 times stiffer thanpine.

APPLICATIONSOFCARBONFIBER

1) **CivilEngineering**
Carbon fiber is used in several structural engineering applications due to its construction benefits and optimum cost. The applications include strengthening of structures made with concrete, steel, timber,cast iron etc. it canalso replace steel due to its high tensile strength and light weight.It is also used to increase the shear strength of old structures like bridges.

2) **Industrial Automation &Robotics**
Carbon fiber reduces the motor and actuator loads and increases the response time.In the business of automation, where machines often run as fast as 24x7,carbon fiber reduces the inertial loads by replacing heavymetal components, which further reduces part fabricationtime and which in turn increases the profit. In developed countries carbon fiber is used in making car’s roof, alloys and other accessories

3) **AircraftsAndSpacecrafts**
It is widely used in aircrafts and spacecraft components where its strength to weight ratio exceeds much more than that of any other material. It is applied in helicopters, gliders, flying jets where high strength and low weight is required. Carbon fiber increases the durability and lowers the maintenance cost.

4) **SportsGoods**
It has wide applications in sports goods and equipments such asstiffening of shoes, hockeysticks, tennis racquets, golf balls etc. it is also to make helmets which act as a protector while playing games.It has high damage tolerance which can be very useful to save lives.

5) **Military**

Military has various types of rough and tough equipments which are very hard and durable and act as as a feguard .Most of them are made from very strong materialslikecarbonfiber,examples-planes, tanks, missiles, helmets, soldier'spersonnelgear,machineguns,protective shieldetc.

6) **HouseholdApplications**

The applications of carbon fiber in home are far beyondour imagination starting from style, comfort, luxury orpractical use. Carbon fiber is used in in bathtubs, coffeetable, phone cases, pen stands, bow ties, chairs etc. Thelook ofblackcarbon fiberisvery attractive.

7) **MedicalApplications**

Carbon fiber offers several applications to medicalfield. The most important is artificial limbs. It is alsoused in x-rays and appears black on x-ray images. Itis also used to strengthen damaged ligaments in theknee. Carbon fiber is usedfor welfare equipment such as wheel chairs, care beds and portable slopes.

CONCLUSIONS

- Carbon fiber plates are very thin, strong, flexible and durable. They can be installed toprovide the optimum cost solution and to give a sustainablef uture design.
- It has high tensile strength, high stiffness, lowthermal expansion, high resistance to fire andcorrosion than any other material like stainlesssteel, glass or aluminum thus making it one of the most important composite materials inindustry.
- The golden factor of carbon fiber is that it possesses strength upto 5 times than that of steel and weightone third to that of steel.
- It has enormous applications in civil engineering, medical field, sports, military, automobile and music industry.
- The history of carbon fiber in India is nearly oftwo decades. Though the technology has been developed mainly in defense and aerospace, its for a in too the rindustrial sectorsis only a matter of time. In India there is a complicated situation between either to reduce the production cost of carbon fiber or increase its fiber properties. But challenges like costreduction, tensile and compressive strength improvement and alternative precursor development still remain.

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Research Paper on Floating Concrete

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ABSTRACT

Floating concrete is a fluid mixture of density less than water, which is suitable to build floating structures, reducing the consumption of land for buildings. This project report addresses the procedure of preparation of mix proportion of floating concrete, materials used & various test results of compressive strength at the age of 7 days & flow, for acceptance of this concrete. Also, it presents an application of this concrete for canoe construction along with a light weight but, strong reinforcement. Despite the self weight ofthe canoe, it can bear a certain amount of external load.

1. INTRODUCTION

What is concrete? (Conventional & Floating Concrete)

Concrete is the most widely-used composite material in the construction industry. It isdurable, weather-resistant, environmentally neutral and economically affordable.
There are many types of concrete each designed for fulfilling specific technical, structuraland aesthetic requirements. In the broadest definition, concrete is a mixture of Portland cement, aggregate (gravel and sand) and potable water.

Fresh concrete is a workable, form-able, non-toxic paste that can be easily poured and formed as per design requirements. During the hydration process, the water reacts with Portland cement to form a crystallized and permanent matrix holding aggregates together. In few days after casting the concrete, the concrete body reaches the pick of its strengths provided curing process is supervised by experienced and trained team in a conditioned environment.
Concrete compressive strength can easily surpass the compressive strength of many naturally occurring rocks; a compressive strength of 70 MPa can be easily achieved in a precast concrete factory and many cast-in-situ concrete elements achieve a compressivestrength of 40 MPa and more.

What is floating concrete structure?

A floating concrete structure is usually a solid body made of reinforced concrete & an inner chain of chambers filled with a lightweight impermeable material, typically polystyrene but, here the concrete is made to float by addition of aluminum powder as an air entraining agent. In addition to this, the concrete includes polypropylene fibers for good binding, nano silica for increasing its strength, $CaCl_2$ as an accelerator & Dr. Fixitfor water proofing. Aluminium mesh instead of steel mesh is used for reinforcement, formaking it light weight & corrosion resistant.

2. MATERIALS USED

The cement used is somewhat similar to Ferrocement but, instead of steel wire mesh, aluminium wire mesh is used possessing a light weight than regular chicken mesh making an innovative type of "Aluminicement"(Carbon fiber mesh can also replace the aluminium mesh as it is the best among the light weight but strong meshes available). Pozzolanic Portland Cement (PPC) reinforced with polypropylene fibers, for increasing the binding among particles was used, pursuing following physical & chemical properties:

Physical properties of Portland Pozzolanic Cement and OPC

Results

Ordinary Portland Cement Blended Pozzolanic Cement

Compressive Strength (MPa)

3 Day	**11.3**	**10.7**
7 Day	**13.2**	**14.3**
28 Day	**16.9**	**21.2**
Setting time (min)		
Initial	**120**	**164**
Final	**166**	**203**
Specific Gravity	**3.107**	**2.936**
Fineness %	**85.4**	**86.2**
Soundness (mm)	**0.5**	**1**

Chemical properties of Portland Pozzolanic Cement and OPCProperty Results

	Ordinary Portland Cement (**%)**	Blended Pozzolanic Cement(%)
Loss on Ignition	**2.05**	**1.05**
InsolubleResidue	**4.1**	**20**
Total alkalis	**0.59**	**0.71**
Chloride Content	**0.07**	**0.01**
SiO_2 Content	**28.7**	**23.5**
Al_2O_3 Content	**13.5**	**12.9**
CaO Content	**53.6**	**47**
MgO Content	**2.21**	**1.74**
Fe_2O_3 Content	**2.27**	**2.04**
SO_3 Content	**2.9**	**2.21**

Ordinary Portland cement is replaced by PPC because of its pozzolanic property as wellas making it economical by the use of cheaper pozzolanic material such as fly ash for sustainable development.

<u>Aggregate</u>

Locally available natural sand with 300 microns maximum size was used as fineaggregate.

<u>Admixtures</u>

Aluminium fine powder is used as gas forming admixture. It generates fluffiness in the concrete same as baking soda does in a cake. This admixture when added to mortar or concrete mixture react chemically with hydroxides present in the cement & form minute bubbles of hydrogen gas of size ranging from 0.1 to 1 mm throughoutthe cement-water

To shorten the setting time of the mix, the accelerating admixture used is CalciumChloride ($CaCl_2$).

Mineral additives

Since we have made a light weight concrete with density less than that of water, itpossesses a little less strength as compared to the conventional concrete. So, to overcome this drawback, nanotechnology is taken as a support.

Nano-SiO_2 having particle size less than 100 nm, has been found to improve concrete workability & strength, increase resistance to water penetration & to helpcontrol the leaching of calcium, which is closely associated with various types of concrete.

Water proofing agent

One of the major requirements of floating concrete is it should not have any leakagethrough it. The porosity of the concrete mortar should almost be equal to zero.

For this reason a water proofing substance is required.

Fixit powder is added to the mortar for making it water resistant.

3. PROPERTIES

Light Weight: Density range from 650 Kg/m3 to 1850 Kg/m3 as compared to 1800 Kg/m^3 to 2400 Kg/m3 for conventional brick and concrete respectively. Despite millions oftiny air-filled cells, it is strong and durable. There is Lightweight advantage for the structure design, leading to savings in supporting structures and foundation.

Compressive Strength: 2.0 to 7.0N/mm^2.

Excellent Acoustic Performance: It can be used as effective sound barrier and for acoustic solutions. Hence, highly suitable for partition walls, floor screens/roofing andpanel material in auditoriums.

Earthquake Resistant: Since lighter than concrete & brick, the lightness of the materialincreases resistance against earthquake.

Insulation: Superior thermal insulation properties compared to that of conventional brickand concrete, so reduces the heating and cooling expenses. In buildings, light-weight concrete will produce a higher fire rated structure.

Workability: Products made from lightweight concrete are lightweight, making them easyto place using less skilled labor. The bricks can be sawed, drilled and shaped like wood using standard hand tools, regular screws and nails. It is simpler than brick or concrete.

Lifespan: Weather proof, termite resistant and fire proof.

Savings in Material: Reduces dead weight of filler walls in framed structures by morethan 50% as compared to brickwork resulting in substantial savings. Due to the biggerand uniform shape of blocks, there is a saving in bed mortar and plaster thickness. In most cases the higher cost of the light-weight concrete is offset by a reduction of structural elements, less reinforcing steel and reduced volume of concrete.

Water Absorption: Closed cellular structures and hence have lower water absorption.

Skim Coating: Do not require plaster and water repellent paint suffices. Wallpapers andplasters can also be applied directly to the surface.

Modulus of Elasticity: The modulus of elasticity of the concrete with lightweightaggregates is lower, 0.5 – 0.75 to that of the normal concrete.

Therefore more deflection is there in lightweight concrete.

4. EXPERIMENTAL VALUES

COMPRESSIVE STRENGTH TEST

Concrete is primarily meant to withstand compressive stresses. Hence, behavior of concrete in compression is of foremost importance.

A cube of 10cm×10cm×10cm was prepared by taking cement:sand ratio as 1:3 & adding 0.08% of aluminium powder by volume of cement, polypropylene fibers in equal amount of cement, 2% $CaCl_2$ by weight of cement, 10% nano silica by weight of cement & a smallquantity of Dr. Fixit powder.

Recommended limit for compressive strength of the concrete is 2-7 N/mm^2 & thecalculated result came to be 3 N/mm^2.

Flow test:

This test gives an indication to the quality of concrete with respect to consistency,cohesiveness & the proneness to segregation.

The mix proportion of concrete is same as mentioned in compressive strength test

Concrete is filled in the mould in two layers, each layer is tamped 25 times & then afterremoval of the mould, the table on which mould is kept is raised & dropped for 15.

The diameter of the spread concrete is measured in about 6 directions & average spreadisFlow is calculated as given below:

Flow, percent = (Spread diameter in cm-25) ×100) / 25

The value could range anything from 0-150

The calculated value of flow came to be 14%.

5. CONCLUSION

Conclusions on the basis of Compressive strength test

Test results obtained show that floating concrete is not as effective in compressionas the conventional Its strength can be improved by addition of substances such as carbon nano fibers& silica nano particles which provide sufficient strength to the

With this amount of strength, floating concrete can be used at harbors & docks forloading & unloading of materials to & from the ships, respectively.

Also, a hollow cube can be built with floating concrete slabs & later it can be filled with Styrofoam for making it compact & can be used in floating structures & henceits load bearing capacity can be

Pumice stone (aggregate size approximately equal to 20 mm) can be used ascoarse aggregates in the concrete mix to increase its compressive

Conclusions on the basis of Flow test

The concrete can be used for marine structures as the flow is within the specified

The durability of the structures is also high in comparison to that of the conventionalconcrete

The problem of segregation is also reduced to a large extent so; it can be used forconstruction of piers of marine

OVERALL CONCLUSION

Floating concrete can be effectively used for building structures such as slabs, barges,buildings etc. Since maximum portion of earth is covered with water, it minimizes the consumption of land for construction works & this is an environment friendly method ofconstruction of boats replacing wood & metals.

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We at engineeringcivil.com are thankful to **Mr Vikramaditya Pandey** for submitting thisuseful paper to us. We hope this would be helpful for engineers seeking information on **Floating Concrete.**

Strength and Sustainability of Bamboo and Equivalent Construction Supplies in Civil Engineering Structures

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ABSTRACT

Bamboo is the woody plant that grows at the quickest rate in the world. Bamboo has a growth rate that is three times that of most other species. Housing is one of the top items, and administrative authorities all over the world are finding it difficult to come up with a solution for the current housing shortfall, despite the fact that they are aware of the lack. In addition to the other materials that are already in use, bamboo appears to be the most promising material. The structural frame approach that is used in bamboo building construction is quite similar to the approach that is used in the design and construction of conventional timber frames. It has been demonstrated that bamboo is suitable because to its low weight, great strength, beautiful appearance, and long-lasting nature. The characteristics of these animals vary greatly from one another. The selection of the appropriate species of bamboo is the first step in developing a successful use of bamboo in engineering. As a result, identification of the many species of bamboo is essential prior to its effective application. Building applications have also made extensive use of it, including as flooring, ceiling, walls, windows, doors, fences, housing roofs, trusses, rafters, and purlins. Additionally, it is utilized in construction as a structural material for bridges, water transportation facilities, and skyscraper scaffoldings. This study on bamboo can also contribute to sustainable development, which should take into careful consideration not only technology and economics but also the environment, culture, and traditions.

Keywords: *concrete, bamboo, reinforcement, Water absorption, bonding strength*

INTRODCTION

The Industrial Revolution more and more new industrial materials have been invented and developedto meet the ever-growing needs of people in the industrial world. As a symbol of the industrialization cast iron and later steel have been developed and widely used in mass production since the middle of the 19th century. Now people can find them everywhere: from building construction in the industry to the kitchen knife in the household. Another industrial material – aluminium – has been mass produced and used in industry no more than one hundred years, but now has taken over the place of steel in many fields because it is as strong as steel, butlighter Compared to steel, cements and plastics bamboo has many advantages like strength, elasticity and lightness, but also disadvantages in processingand connection: its tube structure is very good for tensile and press loadings. At last they found bamboo which is used for replacements of reinforcing bar in concrete for low cost constructions. Bamboo is available in commercial quantities using the established supply system. It is a renewable plant witha short rotation period. Bamboo grows to its full size for about a year. Another two or three years are required for the plant to gain its high strength. A natural material which is available in bulk and ease of use in the rural areas in the developing countries is bamboo. Bamboos occur mostly in tropical and subtropical areas, from sea level to snow capped mountain peaks, with a few species reaching into temperate areas

2 LITERATURE REVIEW

Fujji et al. [1993] investigated the chemistry of the immature culm of a mosobamboo (Phyllostachys pubescens Mazel). The results indicated that the contents of cellulose, hemicellulose and lignin in immature bamboo increased while proceeding downward of the culm. The increase of cellulose in the lower position was also accompanied by an increase in crystallinity.
Amada et al. (1997) investigated the mechanical and physical properties of Bamboo. They conducted a thorough investigation into the structure and purposes of the nodes, which they found to strengthen the Bamboo Culm. They also commented on the advantage Bamboo has over other natural buildingmaterials with its fast growth rate.
Mardjono (1998) provided research with the effort to give some sort of organization of a system to building with Bamboo between cultures, species, and countries having varying designs. The objective of their research was to improve the functions of Bamboo buildings by this organization to provide privacy, safety, comfort, durability, and accessibility. Overall Bamboo used as a structural material suffers from an incredible disadvantage due to inadequate applied scientific research. They do feel that Bamboo productsshould be brought to the level of acknowledged and received building materials. The results of their research will be published as a thesis and guide for designing Bamboo structures to be dispersed to peoplein developing countries.

A study reported in International Standard Organization (ISO) (1999) fashioned lab manual for

determining the physical and mechanical properties ofBamboo. The purpose for publishing this manual is first of all so that these methods are available all over the world. Research is done in so many places, very precise, yet is stuck in the laboratories. With this document, the methods are made available. Secondly, this document gives a practical step by step explanation of how to perform each test specifically following the International Standard Complement Document "Determination of Physical and Mechanical Properties of Bamboo." Another complement document is Bamboo Structural Design (1999). **Janseen (2000)** conducted her study on building with Bamboo. This book covered a wide variety of aspects of Bamboo going back to the structure of the plant and its natural habitat. It gives calculations to show why it"s economically competitive, mechanical properties, its many uses, its natural durability, and the preservation of the Bamboo. In much more detail, it discusses the joints and building with pure Bamboo. In relation to this project, her book does touch on Bamboo used as reinforcement in concrete. Listed in her book are several things that are more of a hassle than steel reinforcement. Of those, the bonding between the Bamboo and concrete is considered the biggestproblem due to absorption of water and smooth wall
Power (2004) tells of a study conducted by the U.K. Department of International Development in response to a devastating earthquake that killed 40,000 peoplein Iran. The engineers were looking for cheapearthquake-proof housing to take the place of mud brick. They constructed a prototype Bamboo reinforced concrete house and used an earthquake simulator to find that the house stood sound during a
7.8 (on the Richter scale) earthquake. They found no cracking in the concrete, the Bamboo to be extremely resilient to earthquakes, and the cost to be split in half compared to mud-and-brick construction

The American Bamboo Society (2005) provided a very intricate collection of specialized terms followed by their definitions relating to Bamboo. It also has a glossary of questions and answers common to someone new to the topic. These questions rangedfrom identifying Bamboo, preserving Bamboo,finding help with your Bamboo, to other topics not as closing connected to the research of this project.

Atul agarwal and Damodar maity (2009) they studied axial compression and bending test was performed on Plain, Steel & Bamboo reinforced members. As explained in there experimental program, For example, a total of 12 columns (150x150x1000mm) were casted using design mix (M20) as per IS code. These columns included 3 of the Bamboo Culm

Amada and Untao (2001) mention that bamboo is themost effective material in construction by the superiorcharacter of bamboo such as being physically powerful, tough, and a low-cost material. Normally, the Culm of bamboo with outer surface layer withstand strongly to any loading with stronger fracture resistance than the node. It suggests that the fibers in the node do not contribute any fracture resistance. The tensile strength of bamboo fibers almost corresponds to that of steel. The main discovery is that the fracture properties of bamboo depend upon the origin of fracture. In the nodes, it is found that the average fracture toughnessis lower than the minimum value of the entire Culm, suggesting that the fibers in the node do not contributeany fracture resistance

Seinfeld (2001) researched the remarkable current uses of Bamboo around the world. In the United States, it is almost completely used as decoration. A discussion is presented on the astonishing feature Bamboo brings to the table as mentioned in otherarticles. Another special feature about Bamboo is that harvesting Bamboo does not harm the plant, producing more of its timbers. Bamboo buildings are definitely a prospect of the future in the US; however in Asia, the Pacific islands, and South & Central America, they are quite traditional. The main prevention of Bamboo structures in America are building codes. There are not standardized codes for buildings of Bamboo though there are attempts towards them. Bamboo is also still being looked at as a way to clean environmental pollution. It is a consumer of Nitrogen, which could soon be part of a huge effort to prevent air pollution.columns of steel reinforcement, 3 columns of plain concrete, 3 columns of untreated bamboo reinforcement & 3columns of treated bamboo reinforcements (with varying percentage of reinforcement; i.e. 3, 5, & 8%). The load deformation curves displayed significant nonlinearity, indicatingthat the bamboo has the capacity to absorb energy. Failure of Columns predominately occurred in shearin shear under compressive loading. Plain concreteand untreated bamboo columns showed brittle behaviour in which, tiny cracks occurred at the surface of the column at about 80% of maximum axialforce. After reaching the maximum load, the load capacity decreased abruptly and it finally failed in fewseconds. There were no visible signs of spoiled concrete covering to warn of impending failure. Whereas in steel and bamboo reinforced columns more ductile behaviour was observed, wherein tiny cracks became visible at surface of columns firstly at 80-90% of maximum axial force. Final failure was accompanied by growing signs of cracks and spalling of concrete. Furthermore, the results, exhibited that the maximum load carrying capacity of steel reinforced (min reinforcement, 0.8%) column isnearly equivalent to that of treated bamboo (8% reinforcement) reinforced column (owing to the strength of bamboo samples). Transverse load test performed on above set of columns revealed the lateral deflection, strain characteristics and failure mode pattern of the steel, plain and bamboo reinforced columns. Hence, further analysis of results obtained, would assist in evolving comprehensive design methodology in case of reinforced columns. Bamboo concrete composite structural members can provide tailored solutions to the eco-housing initiatives at cheaper costs. The results obtained accrue the advantageObtained by the composite members when compared to standard reinforced concrete and plain concrete. However, further studies to achieve higher mechanicalproperties and understanding their behaviours in details would make this a reality.

DESIGNS FOR CONSTRUCTION OFBAMBOO SCAFFOLDS

The commonly used bamboo types are Kao Jue and Mao Jue. They should be 3 to 5 years old and air-driedin vertical positions under indoor condition for at least3 months before use. The nominal length of both Kao Jue and Mao Jue is 6 m. All bamboo members should be free from visual defects, and meet the following requirements on the cross-sectional dimensions. This section provides detailed standards of design and construction of some typical types of single bamboo scaffold, including double-layered, truss-out and signboard bamboo scaffolds. When the recommended standards given in this section are not followed or when other types of bamboo scaffold not covered in this section are used, they should be designed by a design engineer. For a bamboo scaffold for demolition.

CONCRETE MIX PROPORTIONS

The same mix designs can be used as would normally be used with steel reinforced concrete. Concrete slump should be as low as workability will allow. Excess water causes swelling of the bamboo. High early-strength cement is preferred to
Minimize cracks caused by swelling of bamboo when seasoned bamboo cannot be waterproofed.

SIMILARITIES WITH STEELREINFORCED CONCRETE

Bamboo reinforced concrete design is similar to steel reinforcing design. Bamboo reinforcement can be assumed to have the mechanical properties. hen design handbooks are available for steel reinforced concrete, the equations and design procedures can be used to design bamboo reinforced concrete if the above mechanical properties are substituted for the reinforcement. Due to the low modulus ofelasticity of bamboo, flexural members will nearlyalways develop some cracking under normal service loads. If cracking cannot be tolerated, steel reinforced designs or designs based on unreinforced sections are required. Experience has shown that split bamboo works, irrespective of its size, the design engineer
Should also ensure the bamboo scaffold is capable to withstand the increased wind load acting on the plasticsheeting.

Steel Brackets Scaffolds

Steel brackets are essential to the overall stability of a bamboo scaffold. The details of a steel bracket for the support of posts of a bamboo scaffold for construction site. All steel brackets should be securely mounted onto the structural elements of a building with high quality anchor bolts and comply with the following requirements.

- The horizontal spacing between the steel brackets should not be larger than 1.3 m;and
- The concrete strength of the structuralelement to which the steel bracket is fixed should be not less than 25 N/mm2. All anchor bolts should be installed strictly in accordance with the manufacturer’s recommendations.

There may be occasions that a post of a bamboo scaffold does not rest on the steel bracket; the design engineer should ensure that the loading from the misaligned post can be effectively transferred to the steel bracket

Guidelines for Bamboo Scaffolds

- Performance
- Design Engineer
- Drawings and Specifications
- Engineering Justifications

Performs better than whole culms when used as reinforcing. Better bond develops between bamboo and concrete when the reinforcement is-split inaddition to providing more compact reinforcement layers.

CONCLUSIONS

- The addition of bamboo to concrete as a reinforcing material It has been demonstrated that bamboo can replace steel in the construction of basic houses for urban poor people who reside in close proximity to places where bamboo is grown.
- The same method of bamboo reinforcement that was utilized previously for steel reinforcement is now being used for both the main and the distribution reinforcement.
- The structural behavior of the reinforced concrete beam can be strengthened by utilising bamboo sticks as a retrofitted material.
- Bamboo has a high tensile strength and can be utilized as a replacement material for steel reinforment due to the fact that it is less expensive.
- The approach of using bamboo as reinforcement is employed for both the main and distribution reinforcement, just like how it was previously done with steel reinforcement.
- The elasticity modulus of bamboo is significantly lower than that of steel.

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A Review of Vertical Hub Wind Turbine

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ABSTRACT

"Vertical Hub Wind Turbine" hoping to creating strong enormous scope VAWT innovation based of an electrical control framework with direct determined energy converter. This approach considers an improvement where most or the control of turbines can be all overseen by electrical converter framework, lessening venture cost and need of support. In roadways the vehicle endures a ton to go in could time in view of lightning issue. This issue can be overwhelmed by utilizing the Upward Hub Roadway Windmill (VAHW). The fundamental point of this undertaking paper is to deliver energy by involving sustainable power assets as such the breeze is especially ecofriendly and truly compactable one. By involving that energy in valuable way we can deliver a constant power.

Keywords: *Blade Shape, Power Consumption*

INTRODUCTION

A windmill is a plant that changes over the energy of wind into rotational energy (mechanical energy) through vanes called sailsor cutting edges. Hundreds of years prior, windmills generally were utilized to process grain, siphon water, or both. Consequently they frequently were gristmills, wind siphons, or both. Most of present day windmills appear as wind turbines used to create power, or wind siphons used to siphon water, either for land seepage or to remove groundwater. A breeze turbine is a gadget that changes over motor energy from the breeze into electrical power. The term seems to have moved from equal hydroelectric innovation (rotational propeller). The specialized depiction for this kind of machine is an airfoil fueled generator.

Since the Seventh Century individuals have been using the breeze to make their lives more straightforward. The entire idea of windmills began in Persia. The Persians initially utilized the breeze to flood ranch land, smash grain and processing. This is likely where the term windmill came from. Since the far reaching utilization of windmills in Europe, during the Twelfth Hundred years, a few regions, for example, the Netherlands have thrived from making tremendous breeze ranches. The pinnacles without fellow wires are called unattached pinnacles. Something to think about a pinnacle is that it should uphold the heaviness of the windmill alongside the heaviness of the pinnacle. [3]

The principal windmills, in any case, were not entirely solid or energy proficient. Just around 50% of the sail pivot was used. They were generally sluggish and had a low tip speed proportion yet were valuable for force. Since its creation, man has continually attempted to work on the windmill. Thus, throughout the long term, the quantity of cutting edges on windmills has diminished. Most present day windmills have 5-6 cutting edges while past windmills have had 4-8 sharp edges. Past windmill additionally must be physically coordinated

Into the breeze, while present day windmills can be naturally transformed into the breeze. The sail plan and materials used to make them have likewise changed throughout the long term. Generally speaking the height of the rotor is straightforwardly relative to its proficiency. Indeed, a cutting edge wind turbine ought to be somewhere around twenty feet above and 300 feet from a block, however it is much more great for it to be thirty feet above and 500 feet from any deterrent. Various areas have different breeze speeds

.

WORKING OF THE VERTICAL AXIS WIND TURBINE

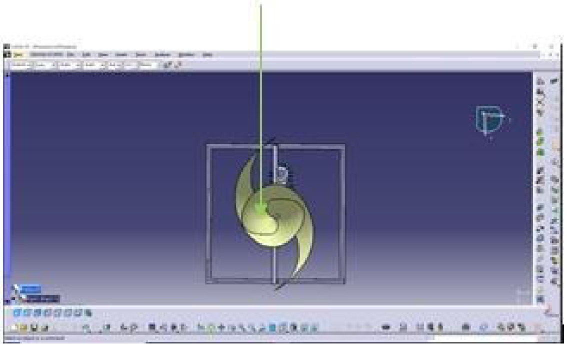

Fig. 1: CAD Model of Vertical Axis Wind Turbine Before discussing the finer details of the system. In thesystem we have taken helical shape of blade, these bladesmounted on vertical shaft. Output of this shaft is given togenerator shaft to produce power. To avoid deflection of rotor shaft we use ball bearing. We arrange the chain drive toincrease the speed generator shaft and for improving theefficiency.

A. Working Steps of System

- An upward pivot wind turbine is kind of wind turbine where the primary rotor shaft is set cross over to the breeze while the principal part are situated at the of the turbine. This course of action permits the generator to be found near the ground, working with administration and fix.
- VAWTs needn't bother with to be pointed into the breeze which eliminates the requirement for wind detecting and direction system.
- At the point when air strikes on the edges at extremely low speed also(upto 2 m/s) the rotor pivots and when rotor turn it pivots the generator shaft at exceptionally high speed due to the a little stuff is mounted on the generator shaft so when one revolution of rotor shaft finished there is 2.5 turn of generator shaft happens.
- At the speed of 60 RPM of generator shaft it produces 10-Watt power.

I. CASE STUDY

Fig. 2: Case study of VAWT

Street light on highway. Case study consideration is system design to produce power of 20 Watt... Capacity of turbine is 50 W, height of blade is 2.14 meter. Number of blades 2.

II. DESIGN CALCULATIONS

A. Selection of Blade

- Average temp=24^0C
- Average wind velocity=8m/s
- Consider power to be generated=30watt

1) Wind power: Pw = ½ ρ AV3
2) Swept area: A=DH
3) Aspect ratio: α = Rotor Height (H)/Rotor Diameter (D)Density of air,

ρ =1.173kg/m^3P=0.5ρ AV^3 A=0.1m^2
Swept area=0.1m^2
Consider turbine efficiency 25% & generator efficiency 80%P = 150watt
P= 0.5ρ A V^3
150 = 1/2×A×1.173×512A=0.5m^2
Taking diameter as 500mm,H=A/D
=0.5/0.5
=1m
From above information we have selected savonious blade ofNACA0018

B. Design of Shaft

T=W×r
=W×0.25 W=W1+W2 W1=W2=1kg W=2×9.81
=19.62N T=19.62×0.25
=4.905N.mFOS=3

$$\tau all = \frac{0.5 \times Sut}{3} = 26.67$$

$$d3 = \frac{538.28 \times 1000}{\Pi \times 26.67}$$

d = 18.59mm
Select std. diameter of shaft as 20mm

C. Selection of Bearings

1) Shaft Bearing (Cylindrical Roller Bearing)

Bearing number NU-2305n= 150rpm
Ln = 45000

d= 25mmL05 =
= 405
L05 = 4.48 L10 [ln( )]^$^{(1/1.5)}$L10 = 654.84 MR
Fa = 200N Fr = 175N Fa/Fr = 1.14
X= 0.56, Y=1.5
Pe = (Fr*X+Fa*Y)*1.5Pe = 597
Pe = $(C/L10)^3$ C = 4455.81 N
4455.81 <32000
Bearing is safe.

2) Bearing Mounted on Generator Shaft (Deep Groove BallBearing)

Bearing number 6300d = 10mm
n= 300rpm LH = 45000

$$L05 = \frac{60 * 300 * 45000}{106}$$
=720

L10 =1164.16MRFa =40N
Fr =45N Fa/Fr = 0.89
X= 1, Y=0.6
Pe = (Fr*X+Fa*Y)*1.5Pe = 100.5
Pe = $(C/L10)^3$C = 5412.54N5412.54<6300

Bearing is safe.

ADVANTAGES

- Reduces or even eliminates the cost of electricity.
- It is good for the environment because windmillsproduce no polluting exhaust
- The cost to operate a windmill is very low
- It helps our country reduce its dependence on foreign oil

CONCLUSION

The upward turbine enjoys the benefit of being deployable in metropolitan or other swarmed zones, while even hub turbines require an enormous impression because of the space required for safe turning of the sharp edges. Further, an upward hub turbine needn't bother with to confront a specific breeze heading, which is significant in a locale where wind course changes everyday.
Change in edge shape permits more revolution of the rotor even at low speed. The helical state of the edge tends to turn the rotor in any event, when the breeze streams from the different bearing. Minimal expense power age.

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A Survey on Thermodynamic Examination of Two-Phase Cascade Refrigeration Framework

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ABSTRACT

Refrigeration and cooling (RAC) assume a vital part in present day human existence for cooling and warming necessities. This region covers a great many applications beginnings from food conservation to working on the warm and thus expectations for everyday comforts of individuals. The use of these gears in homes, structures, vehicles and ventures accommodates warm solace in residing/working climate and consequently plays a vital in expanded modern creation of any country. Because of the rising interest of energy basically for RAC and HP applications (around 26-30%) this prompts debasement of climate, a dangerous atmospheric deviation and exhaustion of ozone layer and so on, to conquer these viewpoints there is earnest need of productive energy use.

Key words: *Thermodynamic Analysis, Cascade RefrigerationSystem, COP, Exergetic Efficiency*

INTRODUCTION

Considering deficiency of energy and a journey to ration it in all potential ways energy preservation is turning into a motto of the current 10 years and new techniques to save energy which is generally squandered are being investigated. Energy recuperation from squander heat as well as to use it for helpful applications to further develop the framework proficiency is developing worry in academic local area and subsequently, is being used for modern establishments now-days. At any point present energy emergencies have constrained the researchers and specialists all around the world to consider the energy preservation estimates in different ventures. Decrease of electric power and nuclear power utilization are attractive however undeniable considering the quick and cutthroat modern development all through the world. Refrigeration and cooling frameworks structure an indispensable part for the modern development and influence both the food and energy issue of a country at large. RAC frameworks are likewise a significant supporter of the energy utilization. Subsequently it is attractive to give a base to energy protection and waste intensity energy recuperation from RAC and HP frameworks.

As energy preservation is turning into an inexorably significant viewpoint/boundary, there is a need to enhance the thermodynamic cycles for the base utilization of energy. Numerous boundaries influence the exhibition of a refrigeration cycle. To upgrade their plan, an intensive report in view of the second law of thermodynamics (exergy examination) examination is required. Albeit, first law of thermodynamic examination strategy is generally regularly utilized, notwithstanding, this is concerned exclusively with the protection of energy and subsequently it can't show how or where irreversibility in the framework or potentially a cycle happens. Then again, second regulation based exergy investigation is another notable technique being utilized to dissect these cycles. Not at all like, the principal regulation, second regulation examination decide the size of irreversible cycles in a framework and subsequently, gives a sign to bring up the bearings in which the designers ought to think more to work on the presentation of warm framework.

CASCADE REFRIGERATION SYSTEM

The principal low temperature refrigeration framework was fundamentally produced for hardening of carbon dioxide and liquefaction and resulting fragmentary refining of gases, for example, air, oxygen, nitrogen, hydrogen and helium Ultra low temperature refrigeration in modern work has expanded hugely over the most recent couple of years [2].

Cascade Process

A.

Overflow framework is only like the parallel fume cycle utilized for the power plants. In a paired fume cycle, a condenser for mercury functions as kettle for water. Also in overflow framework condenser of low temperature cycle functions as evaporator for the high temperature cycle. In overflow framework, a progression of refrigerants with dynamically lower edges of freezing over are utilized in a progression of single stage unit. The outpouring gathering unit utilized two refrigerating frameworks or cycles and alluded to as cycles An and B. The condenser of cycle B, called the "high stage", is normally fan cooled or at times a water supply might be utilized to cool however air cooling is normal. The Evaporator of cycle B is utilized to cool the condenser of cycle A called the "low stage". The unit that comprises of condenser of cycle An and evaporator of cycle B. is frequently alluded to as the "Between stage condenser" or "outpouring condenser". Subsequently a fountain condenser fills in as an evaporator "for high temperature overflow framework (cycle A)". The distinction in low temperature overflow condenser temperature and high temperature overflow evaporator temperature is called temperature cross-over and is essential for heat move. Overflow framework utilize two distinct refrigerants in each stage. The explanation that two refrigeration frameworks are utilized on the grounds that solitary stage framework can't financially accomplish the high-pressure proportion important to get dissipating and gathering temperatures. The high temperature overflow framework utilizes a refrigerant with low bubbling temperature, for example, R-13 or R-13B1. These low bubbling temperature refrigerants have very high strain which guarantees a more modest blower relocation in the low temperature overflow framework and a higher COP [2].
One more arrangement of refrigerants generally utilized for liquefaction of gases in a three-phase overflow framework is smelling salts, ethylene and methane. The extra benefit of a fountain framework over multi stage pressure is that the greasing up oil from one blower can't meander to different blowers.
Overflow arranging integrates a few individual refrigeration frameworks that utilization various refrigerants and have shut heat exchangers to accomplish low working temperatures and sensible consolidating pressure. For a few modern applications which require decently low temp, single stage fume pressure refrigeration cycle and fume ingestion refrigeration cycle become unreasonable consequently overflow framework are utilized to get high temperature differentials between the intensity source and intensity sink. These frameworks are applied for temperature going from - 70oC to - 100o C [3].
Two phase overflow refrigeration framework is addressed by a P-h outline in Fig.1.1 and 1.2 separately. In the framework both Low Temperature Cycle (LTC) and High Temperature Cycle (HTC) work with various refrigerants and thermally associated with one another through an intensity exchanger which goes about as an evaporator for the HTC and a condenser for the LTC. HTC works with refrigerant having high limit and high basic temperature and LTC works with refrigerant having low edge of boiling over. Properties of refrigerants are given in Table I. Fig.1 shows that the condenser rejects heat QHT from the condenser at gathering temperature of Tc to its consolidating medium or climate. The valuable refrigerating impact is produce in evaporator of LTC by engrossing the cooling load QLT from the cooling space at the dissipating temperature Te. Heat consumed by LTC evaporator and work contribution to LTC blower approaches the intensity consumed by HTC evaporator that is overflow condenser. Tc, cas and Te,cas address the consolidating and dissipating temperatures individually. The temperature contrast between them, ΔT= Tc, cas - Te, cas is called temperature cross-over which is essential for heat move.

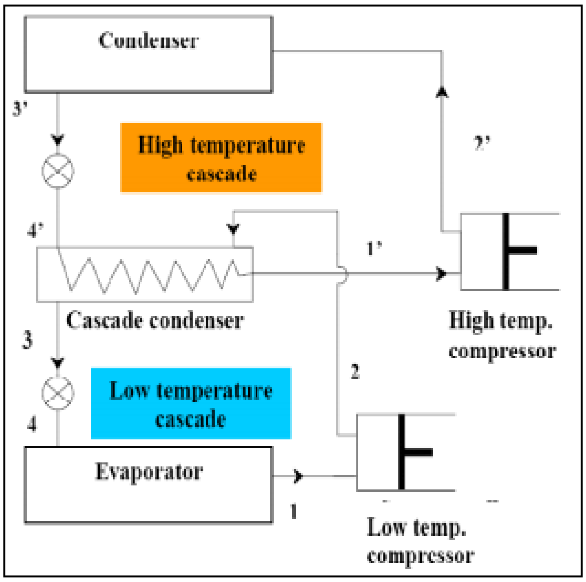

Fig. 1: Two stage cascade refrigeration system

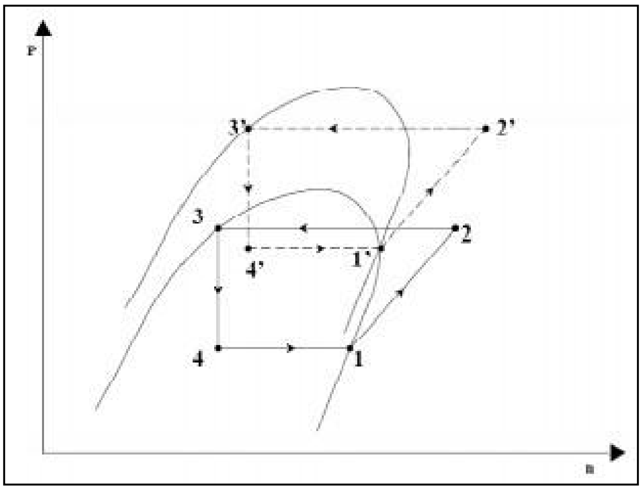

Fig. 2: P-H chart

REVIEW OF PAST STUDIES

Kanoglu (2002) fostered a thermodynamic model to play out the energy investigation of multistage overflow refrigeration cycle for gaseous petrol liquefaction. He additionally acquired an articulation connected with least work. Winkler et.al. (2008) examined on an outpouring framework reproduction calculation and executed with the assistance of a part based displaying instrument for fume pressure frameworks. The low temperature and high temperature fume pressure frameworks comprised of different blowers and the high temperature framework used two condensers. The reproduction instrument, regardless of utilizing straightforward intensity exchanger models, anticipated the COP with a typical mistake of 4.4% and a greatest blunder of 11.3%. Pompous Prada Botia (2018) record presents a consolidated refrigeration framework comprising of two fume pressure refrigeration cycles connected by an intensity exchanger that decreases crafted by the blower as well as expands how much intensity consumed by the refrigerated space because of the fountain stages and works on the COP of a refrigeration framework.

Manoj Dixit et al (2016) concentrate on assists with figuring out the best refrigerants and suitable activity boundaries. Found in the review overflow condenser, blower and refrigerant choke valve are the significant wellspring of exergy obliteration. The examination has been acknowledged through numerical model of the refrigeration framework. Umesh C. Rajmane (2016) study gives the benefits of fume pressure refrigeration framework and likewise synopses different strategies utilized in overflow refrigeration framework. The working boundaries considered in this study incorporate Gathering, Sub Cooling, Vanishing and Super warming temperatures in high - temperature circuit and temperature contrast in Outpouring heat exchanger Dissipating, Superheating, consolidating and Sub-cooling in the low temperature circuit. Umesh C. Rajmane (2017) study is introduced an outpouring refrigeration framework utilizing as refrigerant (R23) in low temperature circuit and R404a in high temperature circuit. The working boundaries considered in this paper incorporate superheating, consolidating, dissipating and sub cooling temperatures in the refrigerant (R404a) high temperature circuit and in the refrigerant (R23) low temperature circuit. Jinkun Zhou et al (2018) figure out that waste intensity can be used in retention refrigeration frameworks. In this article, the presentation of an auto-overflow retention refrigeration framework utilizing R23/R134a/DMF arrangements as the functioning substance was dissected. Streamlining investigation results showed that somewhat, the COP could be expanded when the low tension of the framework diminished. The sensible maximum restriction of the great strain was the high tension at the defining moment of COP, and the sensible lower cutoff of the low strain was the low strain at the defining moment of COP. The COP of the framework tediously expanded with the increment of the mole part of R23 in arrangements. The low R23 mole parts were more proper. J. Alberto Dopazo (2010) did the exploratory assessment of an outpouring refrigeration framework model with CO2 and NH3 for freezing process application. They likewise contrasted the trial results and two normal single stage refrigeration frameworks involving NH3 as refrigerant. A. D. Parekh and P. R. Tailor (2014) thermodynamic examination of outpouring refrigeration framework has been finished utilizing three distinct refrigerant matches R13-R12, R290-R23, and R404A-R2. Thermodynamic investigation shows that out of three refrigerant matches R12-R13, R290-R23 and R404A-R23 the COP of R290-R23 refrigerant pair is most noteworthy.

CONCLUSION

Consistent endeavors have been made by various specialists on various sorts of outpouring refrigeration framework. Miracle to work on their presentation and make them financially savvy. A few scientists have created thermodynamic model for the two phase and fountain refrigeration framework. Additionally different examinations give the benefits of fume pressure refrigeration framework and likewise synopses different procedures utilized in overflow refrigeration framework. The working boundaries considered in this study incorporate Consolidating, Sub Cooling, Vanishing and Super warming temperatures in high - temperature circuit and temperature distinction in Outpouring heat exchanger Dissipating, Superheating, gathering and Sub-cooling in the low temperature circuit.

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A Survey Paper on Wheelchair Development

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ABSTRACT

wheelchair is the significant piece of truly tested individuals and not even gives portability yet additionally assumes crucial part in their regular routine to do active work and social support. In India, as per overview of 2019, number of actually tested individuals utilizing wheelchairs were 2.2 percent. This paper intends to give a total outline of improvement of wheelchair from its creation to the latest phase of the progression as per different scientists. We expect that the data accumulated in this study will improve mindfulness in regards to the examination done in field of wheelchairs, and assists with expanding the utilitarian portability of wheelchair clients by understanding traditional wheelchairs, PW, SW followed by its elements and benefits.

Keywords: *Conventional Wheelchair, PW, SW*

INTRODUCTION

The wheelchair has been in presence for a long time, in mid 90s it was regular and simply restricted to give portability on level surface worked either by client or by help of overseer. As the further exploration occurred, the greater progression was finished in this field. From that point forward, wheelchairs have become lighter, more grounded, and more qualified for ordinary use. Presently a day's wheelchairs are either manual or electrically impelled by engine and battery [16].

As first wheel seat was designed, it had three wheels [14] which subsequently changed over into four wheels wheelchair for greater security and was traditionally worked by client or guardian. Further progression done which results the PW, worked by joystick or controller as versatility gives by engines. However, a few clients like deadened patients, outwardly hindered patients, simple-minded patients couldn't work PW by its own. To beat this issue, the Shrewd wheelchairs were developed which can give Route utilizing co-robot framework.

To see more data about wheelchair, we have made sense of the approach in three sections as customary, PW and SW.

CONVENTIONAL WHEELCHAIR

A. The principal realized committed wheelchair called an invalid's seat concocted by an obscure designer in 1595 and was made for Phillip II of Spain. Thereafter in 1783, John Dawson of Shower, Britain, planned a seat with two enormous haggles little one [37] [48]. Yet, as it wasn't so much that that agreeable, subsequently numerous enhancements were made and in 1869patent for a wheelchair showed the principal model with two back push haggles little front casters like the present regular wheelchairs [15]. Hitherto plan of foldable edges, kills the trouble in transportation of wheelchairs for an extremely long venturing out and permit to ship it inside consuming less space while significant distance

B. voyaging by means of vehicle or transport and so forth. First collapsing wheelchair where developed in 1932 by engineer, Harry Jennings [15]. After this number of instruments were presented by numerous specialists and architects for straightforwardness to collapsing and extending the regular wheelchairs, which makes it more adaptable.

C. Folding Wheelchair

A basic plan for collapsing wheelchair by utilizing an edge from an economically accessible wheelchair and adjusting it to house an ergonomic drive framework which diminishes weight and expanded openness [1]. Inflexible casing wheelchairs are for the most part welded and lighter than foldable edges. Though the collapsing outlines have more power misfortune during the portability on account of darted parts and system.

D. Tricycle

E. It is extremely useful for those patients whose legs are not utilitarian. Tricycles are three wheeled wheelchairs and driven by hand hawks rather than legs where one hand is utilized to turn the sell and the other hand is utilized to guide the tricycle [34]. As one examination, safeguard planned and mounted on a physically worked tricycle to lessen the impact of going over unpleasant ground, prompting further developed ride quality, and expansion in solace because of considerably diminished plentifulness of aggravations [33]. To make it more dependable a retrofitted tricycle plan, so that wheelchair client can get to the mechanized tricycle with wheelchair by incline game plan. Furthermore, equipped for driven by motor of old bike [49].

F. Sports Wheelchair

Wheelchair sports initially started during the 1940s, Since Many advances have since occurred to further develop both the inexorably specific games wheelchairs and other related hardware that have developed to address the issues of individuals that utilization them [27]. There are various customizable multi-sport seats accessible that permit people to take part in different games while exploring various settings using just a single piece of gear [28]. Sport wheelchairs spurs and urges impaired individuals to support in different Games like b-ball, Rugby, wheelchair dashing, Hand cycling and so on

Fig. 1: Sport wheelchair in Wheelchair Racing [50] andRetrofitted Tricycle [49]

As conventional wheelchairs are economical and affordable for every user, to make it more reliable and comfortable there are many modifications have done on it by providing various accessories within minimum cost, such as, safety belts, adjustable backrest, back seat tilting features, support for neck, health kit box etc.

POWER WHEELCHAIR

A. Electric controlled wheelchairs are intended for indoor use, open air use, or even both. They are by and large recommended for people who experience issues in utilizing a manual seat because of arm, hand, shoulder or more broad impairing conditions [4].

B. The idea of the power seat comes in 1953, when Canadian analyst George Klein makes first PW for WWII veterans. By 1954, Klein had a solid framework that utilized a regulator, batteries, a hand control and two engines, the idea that runs power seats today [15].

The fundamental parts utilized for build power wheelchairs are recorded underneath

1) Frame or skeleton: It is the primary assemblage of wheelchair which holds wheels, driving systems, electronic gadgets and supports the seats. Outline is accessible as traditional or unbending, foldable, stretchable and so on.

2) Motors: It gives the movement to wheels through driving framework. DC Outfitted engines utilized because of on stacking conditions, it gives consistent speed.

3) Power stockpile: 12V to 24V DC Dry cell batteries used to give capacity to the engines. By and large lead corrosive batteries favored which are battery-powered, innocuous, and weightless contrasted with others accessible [4] [36].

4) Mechanisms: It makes wheelchair more adaptable to work in antagonistic circumstances like step climbing, shifting or extending, for happy with sitting and so on.

5) Controllers: Basically PW worked through Joystick. In any case, presently a days numerous progression in PW happened which there are a developing number of elective choices that are opening up, incorporates light touch smaller than usual joysticks, switches, touchpads and taste and puff controls [17].

P. Swapna et al. planned Joystick regulator based portability wheelchair for the all conceivable heading of developments like left, right, and straight and back by utilizing the DC equipped engines, uses the power from the lead corrosive batteries [4]. As PWs worked on batteries, it need to re-energize oftentimes which cause power utilization. To decrease reliance on nonrenewable Energy a plan of doubly fueled wheelchair were presented, which runs on sun powered too electric batteries to work DC engines for versatility [3].

C Stair Climbing

Numerous structures have not adjusted debilitated cordial designs like inclines, lifts and so on. Hence commonly wheelchair clients face troubles in those frameworks to reach at highest levels. By taking into account those issue, many specialists and analysts have planned step climbing system for wheelchair that can be effectively climb steps in non-impaired agreeable foundations. The system held by transport line and pulleys on new steel outline connected underneath primary casing to permit it to climb steps utilizing DC Equipped engine [5]. To disregard hindrances like controls and steps, incline and sliding component that makes the ordinary wheelchair to climb the checks in the city and getting to the structures without slope office [12].

C. Stretchable Wheelchair

Wheelchair clients need to take an excess of endeavors for rests on bed as the need might arise to take rest. Likewise it's exceptionally extreme assignment to move deadened patient from wheelchair to cot for guardian and more than one overseers expected in certain circumstances [48]. Understanding those different issues, wheelchair cum cot plays most significant part, which is fit for moving different positions like Semi-Seat and Cot either by electrically or Pneumatic and water powered actuator.

To diminish this issue Thomas Paul et al. planned an Instrument that can be extending into bed by a lead screw associated with a pivot joint which makes an interpretation of transforming movement into straight movement. The level of the cot can be changed utilizing a physically worked Water driven jack [2]. As well as straightforward parallelogram component which lift the seat up alongside the patient and the slider wrench instrument used to extend the seat [35].

Power wheelchairs give many benefits to clients like Expands the portability, builds Mobility, work on Actual Legitimacy and diminishes reliance on others. [31]. this are mostly for clients who have insufficient strength close by muscles to work customary wheelchairs. Step by step many benefits are occurred PW to make it more productive and efficient. PW assumes significant part to work on client's nature of life.[52]

Fig. 2: Frame based Stretchable wheelchair [54] and stairsclimbing wheelchair [12]

SMART WHEELCHAIR

PWs can't satisfy necessities of clients like outwardly weakened individual, people with a most elevated level of Spinal Line Injury [51], where they are simply ready to control a muscle development from neck or more. In such circumstances typical joystick isn't suitable any longer [23]. In this circumstances Shrewd wheelchairs assumes fundamental part as SWs are one steps in the right direction to PW, which works on mechanical framework. Different Sensors and Handling units create it clever that can settle on self-choice to Route.

Presently a day's robot turns into something fundamental in modern as well as in human existence. These robots can give

a help to impair individuals in their day today life [21]. Utilization of robots and simulated intelligence give improved answer for progression of Wheelchair like eye following [21], vision based, and signal controlled, Cerebrum controlled wheelchairs. As per the inabilities as well as necessities, wheelchairs accessible are made sense of.

A. Gesture Controlled SW

Portability of wheelchair done by the hand motion development which in view of the rule that finger development and hand signals can be really converted into PC deciphered signals utilizing Accelerometers [8] [11]. On other hand Myoelectric signals gained from four lower arm muscles action which handled to compute the RMS envelope for each channel to movement order of the wheelchair. [10]

B. Voice Controlled SW

It has made portability helpful involving discourse acknowledgment innovation in which individuals have some control over the wheelchairs with their discourse, without composing on the board or working buttons for the framework [18]. With the utilization of versatile application, client voice order is communicated with the utilization of Bluetooth or Wi-Fi module and took care of to the Microcontroller where predefined order are as of now put away in the recognition framework. What's more, in like manner engine plays out the errand intrigued by the individual. [7] [45]. The wheelchair having mix of touch mode, voice mode and accelerometer based to control route is valuable to all sort of clients [32] [42].

C. SW Utilizing MEMS Innovation

The MEMS (Miniature Electro-Mechanical) innovation for quadriplegics patients deciphers what is happening of the client's head into speed and directional control of the wheelchair [13]. For making it all the more better and simpler, improvement of a Hand-glove controlled wheel seat in light of MEMS innovation gives versatility concurring hand developments deciphers utilizing the flex sensors [44].

D. SW Utilizing PC Vision Innovation

Move toward that utilizes PC vision methods which work with space insight and route, incredibly upgrades the portability of the old and debilitated without expecting them to practice engine control [29]. The on-board PC on the wheelchair runs vision programming that processes the sound system video framework into distance range data and give the route to wheelchair [30]. Ergonomic vision based co-robot, access 360 levels of movement bearing as well as a ceaseless scope of speed and is works together with the mechanical wheelchair as head movements by means of the egocentric PC vision based control [9].

E. Brain Controlled

The Defitech Establishment Seat in Painless Mind Machine Connection point (CNBI) carries out analysis on the utilization of human mind cues to control gadgets and programming to cooperate with the world [20] [19]. Fundamentally BCI taken under two kinds initially is Obtrusive BCI strategies in which terminals put straightforwardly on or inside the cortex. What's more, second is Harmless BCIs, can utilize an assortment of mind cues input, like electroencephalograms (EEG) for the most part utilized [22]. EEG based wheelchair driving framework

that permits a person with portability weaknesses to perform day to day living exercises autonomously. The electrical action of the cerebrum can be observed progressively utilizing a variety of terminals, which are put on the scalp in a cycle known as EEG [39] [40].

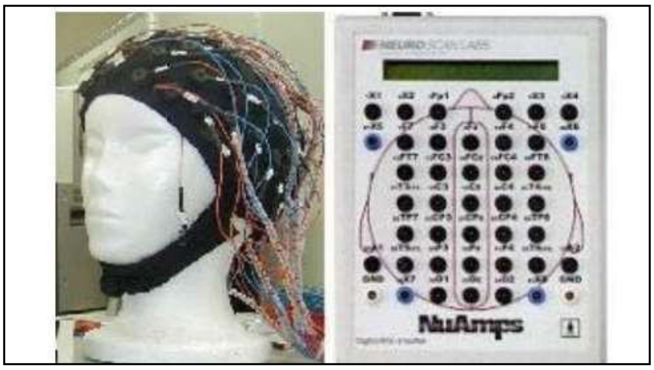

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Fig. 3: Acquisition devices (Scalp and signal amplifier) [26]

By capturing brainwaves produced by synchronized electrical pulses using sensors placed on thescalp, it translates into movement commands by the Arduinomicrocontroller which in turn move the wheelchair [6] [38].The Mind controlled wheelchair controls the direction andmotion of wheelchair based on the decision taken by theuser. The mind wave headset is used in the mind-controlledwheelchair to pick up EEG signals from the brain [25]. EEGsigns to control wheelchair has been viewed theimprovement of an eye blink which offers climb totrademark signals, these exercises can be used to control an external structure [24].

Benefits of brain-controlled SW includes: easy to handle, Suitable for all kind people, Less power consumption, Wireless control, Less interference due to encoding techniques, Less deviation and high sensitivity,Flexible hardware changes etc. [6].

A. Features equipped SW

As the SW are very known for self-navigation and operated on user command, sometimes user cannot notice the obstacles in pathway and collision may takes place. To avoid such situations the obstacles avoiding sensors mainly used, which not only detects the obstacles but also stops the WC. Now a days many SW are equipped with obstacles avoiding sensors, GPS and GSM system to locate on Google maps [4]. SW are autonomous and helps the patient to be independent. Assistive can improve the quality of life aswell as the mobility and safety for disabled people [41] [43].Co-robot control system used in wheelchair provides a morenatural human robot interface and enhance the mobility of SW without hand usage [10]. There are many new concepts have available in wheelchairs according to users need. To make it more comfortable and safe research have done like two seat Wheelchair, size shifting wheelchair, illuminated wheelchair, career wheelchair, etc. [53].

CONCLUSION

Subsequent to concentrating on the writing we have surveyed that there are extensive variety of changes occurred in wheelchair from ordinary to PW and SW. Wheelchairs are accessible for all sort of clients as per requests and usefulness. As sensors and controlling units are getting more modest and less expensive, wheelchairs are accessible in less expense as well with respect to Manny applications like indoor or outside portability, sports and so forth. Likewise mechanical technology and man-made brainpower applied for creating SW. Excursion of Wheelchair has started from ordinary to SW followed by the PW, despite everything research is occurring to make it more agreeable and efficient.

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Analysis of Forced Convection Heat Transfer to Improve the Thermal Performance by using Pipe with Triangular Fin Inserts

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ABSTRACT

Energy is converted, transferred, and used in the heat transfer enhancement procedures used in industrial, automotive, and home applications. Heat augmentation techniques are used to increase heat transmission in a variety of applications that can greatly enhance the thermal performance of heat-based equipment. By raising the fluid's turbulence, heat augmentation techniques raise the convective heat transfer coefficient. Additionally, this method increases pressure drop, which raises the price of the pump. Therefore, the pressure drop and heat transfer rate should be balanced optimally in the augmentation approach.

INTRODUCTION

A pump, fan, suction device, or other external source creates fluid motion during forced convection heat transfer, which is a sort of transport mechanism. It need to be regarded as one of the primary techniques for beneficial heat transfer because it is capable of efficiently transferring large volumes of heat energy. Air conditioning, central heating, steam turbines, and many more devices all use this process on a regular basis.

It is employed in a variety of industries, including the fertilizer industry's prilling tower, the electronics industry, particularly in computers where the processor is cooled by airflow from a fan, and the food industry for the baking of bread and the hardening of ice cream. Meat chillers, testing of the soil and asphalt For cooling inside electronic components like laptops, computers, laptop gaming devices, in forced convection ovens perfect for baking, drying, conditioning, sterilizing, and quality control, etc., in power plants like geothermal power plants, nuclear power plants, etc. Use pipe with triangular fin inserts for experimentation. These inserts feature a 20mm pitch and a 100mm spacing.

HEAT TRANSFER ENHANCEMENT

The process of improving heat transfer involves altering a heat transfer surface or the flow cross section to either improve the surface area or the heat transfer coefficient between the surface and a fluid, allowing for more heat to be transferred while maintaining a smaller temperature differential. Surface or fluid vibration, electrostatic fields, or mechanical stirrers can help improve heat transmission. Because they needed the use of outside power, these latter approaches are frequently referred to as active procedures.

Greater surface area, greater turbulence, and improved mixing or flow swirl can all increase heat transmission as a result of surface treatment. In addition to increasing heat transmission, these actions frequently result in a rise in pressure drop.

Due to forced convection's ability to:

1. Reduce the amount of heat transfer surface area needed for a given application, hence lowering the cost; the increasing attractiveness of various heat transfer enhancement techniques are acquiring industrial importance.
2. Permit closer conceptualization temperature
3. Increase the forced convection equipment's heating capacity.

A thorough investigation is needed to establish the economic benefits of improvement in any practical application. Such an analysis must take running costs into account as well as any potential first cost increases brought on by improved forced convection heat transfer performance. Any improvement in the heat transfer coefficient brought on by a clean surface can be swiftly undone by accelerating fouling.

ADVANTAGES OF AUGMENTATION TECHNIQUES

The advantages of installing tabulators are listed below; however, they will vary depending on the type of forced convection and the problems you may be attempting to solve.

- Better Heat Transfer.
- An increase in the heat transfer coefficient of more than three times.
- Better Performance inside the apparatus.
- To create turbulent flow from laminar flow.
- Cleaning Oneself.
- A decrease in fouling.
- Lessening of film buildup.
- Cost savings during downtime.
- Temperature that is constant and uniform.
- Lessens gradients that could lead to thermal breakdown.
- Simple to set up and take down.

LITERATURE REVIEW

Kurhade Anant, et al.'s [1] investigation into the forced convection heat transfer increase employing twisted tape inserts with circular holes. He used copper twisted tapes with holes to study the friction factor and heat transfer. He employed test equipment with pipes that were 500 mm long, 32 mm in diameter on the outside, and 28 mm within. The coil is assumed to be 500 mm long, 16 mm wide, and have twist ratios of 5.5, 6.5, and 8.5. He discovered that the twist ratio is inversely related to friction factor and directly proportional to the rate of heat transfer.

The one method to improve the heat transfer rate of the tube side has been presented by P.S. Desale and N.C. Ghuge [2]. In general, passive and active strategies for improving heat transmission can be separated into two categories. The drawback of active approaches is that they require external power sources in order to increase heat transfer rates. On the other hand, since extended surfaces, rough surfaces, and swirl flow devices don't require any additional external power, passive solutions have typically been favoured by many researchers. A type of passive heat transfer enhancement technology known as a coiled wire insert is widely utilized in many heat transfer applications, including air conditioning and refrigeration systems, heat recovery operations, food and dairy processing, and chemical processing facilities.

The investigation by Naga Sarada S., et al. [3] looked into the use of mesh inserts and air as the working fluid to increase turbulent flow and heat transmission in a horizontal tube. He noticed that the pressure drop only increased by roughly 1.45 times while the augmentation of heat transmission by mesh inserts increased by a factor of 2 when compared to a plain tube at the same mass flow rate. Using a porous insert with low porosity will improve heat transmission even more for a constant diameter.

Regarding the improvement of forced convective heat transfer in single-phase and two-phase flows, Arthur E. Bergles et al. [4] concentrate on the characterization of twisted-tape-induced helical swirl flows. Retrofitting existing heat-forced convection systems to increase their heat-load capacity is a common practice.Twisted tapes can significantly reduce the size of new forced convection systems as compared to conventional tubular exchangers when used for a certain heat duty and process application. The study focuses on the structure and scaling of single-phase swirl flow in the twisted tape-induced swirl flow pattern as well as the computational properties of swirl in circular tubes with twisted tape inserts. In order to promote cross-stream mixing, the primary mechanism must impart a centrifugal force component to the longitudinal fluid motion. This superimposes secondary circulation over the main axial flow. Laminar and turbulent heat transfer coefficient and friction factor correlations are shown, with an emphasis on the dampening effect of swirl on the transition area.

The impact of turbulent flow through a tube using double helical tape inserts has been studied by M.M.K. Bhuiya et al[5]. He employed helical tape with angles of 9, 15, 21, and 28 degrees with a Reynolds number between 22000 and 51000.He used a brass tube that was 1500 mm long, 70 mm inside diameter, and 90 mm outside diameter.The tapes are manufactured of mild steel, with appropriate pitches of 600mm, 770mm, 1035mm, and 1500mm for helix angles of 9o, 15o, 21o, and 28o. He discovered that there was a noticeable rise in the Nusselt number and friction factor.

Amnart Boonloi et al.'s [6] investigation into the properties of heat transport and forced convection using twisted tapes. Heusedhole size (l/d), LR = 0, 0, 0, 0, and twisted ratio (l/d), LR = 0, 0, 0, and 0, respectively. The experiment used turbulence between Re= 3000 and 10000. In this experiment, a straightforward algorithm and the finite volume method are employed. The augmentation of heat transport was determined to be better.

In this publication, Suhas V. Patil et al. [7] examine research done over the past ten years on improving heat transfer in a square duct and a circular tube.Because twisted tape and screw tape inserts are proven to be a cost-effective instrument in the field of improving heat transmission, attention is placed on these efforts in this study.

EXPERIMENTAL SET-UP

FORCED CONVECTION EQUIPMENT

The primary objective of dissertation work is the development of the test section. Here, a copper tube with an inner diameter of 20.4mm and a length of 1000mm is employed as the test section. A 150mm long, 25.4mm inner diameter G.I. pipe with five thermocouples installed on the test section pipe and two additional thermocouples at the inlet and exit with leak-proof couplings is brazed onto the end of a copper pipe. A blower is attached to one end of the pipe, leaving the other end open to permit airflow.

Figure 1 Schematic Representation of Actual Setup

BLOWER

The test area is circulated with hot air using a centrifugal blower. The requirements are as follows:

1. 4.8 Amps at 120 Volts, 50 Hertz.

2.5 m3/min at 12000 RPM is the maximum discharge.

Figure 2 Blower

TEST SECTION

The test portion consists of a copper pipe that is 1000mm long and is encircled by cotton thread. GI pipe has fittings on both sides. To heat the test section, a nichrome wire band type heater is installed on the copper pipe. For the purpose of insulation, cotton thread is put on this.

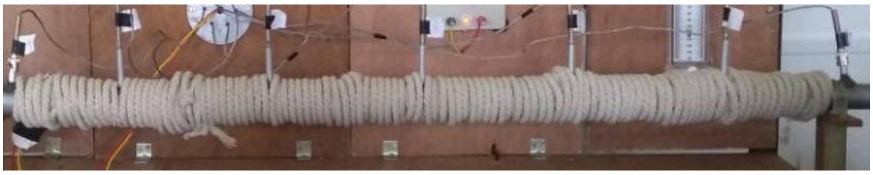


Figure 3 Test Section

CONTROL PANEL

A control panel is used to regulate the heater's power rating and measure various temperatures. It includes:

Temperature Gauge: An eight-channel multi-point indicator (DTI-108) with precision is installed in the control panel. The temperature at the installed place on the test section is indicated. Two of the five thermocouples are installed on the inlet and two are present on the test portion.

Figure 4 Control Panel

MANOMETER

A calibrated manometer is employed, as indicated in fig. U-tube manometer is what it is. Water is used as the manometric fluid in the U-tube manometer. The pressure drop is measured using itacross the entire test. The limbs of the manometer are connected to the nipples of the pipe using flexible pipe.

Figure 5 Manometer

PT -100 RTD TEMPERATURE SENSOR

Temperature measurements are performed using calibrated PT-100 RTD sensors. On the test part are five RTD sensors.One is on the section's inlet, while the other is on the outflow. Both are leak-proof. (-10 to 5)°C is the measurement's range.

THE INSERT

The experiment's insert was an aluminum pipe with a GI triangular fin attached on it. The current project focuses on determining the heat transfer coefficient.

ID of copper pipe: 20.5mm

OD=25.5mm copper

Copper is the test section's material.

1 m for the test part

P is Pitch

D is Pipe Diameter

S is Spacing

T is Thickness of Pipe

Diameter is 9mm

Thickness is 0.9mm

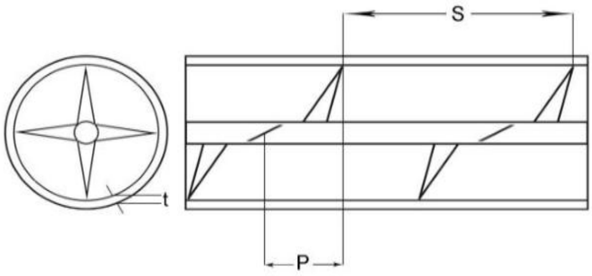


Figure 6 Arrangement of Pipe with Triangular Fin Insert inTest Section

Figure 7 Pipe with Triangular Fin Insert

The triangular-shaped GI fins mounted on the 1150 mm long, 9 mm in diameter, and 0.9 mm thick aluminum pipe. A 9 mm-diameter aluminum pipe with a length of 1150 mm was cut.

For the creation of triangular fins, the GI sheet measuring 0.8 mm was cut.With a hexa blade, 12mm cuts for triangular fins were made on pipe with an adjacent pitch of 30mm and spacing of 160mm. Helical marking was performed on pipe with a 300 degree angle. Interference fitting was used to attach the triangular fins to the slots in the aluminum pipe, and aeraldite was used to keep them in place. The increase in surface area is to blame for this. It was discovered that this improves heat transmission well.

ARRANGEMENT FOR INSERT INSIDE THE TEST SECTION

The pipe with the triangular fin is arranged to fit inside the test portion. The inlet and outlet parts are designed with flanged connections for convenience, which makes it easier to install the inserts and produces leak-proof joints.

Figure 8 f Pipe with Triangular Fin Insert inTest Section

EXPERIMENTAL INVESTIGATION

This chapter explains the information regarding the experimental setup and methodology used for the project work. Research on heat augmentation strategies has been conducted by numerous writers. In the current work, it is suggested that by inserting twisted tapes and analyzing its performance, Nusselt's Number, Reynolds Number, and heat transfer coefficient be studied.

EXPERIMENTAL SETUP

It consists of a blower to force air into the test portion, a u-tube manometer, and other components.The air supply is heated using a band-type nichrome wire heater. Copper pipe measuring 1000 mm in length, 20.4 mm in inner and 25.4 mm in outer diameter, and 2.5 mm in wall thickness make up a test section. The heat exchanger's thermal performance is examined by inserting a pipe with a triangular fin insert from one end of the tube and adjusting the pitch.

EXPERIMENTAL PROCEDURE

- Turn on the main power switch and the dimmerstat's zero position.
- Turn on the blower and change the air flow using the valve to the appropriate manometer level difference.
- By setting the desired heater input with a dimmerstat, begin heating the test part.
- Until the steady state is established, take readings from all 7 thermocouples every 10 minutes.
- Record the heater input as well.

OBSERVATION

READINGS WITHOUT INSERTS

I=0.07 ampere, V=70 Volts

Manometric Reading=50mm of water

Temp in °C	Time in minutes				
	10	20	30	40	50
T_1	43.6	44.2	44.2	44.3	44.6
T_2	38.0	38.2	38.5	38.7	38.7
T_3	38.0	38.5	38.7	39.0	39.0
T_4	37.2	37.7	37.9	38.2	38.2
T_5	38.2	38.7	39.0	39.3	39.3
T_6	37.2	37.8	38.0	38.3	38.3
T_7	42.1	42.8	42.8	43.1	43.1

I=0.07 ampere, V=70 Volts

Manometric Reading=80mm of water

Temp in °C	Time in minutes				
	10	20	30	40	50
T_1	33.3	39.0	39.3	39.5	39.6
T_2	30.4	34.0	35.8	37.9	37.9
T_3	30.7	34.9	36.9	38.5	38.5
T_4	30.5	34.5	35.4	37.5	37.7
T_5	30.9	35.6	36.8	38.3	38.3
T_6	30.6	35.0	36.7	38.3	38.9
T_7	33.6	38.2	38.9	39.3	39.3

I=0.07 ampere, V=70 Volts

Manometric Reading = 110mm of water

Temp in °C	Time in minutes				
	10	20	30	40	50
T_1	37.6	40.1	41.0	42.9	43.0
T_2	33.5	35.5	36.9	39.5	39.5
T_3	34.1	36.4	37.2	36.8	36.9
T_4	34.0	36.1	38.6	38.0	38.0
T_5	35.0	37.5	38.4	38.4	38.3
T_6	34.4	36.8	37.6	39.8	39.8
T_7	37.0	39.8	40.8	41.4	41.8

I=0.07 ampere, V=70 Volts

Mano-metric Reading= 125mm of water

Temp in °C	Time in minutes				
	10	20	30	40	50
T_1	42.3	44.8	45.1	45.2	45.2
T_2	36.0	38.7	41.6	42.6	42.7
T_3	36.8	39.7	41.8	43.0	43.1
T_4	36.2	39.0	42.3	43.5	43.5
T_5	37.8	40.9	42.6	43.7	43.9
T_6	36.8	39.8	42.0	42.3	42.3
T_7	41.9	43.7	44.2	44.7	44.7

READINGS WITH INSERTS

I=0.07 ampere, V=70 Volts

Mano-metric Reading=50mm of water

Temp in °C Time in minutes

	10	20	30	40	50
T_1	45.9	45.5	45.6	45.8	45.8
T_2	37.7	39.6	40.1	40.3	40.2
T_3	38.2	40.3	40.8	40.9	40.9
T_4	38	39.6	40.3	40.5	40.4
T_5	38.9	40.9	41.6	41.8	41.8
T_6	38.2	40.0	40.7	40.9	40.9
T_7	41.5	43.8	44.4	44.5	44.5

I=0.07 ampere, V=70 Volts

Mano-metric Reading=80mm of water

Temp in °C			Time in minutes		
	10	20	30	40	50
T_1	40.2	43.2	44.0	46.4	46.4
T_2	35.1	37.2	38.0	38.4	38.4
T_3	35.8	38.4	39.2	39.6	39.6
T_4	35.3	37.5	38.4	38.8	38.9
T_5	36.4	39.0	40.2	40.8	40.8
T_6	35.6	38.3	39.3	40.0	40.0
T_7	39.1	42.2	43.5	44.1	44.1

I=0.07 ampere, V=70 Volts

Mano-metric Reading=110mm of water

Temp in °C			Time in minutes		
	10	20	30	40	50
T_1	44.0	46.2	46.3	46.5	46.5
T_2	36.7	38.8	40.7	41.8	41.9
T_3	37.7	40.1	41.0	41.9	42.3

T_4	37.3	39.2	42.0	42.8	44.0
T_5	38.9	41.3	42.1	42.7	42.7
T_6	37.9	40.3	41.0	42.3	42.9
T_7	40.9	45.1	45.6	45.8	45.9

I=0.07 ampere, V=70 Volts

Mano-metric Reading=125mm of water

Temp in °C	Time in minutes				
	10	20	30	40	50
T_1	45.2	47.8	48.3	48.6	48.6
T_2	36.5	40.3	40.5	40.8	40.9
T_3	37.2	41.1	41.9	42.1	42.1
T_4	36.6	39.8	41.2	41.3	41.3
T_5	37.8	41.7	42.7	43.3	43.3
T_6	36.7	40.4	41.2	41.9	42.0
T_7	41.2	45.5	47.2	47.5	47.5

SAMPLE CALCULATIONS

1)Bulk mean temperature of air,

T mean = (T1 +T7)/2

= (44.6+43.1)/2

= 43.85 °C

2) Properties of Air at T mean ,

ρ air = 1.1131 kg/m3

CPA = 1.007 kJ/kgK

3) Surface Temperature,

Tsurface = (T2 + T3 +T4 +T5 +T6)/5

= (38.7+39+38.2+39.3+38.3)/5

= 38.7 °C

4) Properties of Air at Film,

μ = Dynamic viscosity of air (Ns/m2)

k =Thermal conductivity of air(W/mK)

5) Average Velocity of Air(m/s),

V= √(gH ...(HAir = Hwater *1000/ ρair)

=√ (2 ∗ 9.81 ∗ 44.9195)

= 29.6870 m/sec.

6) Mass flow rate of air,

m = ρair (V πr2)Cd

Where, Cd = Coefficient of discharge

= 3 * 9 678*(π/4 *(0.022)2*0.6

=7.5367*103 kg/sec.

7) Heat flow,

Q= ma Cpa (T7 -T1)

= 7.5367*1007*(43.1 – 44.6)

= -11.3841 W.

Q = havg (πdL *(Tsurface -Tmean)

-11.3841 = havg *π ∗ 0.0221*(38.7 – 43.89)

havg = 31.98 W/m2 °C.

8) Film Temperature,

Tfilm = (Ts +Tmean)/2 = 41.27°C

Properties of air at T film from standard air properties at

1atm pressure,

ρ = 1.1224 kg/m3

μ = 1.9238 kg/ms

$Pr = 0.7251$

$Re = \rho Vd/\mu$

= (4∗ 9 44∗ / (9 38∗ -5)

= 37787.50

RESULTS

The previous part covered both the experimental research and the computations. The interpretation of the results is now covered in this section. The impact of various Reynolds numbers on the Nusselt's Number and performance assessment is investigated. These specifications are taken into account for simple tubes and pipes

with triangular fins. The comparative analysis that followed is summarized as follows.

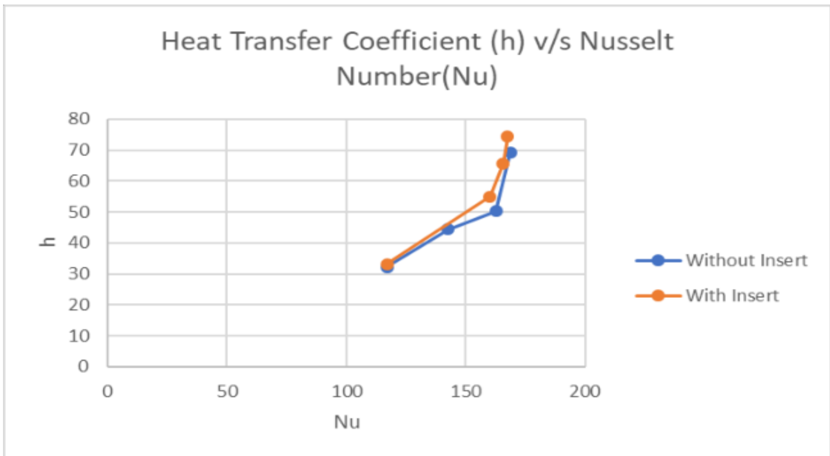
Table 1

Sr.No.	**1)**	**2)**	**3)**	**4)**
T_m(°C)	43.8	39.4	42.4	44.9
T_s(°C)	38.7	38.3	38.5	43.7
T_{in}(°C)	44.6	39.6	43	45.2
T_{out} (°C)	43.1	39.3	41.8	44.7
C_{pa} (J/kgK)	1007	1007	1007	1007
m_a (kg/s)10^{-3}	7.59	9.67	11.2	11.89
H(mm of water)	50	80	110	125
V(m/s)	29.4	36.9	43.9	47
H W/Km^2	32.2	44.4	50.2	69.2
T_F(°C)	41.2	38.8	40.4	44.3
Re	37788	48117.2	56643.6	59329
Pr	0.7251	0.7257	0.7253	0.7242
Nu	116.9	142.62	162.61	168.7

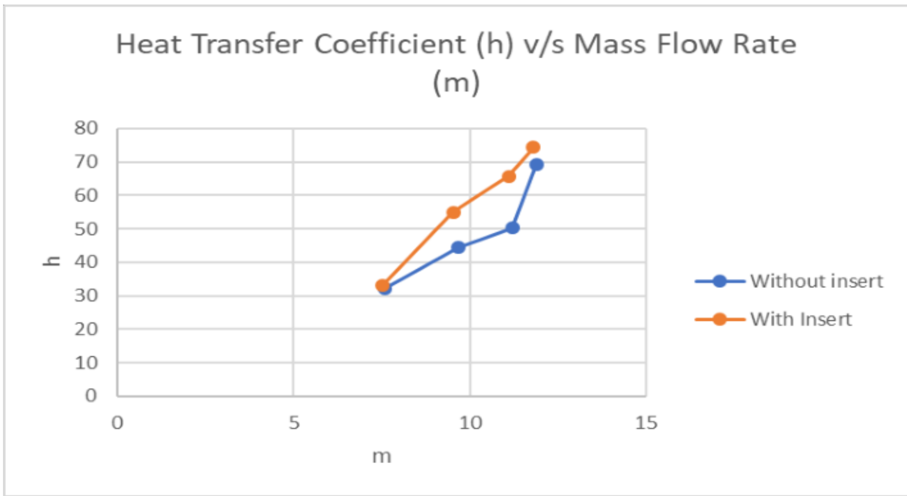
Table 2

Sr.No.	1)	2)	3)	4)
T_m(°C)	45.15	45.25	46.7	48.05
T_s(°C)	40.85	39.54	42.76	45.5
T_{in}(°C)	45.8	46.4	47.5	48.6
T_{out} (°C)	44.5	44.1	45.9	47.5
C_{pa} (J/kgK)	1007	1007	1007	1007
m_a (kg/s)10^{-3}	7.52	9.52	11.1	11.8
H(mm of water)	50	80	110	125
V(m/s)	29.75	37.63	44.22	47.28
H W/Km^2	33.12	55	65.67	74.41
T_F(°C)	43	42.39	44.73	46.77
Re	37817	47996.5	55666.8	58837.6
Pr	0.7246	0.7248	0.7241	0.7236
Nu	116.93	165.69	160.26	167.53

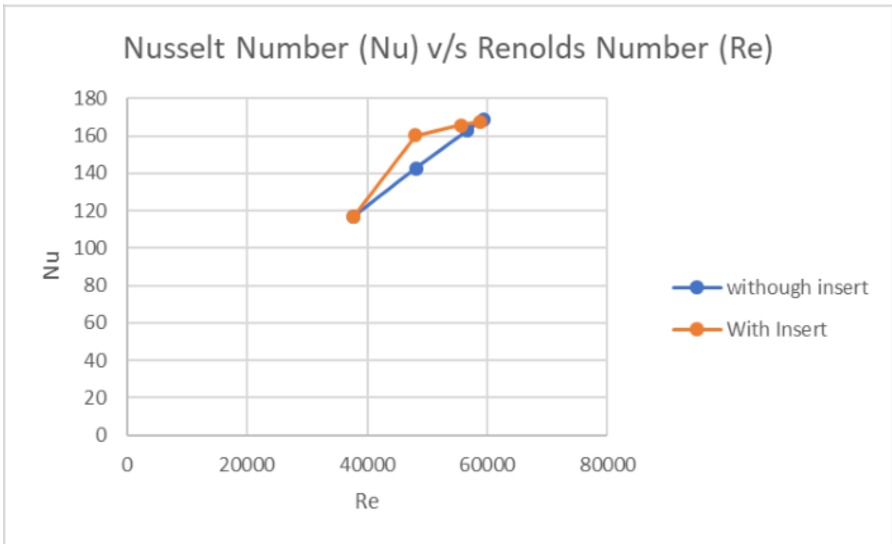
GRAPHS



Graph 1 Heat transfer coefficient(h) v/s NusseltNumber (Nu)



Graph 2 Heat transfer coefficient (h) v/s Mass flow rate(m)



Graph 3 Nusselt Number (Nu) v/s Reynolds Number(Re)

CONCLUSIONS

1. As mass flow rate increases, Nusselt's Number does as well, but pressure drop also rises.
2. By using fins on the inner tube's outer surface, heat exchanger effectiveness has been significantly improved.Less space between the two fins has been found to be a good improvement for triangular fins.
3. While inserts can be utilized to speed up heat transfer in a heat pipe, they also result in a greater pressure drop. The operational cost rises as the pressure-drop does as well. So, based on the need, one of the aforementioned inserts for heat transfer enhancement can be used.

4. The friction factor in the finned tube steadily reduces with increasing distance between two fins (space = 160mm) and with rising Reynolds number increment.
5. Based on the current experimental data, new correlations for the Nusselt number and heat transfer coefficient are provided for use in real-world applications. Reasonable agreement exists between the conclusions drawn from the experimental data and those drawn from the suggested correlations.

SCOPE & FUTURE

1) The distance between two adjacent fins may be changed, and its impact on the heat transfer coefficient and friction factor can be easily measured.
2) Since the pressure drop results from this alteration, research can be done to reduce it.
3) Insert design can also have an impact on the friction factor and heat transfer coefficient.
4) Viscose liquids can be used for experimental work at low Reynolds numbers.
5) The same experiment can be done using cooling procedures as well. to increase the forced convection's rate of heat transmission. One of the passive heat transfer enhancement methods that is widely utilized in a variety of heat transfer applications, including air conditioning and refrigeration systems, food and dairy processing, heat recovery operations, and chemical processing facilities, is the employment of inserts.

NOMENCLATURE

V_a = Air Velocity

Q = Discharge of Air

C_d = Coefficient of Discharge

A_1 = Area of Pipe (Test Section)

A_2 = Area of Orifice

H_m = Difference in Manometer Reading

T_1 = Inlet Air Temperature

T_7 = Exit Air Temperature

T_2 to T_6 = Temperatures of Test Section

V = Input Voltage

I = Input Current

Re = Reynolds Number

θ = Kinematic Viscosity

Nu = Nusselt Number

Pr = Prandtl Number

K = Thermal Conductivity

h = Heat Transfer Coefficient

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Biosynthesis and Clinical Uses of Polyhydroxybutyrate, a Bioplastics from Sustainable

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ABSTRACT

Biopolymers, the new result of Biomaterial designing has a few applications in our day to day way of life since biopolymers are viable with human way of life and furthermore eco-accommodating to the climate. Biopolymers are biodegradable polymers from living organic entities that comprise the biggest part of the cells. Polyhydroxybutyrates are very much described sort of polyhydroxyalkanoate that are orchestrated and catabolized by different living beings. Normally, the PHB is a carbon digestion item under the states of supplement pressure other than carbon source and processed for energy when energy source not accessible. The PHB is thought of as a decent option in contrast to the petrol determined polymer because of their great mechanical properties. The biocompatibility and cyto harmfulness of PHB have been explored in various cell societies and creature models that uncover the PHB as nontoxic and biocompatible material. In view of its promising properties, PHB pulled in much interest in the field of clinical, compound and drug enterprises.

Keywords - *polyhydroxybutyrate, PHB*

I. INTRODUCTION Polyhydroxybutyrate (PHB) is the notable polymer in the group of polyhydroxyalkanoate (PHA). As of now, polyhydroxybutyrates are created by in excess of 300 microorganisms has a place with the Gram-Positive and Gram-negative gathering by microbial maturations [1]. PHBs are absorbed intra cellularly in numerous microorganisms when the cells encompassing contains unequal development conditions like restricted centralizations of oxygen, nitrogen, phosphorous, sulfur or minor components like magnesium, calcium, ferrous and high groupings of carbon [2]. The PHB likewise created by utilizing the recombinant microorganisms which empower to get away from the need to restrict nitrogen sources. Later on, the creation of PHB will likewise be conceivable by agribusiness utilizing transgenic plants [3]. The PHB is an eco-accommodating polymer that can be effectively biodegradable under vigorous and anaerobic condition. PHB is a biodegradable polymer which can corrupt under vigorous circumstances into carbon dioxide and water and under anaerobic circumstances to methane [4]. The PHB is viewed as a decent option in contrast to the oil determined polymer.

The PHB has been created in huge scope due to their biodegradability and biocompatibility. PHB is a tailor-created material can be likewise being expelled, shaped, turned into strands, made into films and mixed with engineered polymers [5]. PHB has been generally utilized in industry for bundling, as a restorative compartment and in the clinical field for creating inserts and in pharmacological as a medication conveyance gadget [6].

II. STRUCTURE AND PROPERTIES OF PHB

PHBs are sugar based biopolymers which are homopolymers of D (-) β-hydroxybutyrate comprising of three to five carbon atoms and linked by ester bonds. The molecular weight of PHB differs from 45,000 to a million, depending on the organism, conditions of growth and method of extraction [7]

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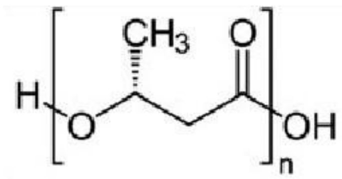
Figure 1 Chemical Structure of Poly-β-hydroxybutyrate (PHB)



Unlike most degradable polymer, the PHB exhibit resistance to hydrolytic degradation because ofhydrophobicity. The PHB is readily soluble in chloroform and other chlorinated hydrocarbons [8]. The melting point (T_m) ranges from 171–182 °C and the glass transition temperature (T_g) is around 5-10 °C.

The polymer is too brittle for most practical applications. The brittleness of PHB depends on the degreeof crystallinity, glass transition temperature, and microstructure. The additions of the UV absorber and the antioxidant additives have improved the UV stability of PHB, with a significant reduction in the photodegradation rate, as observed by mechanical properties, molecular weight and crystallinity degree [9].

Table 1 Physical Properties of PHB and Polypropylene [10]

Physical Property	**PHB**	**Polypropylene**
Molecular weight (10^5 g mol^{-1})	1-8	2.2-7
Density [g cm^{-3}]	1.23-1.25	0.905-0.94
Melting point T_m [^{0}C]	171-182	171-186
Crystallinity [%]	65-80	65-70
Glass Transition Temperature T_g [^{0}C]	5-10	5-15
Oxygen permeability [cm^3/m^2 atm d]	45	1700
UV resistance	Good	Bad
Solvent resistance	Bad	Good
Flexural modulus [GPa]	3.5-4	1.7
Tensile strength [MPa]	40	39
Extension to break [%]	6-8	400
Biodegradability	Yes	No

III. PHB PRODUCERSPHB

was first distinguished and disconnected from the Bacillus sp. [11]. Numerous bacterial species have been accounted for the amassing of PHB and advanced for the creation. They are tracked down in various heterotrophic, autotrophic oxygen consuming microbes, photosynthetic anaerobic microorganisms, actinomycetes, and cyanobacteria. Aside from microscopic organisms, they are available in growths and studies uncovering eukaryotic creation of PHB too.

The high yielding microorganisms incorporate Alcaligenes eutrophus, Alcaligenes latus, Azotobacter vinelandii, methylotrophs, Pseudomonas oleovorans and recombinant Escherichia coli. PHB creation likewise revealed in Bacillus megaterium, Bacillus thuringiensis, Rhodobacter capsulatus, Saccharococcus thermophiles, Staphylococcus sp., Bacillus subtilis, and Pseudomonas sp. [10].

Creation of PHA by different marine organisms likewise revealed in numerous microorganisms that incorporates Streptomyces fradiae, Halomonas campisalis, Methylobacterium rhodesianum, Halomonas profundus sp., Pseudomonas aeruginosa, Phaeodactylum tricornutum, Sphaerotilus natans, Streptomyces coelicolor, and Streptomyces halstedii [12].

PHB creation was accounted for in two transgenic yeasts; Saccharomyces cerevisiae INVSc1/PHA1 holding onto the PHB synthase qualities of Ralstonia eutropha in its cytoplasm, and Schizosaccharomyces pombe Q01/PHB, PHB biothensyzie qualities were coordinated into the chromosome [13].

PHB BIOSYNTHESIS

The beginning substance for the biosynthesis of PHB is an acetyl CoA, which is created from glucose. The starvation condition smothers the action of citrate synthase and redirects the acetyl units from Krab's cycle to start the creation of PHB.

The biosynthesis of PHB catalyzed by the three enzymatic reactions by three different enzymes. In the first reaction, a higher concentration of acetyl CoA activates β-ketothiolase (encoded by phbA) which condense acetyl CoA to Aceto-acetyl CoA. The second reaction reduces the aceto-acetyl CoA to 3- hydroxybutyrl-CoA by aceto-acetyl CoA reductase (encoded by phbB). The final reaction in which PHB polymers are produced from the 3-hydroxybutyryl-CoA by PHB synthase, encoded by phbC [10].

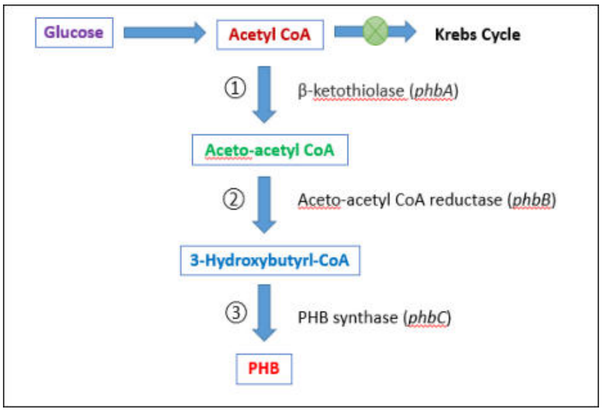


Figure 2 Biosynthesis of PHB

IV. COMMERCIAL PRODUCTION OF PHB

24 notable organizations are engaged with enormous scope creation of polyhydroxyalkanoates. At present numerous PHA items are industrially accessible available and new items are supposed to be created. Albeit numerous PHA has been accounted for, just four of them have been delivered for an enormous scope for business and PHB is one among them [14]. Since the properties of PHB are closer

to the polypropylene, the development of PHB is of extensive interest.

Table 2 Commercial PHB in the Market

Trade Name	Company	Location
Biomer	Biomer	Germany
Minerv	Bio-on	Italy
Biocycle	PHB Industrial	Brazil
Mirel	Telles	USA
Biogreen	Mitsubishi	Japan
Biomatera	Biomatera	Canada

V. BIODEGRADATION OF PHB

The extracellul

ar compounds answerable for the biodegradation of PHB were recognized as PHB depolymerase. PHB polymerases separate the polymer into monomer blocks, called hydroxy acids. This enzymatic response is two stages; restricting of chemicals to the PHB by its dynamic site and cleavage of the ester connection between the monomer atoms. Carbon dioxide and water are the debasement item under the oxygen consuming circumstances carbon dioxide and water and carbon dioxide and methane are the corruption item under the anaerobic circumstances.

PHA depolymerases are disseminated in numerous natural circumstances and most of PHB depolymerases were secluded and cleansed from different microorganisms, have a place with the Pseudomonas lemoignei, Streptomyces venezuelae, Penicillium oxalicum, Streptomyces peels, Streptomyces ascomycinicus, Bacillus megaterium, Rhodospirillum rubrum, Saccharomonospora class, Clostridium botulinum, Clostridium acetobutylicum, Fusarium solani, Pseudozyma Antarctica, Candida guilliermondii, Debaryomyces hansenii, Alcaligenes faecalis [15].

Medical Applications of PHB

Cardiovascular item

The in-vivo degradability of PHB makes this material for use in the assembling of cardiovascular embeds like pericardial patches, vascular unions, and heart valve. Polyhydroxybutyrate patches can restrict postoperative pericardial grips. A clinical report with 39 of the 50 human patients conceded for sidestep a medical procedure as well as valvular supplanting was inspected with mechanized tomography. A couple of instances of postoperative grips were accounted for the gathering getting PHB patches [16].

PHB as a medication transporter

Polyhydroxybutyrate can be utilized as a potential chemoembolization specialist. Microspheres with a size of 5-100 μm were stacked with drugs by a dissolvable dissipation strategy by using the dissolvable like methylene chloride, refined water, and polyvinyl liquor, scattering medium, and emulsifier, individually. The size of microsphere was changed by changing the underlying polymer/dissolvable proportion, emulsifier focus, blending rate, and beginning medication fixation.

The medication stacking limit of microsphere was exceptionally high and up to 407.6 mg rifampicin/g, PHB was accomplished. Drug discharge rates were exceptionally fast and practically 90% of the medication stacked was delivered in around 24 h [17].

Wound administration

Analysts are creating novel materials for upgrading the injury mending, in view of the limits of customary dressings. Wound dressing materials built from PHB polymer as movies and electrospun films were inspected for wound mending properties. The degradable P(3HB/4HB) polymers diminish aggravation and work on the angiogenic properties of the skin and mending of the injury was seen at day 14 [18]. PHB is likewise utilized in clinical regions to make careful stitches which keep away from the development of a sinewy case, lessen the size of the scar, and furthermore debase into non-poisonous and, surprisingly, valuable items [19].

Nerve Channels

Fringe nerve recovery is a confounded interaction after the fringe nerve injury. The nerve recovery requires reasonable aides for overcoming any issues in nerve injury to reestablish nerve capabilities. Hazari et al., looked at the degree of recovery in PHB channels with nerve autografts in a 10-mm nerve hole of the rodent sciatic nerve. Great angiogenesis were identified at the nerve closes and through the walls of the conductor. No disappointment was seen in any of the embedded conductors. Long reabsorption season of PHB channels guaranteed the recovery and development of the nerve, in this manner empowering the nerve to endure the pressure of preparation [20].

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CFD Investigation for the Impact of Three-sided and Pentagonal Ribs on Execution of Sun oriented Air Radiator

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ABSTRACT

Sunlight based energy can be changed over actually utilizing Sun oriented Air Radiator. Also, the adequacy of Sunlight based Air Radiator can be expanded by utilizing better and harsh safeguard plate. Harshness on the safeguard plate lead to increment in choppiness and expansion in air travel length, prompting expansion in the presentation of Sunlight based Air Radiator. Computational Liquid Elements is one of the most amazing devices to figure out the impact of any boundary of types of gear in plan stage as it were. In the current paper, three dimensional CFD examination of a sunlight-based air radiator with three-sided and pentagonal ribs has been finished to concentrate on heat move and liquid stream conduct. Impact of different unpleasantness boundaries, for example, heat move coefficient, Reynolds number, Nusselt number has likewise been covered.

Keywords: *Solar Air Heater, Ribs, Turbulence Model, CFD Analysis, Absorber Plate*

INTRODUCTION:

Sun powered radiation can be changed over into nuclear power utilizing Sun based Air Radiator. This nuclear power is modest and can be utilized for some applications including food industry, structures, for modern items, and so on. A safeguard plate, a back plate, protection and straightforward cover are the essential parts of the sun-oriented air warmer.

To expand the exhibition of Sun oriented Air Warmer, warming limit of safeguard plate should be expanded. The current exploration paper presents the impact of stream and harshness boundaries on heat move and stream contact attributes of a misleadingly roughened sun-oriented air radiator with three-sided and pentagon ribs on the safeguard plate. The impact on warm properties has likewise been covered, for example, Reynolds number, Nusselts number and intensity move coefficient. The outcomes are likewise contrasted and that for a level plate.

LITERATURE REVIEW

Singh et al., 2012, affirmed that misleadingly rib roughened sunlight-based air radiators have higher proficiency than the ordinary level plate sun-oriented air warmer Yadav, et al., 2013 and Lahori et al, 2016 introduced survey of the writing covering the use of CFD for plan of sun powered air warmers. Hu et al, 2013, fostered a mathematical model for anticipating inside stream and intensity

move qualities for sun oriented air warmer. Boulemtafes-Boukadoum et al, 2014, introduced mathematical examination for heat move improvement in sun powered air warmers with misleadingly roughened safeguard plate. Lahori et al, 2016 underlined on expanding air travel length for expanding execution of sun powered air warmer. Kumar et al., 2017, involved Familiar programming for reenacting 2 D stream for sun based air warmer. Prasad et. al., 2017, introduced numerical and mathematical investigation for sun based air warmer. Manjunath et. al., 2017, examined the impact of disturbance of
level plate sun oriented air warmer.

Abhay et al, 2018, utilized fake unpleasantness to expand the intensity move rate for backhanded kind sun based air radiator. Salih et. al., 2019, explored the warm execution of a twofold pass sun powered air radiator. Raj et. al, 2019, investigated a twofold pass sun powered air radiator framework.

GEOMETRIC MODELING

The geometry of Solar Air Heater was modelled in ANSYS Design Modeler with dimensions given in Table 1.

L1 (mm)	L2 (mm)	L3 (mm)	W (mm)	H (mm)	D (mm)	E (mm)	P (mm)
245	280	115	100	20	33.33	2	10, 15, 20, 25

Table 1: Geometric parameters of Solar air Heater with ribs

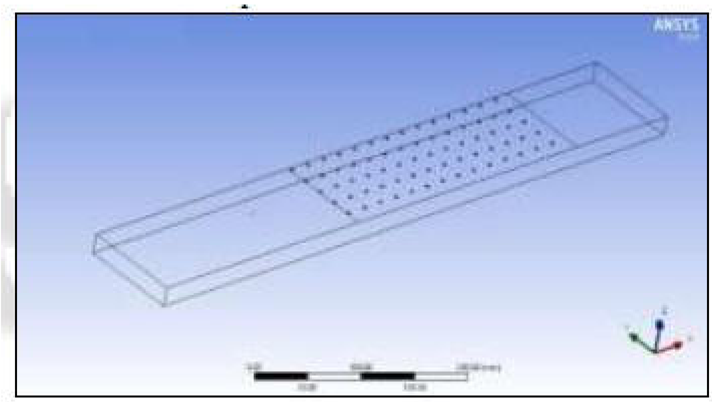

Fig. 1: Solar Air Heater with triangular and pentagon ribs onthe absorber plate with 20 mm pitch value

I. MESHING

The geometry is descritised into small elements as per specified in Table 2.

Rib pitch (P)	No. of nodes	No. of element
10	71932	185110
15	52315	136258
20	38379	101371
25	32573	87532

Table 2: Meshing details

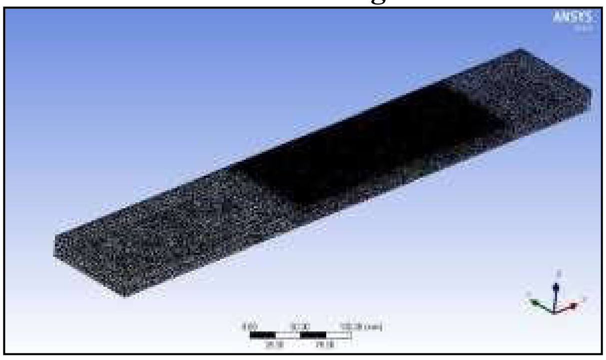

Fig. 2: Meshing of the Solar Air Heater

II. INPUT PARAMETERS AND BOUNDARY CONDITIONS

The range of operating parameters were specified as inputparameters and boundary conditions as given in Table 3.

Operating parameters	Range
Uniform heat flux, ‘q’	1000 w/m^2
Reynolds number, ‘Re’	8000, 1200, 15000
Prandtl number, 'Pr’	0.71
Relative roughness pitch, ‘P/e’	5, 7.5, 10, 12.5
Relative roughness height, ‘e/D’	0.060

Duct aspect ratio, 'W/H'	5

Table 3: Range of operating parameter

III. RESULTS AND DISCUSSIONS

ANSYS Fluent was used for analysis. Followingtemperature contours were obtained.

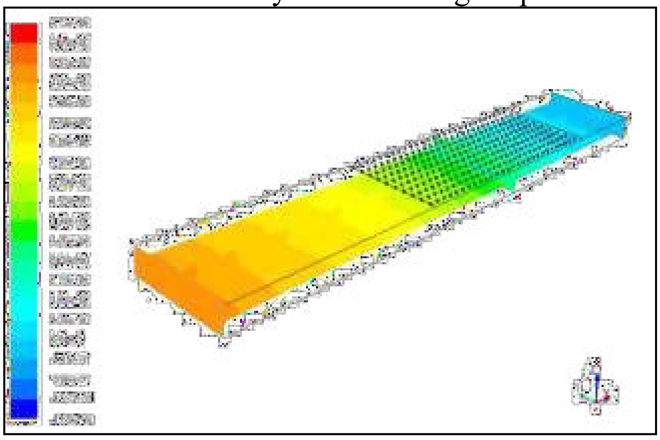

Fig. 3: Temperature contour for triangular-pentagon ribs fore=2, p=10, Re-8000-pressure of the absorber plate

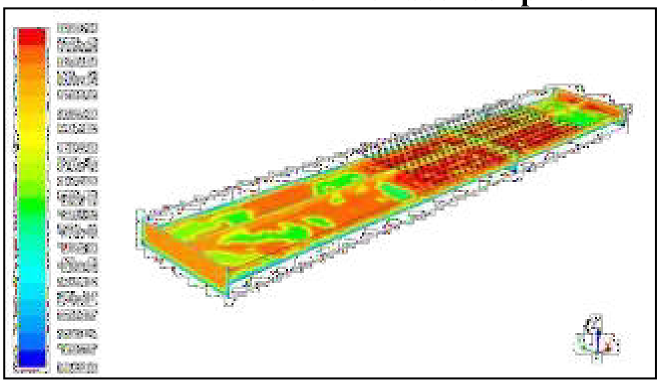

Fig. 4: Velocity of air at absorber plate for e=2, p=10, Re-8000

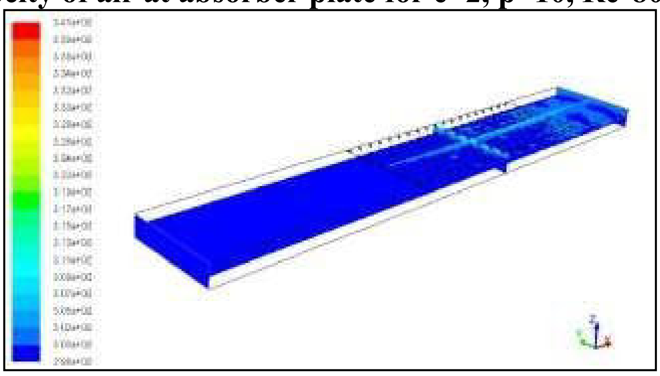

Fig. 5: Temperature of absorber plate for e=2, p=15 and Re-12000

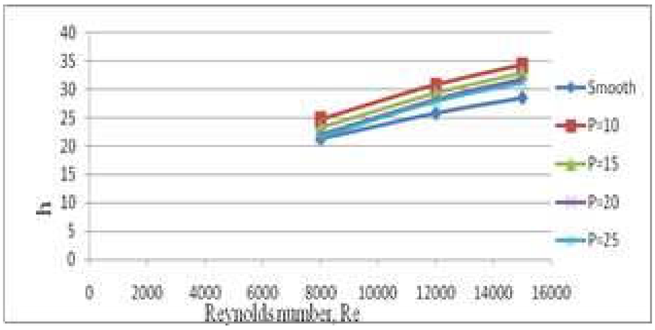

Fig. 6: Reynold's Number (Re) vs Heat Transfer Coefficient (h) plot

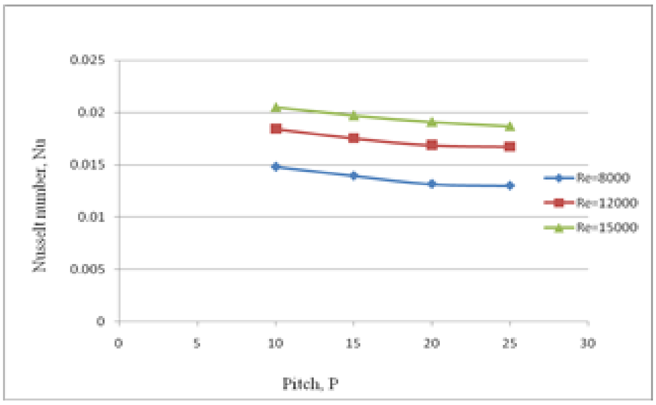

Fig. 7: Variation in Pitch (P) vs Nusselt's Number (Nu) Nusselt number increases with increase in

Reynolds number whereas it decreases with increase in roughness pitch. Friction factor decreases with increase in Reynolds number. The heat transfer decreases with increase in pitch and increases with increase in Nusselt number. Heattransfer increases with increase in Reynolds number and decreases with increase in pitch.

CONCLUSIONS

A three dimensional CFD investigation of sun powered air warmer has been done to concentrate on the impact of harshness of safeguard plate on its presentation. The impact of boundaries, for example, Reynolds' number, Nusselt number, harshness level, relative unpleasantness pitch and unpleasantness level have been read up for the exhibition expectation of sunlight-based air warmer. The typical Nusselt number increments with expansion in Reynolds number. The typical contact considers diminishes with increment relative Reynolds number.

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Continuum Demonstrating of Nanoindentation into In an upward direction Adjusted Carbon Nanotubeforests by Limited Component Technique

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ABSTRACT

Nanoindentation is a proper method to concentrate on the way of behaving of the materials at the nanoscale. Carbon nanotubes are allotropies of carbon with exceptional mechanical properties. Youthful's modulus is one such property managing its versatile way of behaving. In an upward direction Adjusted Carbon Nanotubes (VANCT'S) are a group of carbon nanotubes that are developed during the union of carbon nanotubes. Nanoindentation can be utilized to portray the mechanical properties of VACNT'S. On the other hand, mathematical methods, for example, Limited Component Displaying (FEM) can be utilized to recreate such a cycle to know the material science and mechanics of Vanct's. In the current work, continuum demonstrating has been utilized to mimic nanoindentation into in an upward direction adjusted carbon nanotube. The heap uprooting bends are gotten as the result of mathematical reproduction.

Keywords: *Finite Element Method, Load-DisplacementCurves, Nanoindentation, Vertically Aligned CarbonNanotube Forests, Stress-Strain Distribution*

INTRODUCTION

The nanoindentation interaction manages a jewel tip squeezed into the example surface and consequently, having arrived at a given greatest profundity for the most extreme burden applied. The tip is brought back and taken out. During the interaction, the stacking and the uprooting of the indenter are recorded. The recorded consequence of such an investigation is, consequently, a hardness esteem as well as the total history of the disfigurements happening during the test. A heap relocation bend comprises of a stacking and a dumping bend. The stacking bend shows the obstruction of the example against the infiltration of the tip and reflects both the versatile and the plastic properties. The dumping bend not entirely set in stone by the versatile recuperation of the indent. From such burden removal bend, hardness nd Youthful's modulus of the example can be resolved utilizing a proper examination model. In this manner, the prerequisites for a fruitful utilization of the Nanoindentation procedure are a device equipped for performing space tests and at the same time recording the applied burden and the comparing removal of the indenter. The other prerequisite is a technique for the examination of the deliberate burden removal bends.

The mechanical properties of Carbon Nano Cylinders (CNT) assume a significant part in different applications. The fundamental mechanical property of CNTs is its Young's modulus. Trial strategies have been planned and sub-atomic and continuum displaying and recreations have been finished to separate the different mechanical properties like hub modulus, bowing modulus of flexibility, and so forth. VACNTs have turned into a flow subject of exploration due to applications beginning from field outflow gadgets to Microelectronics frameworks utilized for the development of super-hydrophobic surfaces.

These days, the nanoindentation has turned into a dependable device for the assurance of mechanical properties of CNTs and the constituents VACNT timberlands, Hiroshi Kinoshita, et al. (2004) [1].

LITERATURE SURVEY

Carbon nanotubes are limited scale tubes carbon particles with the breadth in couple of nanometers and length can be in miniature or millimeters having predominant mechanical properties, Iijima, (1991) [2].

The principal mechanical property of CNTs is its Young's modulus when it is displayed as a continuum empty chamber. Numerous trial procedures have been utilized to gauge Youthful's modulus of CNTs and firmness at room temperature, Krishnan, et al. (1998) [3] and the electric, mechanical, and field outflow properties, Wang, et al. (2000) [4], of CNTs. Versatile properties of CNTs have been assessed utilizing an experimental power consistent model, Lu, (1997) [5]. A model connecting underlying mechanics and MM of CNTs has been created, Falsehood, and Chou, (2003) [6]. As a general rule, nanoindentation has been utilized to describe the mechanical properties of slim movies and mass materials. Mathematical strategies like FEM has been utilized to reproduce the cycle and acquire the heap uprooting qualities. Mass materials and slim movies of Titanium and copper exposed to nanoindentation have been recreated by FEM strategy [7]. FEM has been applied to recreate and get the flexible way of behaving of organic cells [8]. Nanoindentation into In an upward direction Adjusted Carbon Nano Cylinders (VACNTs) have been led to research the Miniature tribological properties with movie thickness 6 μm, and measure the basic shell-clasping load by hub compacting, Waters, et al. (2005) [9]. In view of the writing study and accessible information, logical conditions have been acquired for the misshapening of VANCNT's for twisting, pressure, and clasping loads [10]. The pictures of three unique examples of VACNTs shifted at 25° on which nanoindentation tests have been led are displayed in Figure-1,2 and 3 separately on three examples Qia, et al. (2003) [11]. Aside from nanoindentation, straightforward pivotal pressure tests likewise have been led on Vacnt's. Limited component examination has been carried on uniaxial pressure of round and hollow heaps of upward adjusted carbon nanotubes to concentrate on the distortion due to clasping [12].

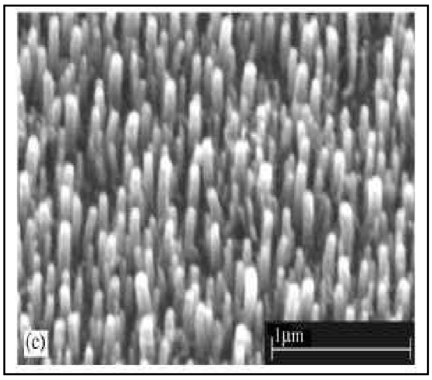


Fig. 1: VACNT (Sample-A)

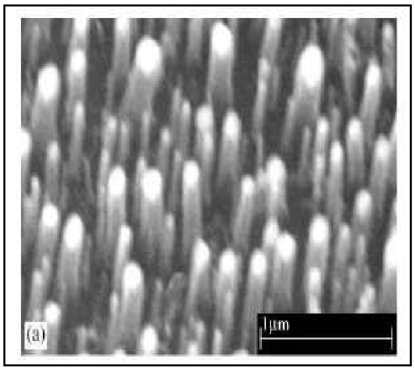


Fig. 2: VACNT (Sample-B)

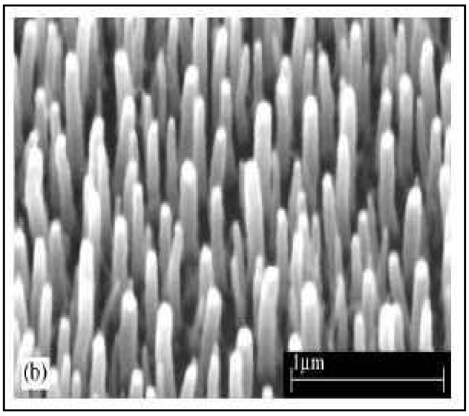


Fig. 3: VACNT (Sample-C), Qia, et al. [11]

FINITE ELEMENT MODELLING

The geometry and the shape of the materis andtheir related properties are given in Table – 1.

Table 1: Specifications of VACNTs [11]

Sl. No.	Details of sample materials			Indenter	
	Name	Behavior	Size (Diameter& Length) in nm	Shape& Size	Material
1	Sample-A	Elastic	104 & 930	Conical& 50 nm	Diamond
2	Sample-B	Elastic	90 & 1150	Conical& 50 nm	Diamond
3	Sample- c	Elastic	55 & 570	Conical& 50 nm	Diamond

A. Modeling and Simulation Process

The VACNTs are displayed as cantilever pillar structures for Space and twisting activity. In this way, a 2-D Axisymmetric strong tube shaped model that addresses the cantilever pillar structure has been utilized for the purpose of displaying. The math and the example subtleties and the indenter are displayed in Table-1. The Poisson Proportion for every one of the examples is 0.45. Limited component reenactment programming ANSYS is utilized for the demonstrating. 2-layered displaying has been conveyed to mimic the nanoindentation into Vacnt's. 2 D primary strong four noded component PLANE 42 is utilized to work the model. The component comprises of two levels of opportunity at every hub. The cross section of the 2D model is displayed in Figure-4. The hubs at the main concern of the half-space are limited to move in both X and Y bearings. A space force is applied at the contact point in descending Y-bearing and horizontal power in X-heading. Sloped stacking is viewed as beginning from 20 to 60 in increases. The Information and material properties for the three examples - A, B, and C are given for Recreation. A similar technique is stretched out for 3D displaying. The reenactment is done for load-uprooting conduct.

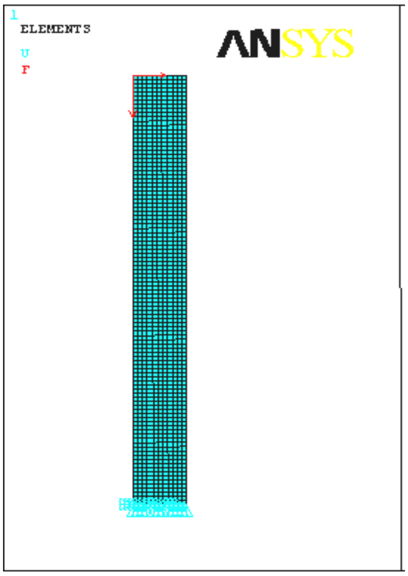


Fig. 4: 2-D Mesh of the VACNTRESULTS AND DISCUSSIONS

The outcomes comprise of Burden versus space profundity bends that are acquired by FEM for the three VACNT's examples. The comparing pressure strain forms are likewise displayed as result results.

The joined burden uprooting bends for every one of the three examples are displayed in Figure-5(a). It very well may be seen that the greatest space profundity for the example an is 561 nm. Additionally, for the examples B and C are 709 nm and 485 nm separately and are in great relationship to exploratory qualities accessible in writing as 712 and 490. In this manner the outcomes are associated. The relocation, von mises anxiety dispersions for test an are displayed in figure-6(a), 6(b) and 6(c) separately. The Y-displacement, stress and shapes for test B are displayed in Figures-7(a),7(b) and 7(c) separately.

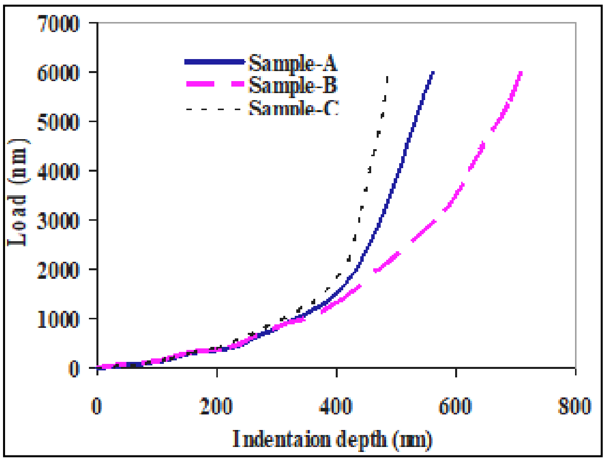
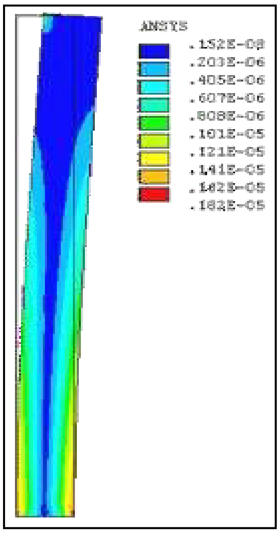


Fig. 5 (a): Load-indentation depth curves (FEM).



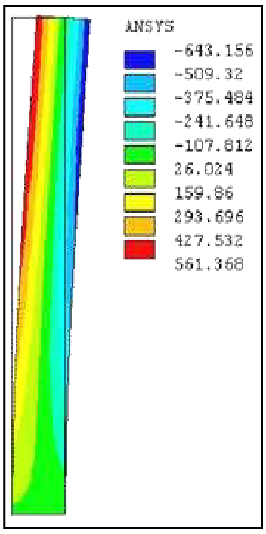


Fig. 6(a)

Fig. 6(b)

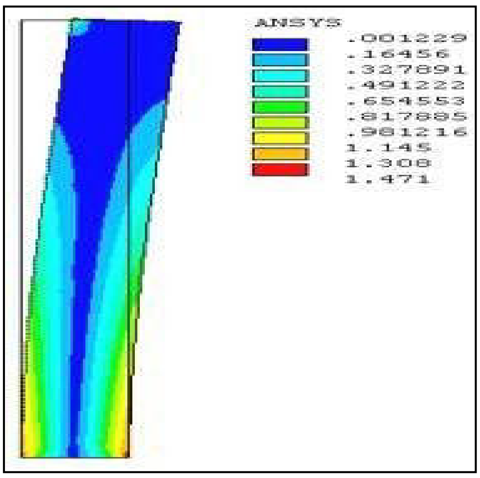
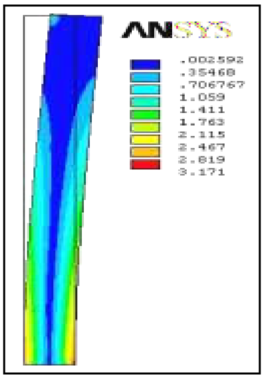
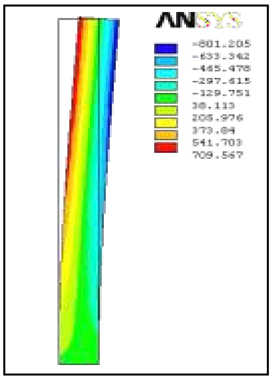


Fig. 6(c)

Fig. 6: Displacement, stress and strain contours(Sample-A)





. Fig. 7(a) Fig. 7(b)

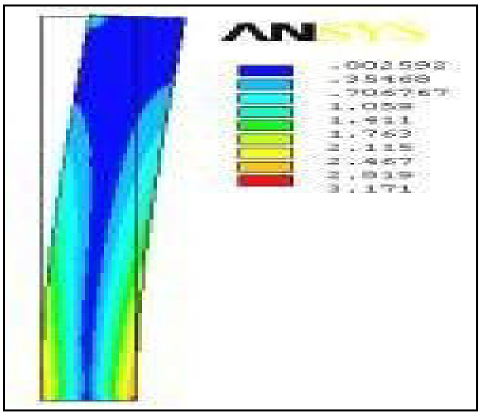


Fig. 7(c)

Fig. 7: Displacement, stress and strain contours(Sample-B)

The load-displacement behavioral curve of Sample-C shows less scatter than those of Sample-A and Sample-B since the Sample-C has the highest nanotube areal density. Sample-C is considered for three-dimensional modeling of nanoindentation. The simulation is conducted by assuming a single CNT as a continuum tube. The Von-Mises stress distributions for 3-dimensional models are shown in Figure-8

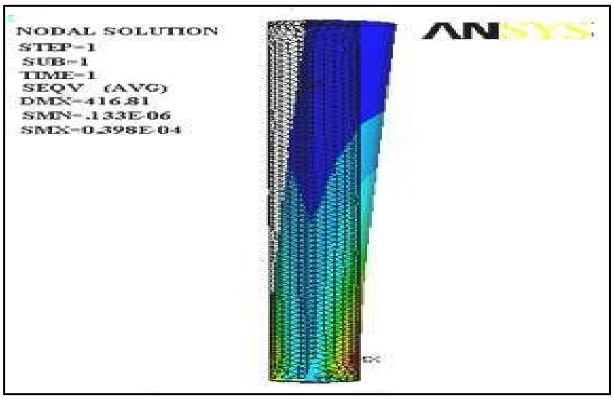


Fig. 8: Von Mises stress distribution (Sample-C)

CONCLUSIONS:

Limited Component Strategy has been utilized to reenact the nanoindentation cycle into upward adjusted carbon nanotubes; the got load-removal has been utilized to plot the bends from which the mechanical properties can be assessed. The heap uprooting information got by the FEM of Nanoindentation are contrasted and approved and the outcomes accessible in the writing. The outcomes are in great understanding. Accordingly the outcomes are shown as burden removal bends acquired from FEM information and furthermore as stress-strain shapes.

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Concentrate on Mechanical Properties and Effect Strength of Composite Fiber Built up Superior Execution Concrete with Metakaolin

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ABSTRACT

The review manages the Mechanical properties and Effect Strength of composite fiber supported elite execution Concrete containing Metakaolin, composites strands like (steel and polypropylene) in various extents. The Metakaolin utilized in the proportion of 0% &10% for concrete having steel strands of different extent ie 0% 0.50 % 0.75 % and 1.00 % and 0.25 % polypropylene filaments of volume of fastener consistent is utilized for the blend. Two different total cover proportions are utilized in the blend
for example, 2.25 and 2.50 and different water folio proportion utilized are 0.30, 0.35 and 0.40 alongside super plasticizer utilized in the review. Also, each succession contains crystals, chambers, 3D shapes and Effect chambers according to Indian norm. The review work is completed to track down the compressive strength term at 7 days, 28 days and split elasticity, flexural strength at the time of 28 days. Concrete likewise displays pressure rate awareness in each of the three stacking cases. it can't anticipate the high-pressure rate for the substantial yet with the effect opposition it tends to be anticipated. The drop weight influence test is acted in this Review work and effect obstruction test performed out at the length of 28 days. These blends are dissected and tried to track down the best viable blend to the strength attributes of the substantial blends.

***Keywords**: High performance concrete, Metakaolin, Steel Fibers, Polypropylene Fibers, Compressive Strength, Tensile Strength, Flexural Strength and Impact strength of concrete*

INTRODUCTION

In natural materials, for example, totals, sand, rock, squashed stones and so on blended in with Portland concrete and water to got a useful combination alluded as concrete cement. It tends to be projected into bars and piece. Compound response happens following not many long periods of blending makes the combinations solidified and cements. High strength concrete is acquired with lower worth of penetrability accomplished by superior execution concrete (HPC). Re-development of existing designs and proposed development requires elite execution sturdy material that offers more prominent support life of substantial designs with low upkeep. Substantial breaking mostly happens because of volumetric changes in the dampness, low protection from influence, high crumbling because of capacity, utilization of ill-advised nature of the admixtures. Less miniature breaking, high strength qualities ascribes to HPC. Elite Execution Concrete expected to work on the exhibition of substantial qualities under plans of burdens, climatic climate and give better upkeep and conservative. It additionally expands life of the designs. Superior execution substantial need note required new plan devices aside from appropriate quality blend. Acquaint of filaments been displayed with increment holding between the admixtures and cementitious material. Head models of effect strength of cement is the capacity of example to endure rehashed number of blows and to assimilate influence energy, target influence energy is determined . Influence strength of HPC increments with an expansions in compressive strength, precision and the surface harshness. It likewise relies upon the effect strength. The drop weight influence test is acted in this examination. Other then pressure, flexural and elastic test, influence test is carried on the solidified cement. It is an elective technique for getting the ideal strength.

LITERATURE REVIEW

R.Sivakumar, Mohanraj.N, Saratahkumar.D, T.S.Vekatachalam [1]. Showed that Metakaolin is a alternate material for high performance concrete. Concrete properties with metakaolin is most common preferred additives in HPC.. The various proportion of metakaolin used was 0 %, 5.00 %, 10.00 %, 15.00 %, by the weight of cement. prepared cubes and cylinders to determine performance and durability of mix of it. The results shows that the replacing mix till last percent has to observed and effect on strength properties with metakaolin..

Vivek Bindiganavile, Nemkumar, Banthia and Brendt Aarup [2]. Represented the difference between Compact reinforced composite (CRC) and fibres reinforced concrete (FRC) by impact loading.CRC has the ability of distributing greater energy compared with conventional FRC polymeric orsteel fibres. Different types of ultra -high performance FRCs such as CRCs have been developed and shown to possess a much greater capacity to absorb energy under static loading.

Sumathi.A, K.Sarvana, Raja Mohan [3]. Showed that inclusion of hooked end steel Fibres relating to increase in compression , Split tensile and modulus of rupture with duration and increase of steel Fibre content in volume fractions (0.50 %, 1
.00 %, 1.50 % and 2.00 %) in related to resist concrete at 28days. After 28 days curing in sulphuric and Hydro chloric acids, the percentage of weight loss is minimum for different percentage of steel Fibre when compared to control concrete.

Aiswarya S, Dilip C PrinceArulraj G [4]. Metakaolin obtained by thermal process of kaolin clay. Consisting lamellar particles with amorphorous in nature from the past investigation is proved that metakaolin is intended siliceous material promotingcharacteristics of mix. plasticizers in use reduces setting time of the mix.

MATERIALS

1. Cement (OPC): Ultra tech concrete 43 grade was utilized. Explicit Gravity of Concrete was 3.08
2. Coarse total: - squashed stone metal with 60% passing 20 mm and held on 12.5mm sifter and 40% passing 12.5mm and held on 4.75mm strainer were utilized. The heaviness of coarse total was 60% of the all out total and explicit gravity of coarse total was 2.70.

3. Fine total: - Waterway sand from nearby sources was utilized as fine total. Explicit Gravity was 2.50.
4. Water: utilized for both blending and restoring ought to be liberated from hurtful measures of unsafe materials. In the current work drinkable faucet water was blended straightforwardly with concrete.
5. Meta kaolin : it is gotten from the 20 micron restricted organization at Vadodara in Gujarath. The particular gravity of metakaolin is 2.60.
6. Super plasticizer: To work on the usefulness of the blends, a high reach water diminishing specialist Fosroc conplast SP430 (SNF-Sulphonated Naphthalene Formaldehyde) is utilized.

7 Steel strands: Pleated steel filaments of 30mm length with a dia of 0.6mm and a viewpoint proportion of 50, t hickness is 7840 Kg/m3 and explicit gravity is 7.9 were utilized all through the trial program.

Polypropylene filaments: RECRON 3S TYPE-CT 2012 polypropylene strands of thickness 946 Kg/m3 are utilized in trial program

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MIX DESIGN

Sample calculation of the quantities required for the mix with aggregate-binder ratio 2.5 and for water binder ratios of 0.30, 0.35 and 0.40 and for 0%,and 10% METAKAOLIN are tabulated below.

	0% Metakaolin			10% Metakaolin		
Materials	0.30 % W / B Ratio	0.35 %W / B Ratio	0.40 %W / B ratio	0.30 %W / B ratio	0.35 % W / B ratio	0.40 W / B ratio
Cement (kg)	20.62	19.95	19.32	18.48	17.88	17.32
Metakaolin(kg)	-	-	-	2.50	1.99	1.92
Water (ml)	6190	6980	7730	6160	6950	7700
Coarse aggregates (kg)	27.84	26.93	26.08	27.72	26.82	25.98
Fine aggregates (kg)	18.56	17.95	17.39	18.42	17.88	17.32

Super plasticizer (ml)	280	237	229	219	212	20 5
Mix proportion	1:0.9: 1.35	1:0.9: 1.35	1:0.9: 1.35	1:1:1. 5	1:1:1 .5	1:1 :1. 5

RESEARCH METHODOLOGY

In this study the combinations of Metakaolin in proportion of 0% and 10% was utilized in the substantial blend containing steel fiber of various measurement for example 0%, 0.5%, 0.75% and 1% and 0.25% polypropylene fiber consistent was utilized for Metakaolin substantial blends. A total fastener proportion of 2.5 and different water folio proportion ie 0.30, 0.35 and 0.40 with super plasticizer of 0.6% was utilized in this examination. Every series comprises crystals, chambers 3D shapes and effect chambers according to IS standard. The tests are directed to figure out the compressive strength at 7 years old days and 28, flexural strength, split rigidity and effect test at 28 years old days.

RESULTS AND DISCUSSION

Compressive strength test:

Pressure test is completed on examples shapes in 3D squares and chamber. The block example is of size 100 x 100 x100 mm and chamber is of size 100mm breadth x 200 mm level Keeping up with the proportion of the width of the example to most extreme size of the total not less 3 to 1 .Metal molds, ideally steel or cast iron are utilized to keep from bending

1: Testing of cubes and crack pattern

Sl.no	Mineral Admixture(%) by wt. of cement	W/B Ratio	7 DAY'S Average Compressive Strength in N/mm2							
			A/B = 2.25				A/B = 2.50			
			Total fiber Volume Fraction (%)				Total fiber Volume Fraction (%)			
			0%	0.75 %	1.00 %	1.25 %	0%	0.75 %		1.25 %
1	0 % MK	0.300	50.83	55.61	57.92	58.92	44.73	48.79		52.75
2		0.35	48.70	52.01	54.90	56.23	42.34	44.68		50.84
3		0.400	46.23	49.47	52.69	54.06	40.20	42.24		48.39
4	10% MK	0.300	61.23	64.96	70.12	71.25	54.71	59.19		62.11
5		0.35	58.24	61.97	64.53	68.65	52.46	55.28		61.07
6		0.400	56.12	59.87	62.36	64.46	50.29	52.24		58.75

Table 1 : Compressive strength at 7 days

Graph 1 : Compressive strength at 7 days with A/B ratio 2.25 and 2.50

The cement can be replaced maximum by 10 % with Metakaolin as admixture to achieve maximum compressive strength at 7 days for composite fiber (Steel and PPF) reinforced high performance concrete.It is observed that with with A/B ratio 2.25, 10 % of replacement of cement by Metakaolin , W/B ratio 0.30 strength increases by 10.47 % compared to A/B ratio 2.50.

	Mineral Admixture (%) by wt.of cement	W/B Ratio	28 DAY'S Average Compressive Strength in N/mm2							
			A/B = 2.25				A/B = 2.50			
			Total fiber Volume Fraction (%)				Total fiber Volume Fraction (%)			
			0%	0.75 %	1.00 %	1.25 %	0 %	0.75 %	1.00 %	1.25 %
	0	300	59.21	65.07	67.58	68.59	51.90	57.82	59.49	1.25
		0.35	57.68	62.95	64.64	66.68	50.12	55.34	57.25	59.98
		0.400	55.74	59.48	63.54	3.17	48.26	50.21	54.15	56.65
	10% MK	.300	73.79	73.79	76.58	78.22	63.24	66.71	8.13	69.36
		0.35	71.58	71.58	72.96	75.98	61.12	64.02	66.39	68.14
		0.400	68.19	68.19	69.94	71.96	8.29	59.33	62.95	66.06

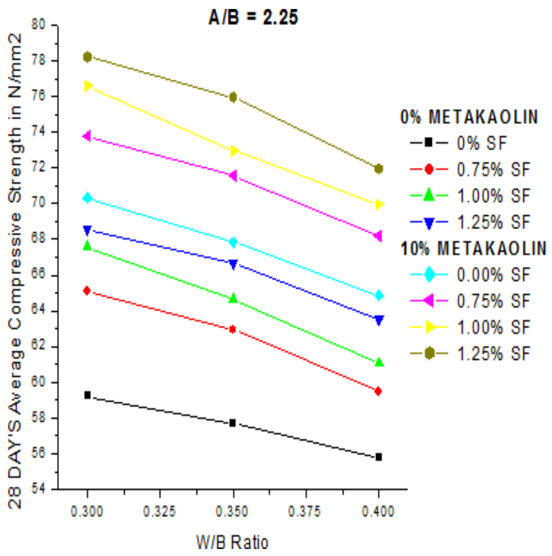
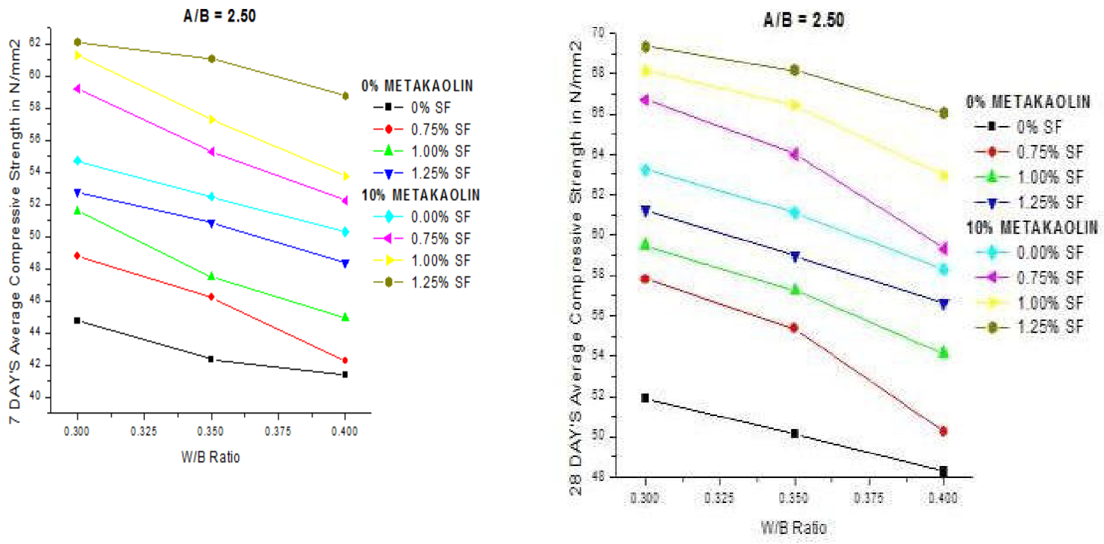


Table 2: Compressive strength at 28 days



Graph 2: Compressive strength at 28 days with A/B ratio 2.25 and 2.50

The concrete can be supplanted greatest by 10% with Metakaolin as mineral admixture to accomplish most extreme compressive strength at 28 days for composite fiber (Steel and PPF) built up superior execution concrete. The rate expansions in compressive strength at 28 days of 1.25% composite (Steel and PPF) fiber volume with 10% Metakaolin elite execution concrete over plain superior execution concrete without fiber and Metakaolin. It is seen that with A/B proportion 2.25, 10 % of substitution of concrete by Metakaolin compressive strength at 28 days increments by 10.70 % contrasted with compressive strength at 7 days At long last reasoned that A/B and W/B proportion increments , compressive strength of substantial reductions

Split tensile test:

Strength properties of cement is acquired by performing Rigidity. Example size of 100 mm width , 200 mm level and 3mm thick round and hollow shape is utilized. The chamber is set on a level plane between the two plates of the compressive testing machine and the heap is applied. The heap at which the example at last falls flat is noted and parted rigidity is determined.

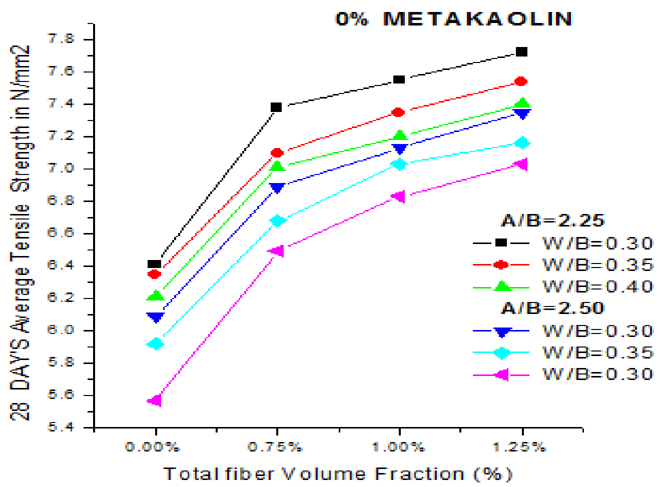
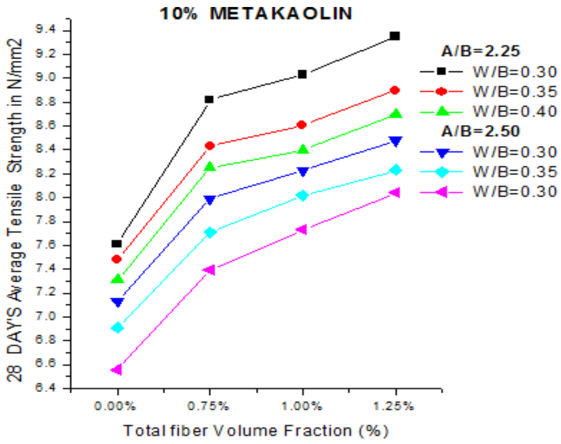


Table 3: Split tensile strength at 28 days



28 DAY'S Average Tensile Strength in N/mm2								
Mineral Admixture(%) by wt. of cement								
Sl.no	A/B ratio	Total fiber Volume Fraction (%)	0% MK W/B ratios			10% MK W/B ratios		
			0.30	0.35	0.40	0.30	0.35	0.40
1	2.25	0.00%	6.41	6.35	6.21	7.61	7.48	7.31
2		0.75%	7.38	7.10	7.01	8.82	8.43	8.25
3		1.00%	7.55	7.35	7.14	9.03	8.61	8.40
4		1.25%	7.72	7.54	7.40	9.35	8.90	8.70
5	2.50	0.00%	6.09	5.92	5.57	7.13	6.91	6.56
6		0.75%	6.89	6.68	6.49	7.99	7.71	7.39
7		1.00%	7.23	7.03	6.83	8.23	8.02	7.73
8		1.25%	7.35	7.16	7.03	8.48	8.23	8.04

Graph 3: Tensile strength at 28 days with 0 % and 10% Metakaolin

There is an increase of 17.43% in split tensile strength at 28 days of 1.25% composite (Steel and PPF) fibre volume with 10% Metakaolin high performance concrete over plain high performance concrete without fibre and Metakaolin of A/B 2.25 & W/B 0.3.

Flexural strength test:

One more estimation of elasticity of cement is Flexural strength test. It is a proportion of unreinforced cement footer or chunk to oppose disappointment in twisting. Its deliberate by stacking 100 x 100 x 500 mm cement footer with a range length no less than multiple times the profundity. It is additionally communicated as Modulus of crack (M R). Not set in stone by third point stacking or focus point stacking. On account of third point stacking ,it is applied a good ways off of L/3 from the one finish o

f the corner shaft.

Fig 2: Testing of beams and crack pattern

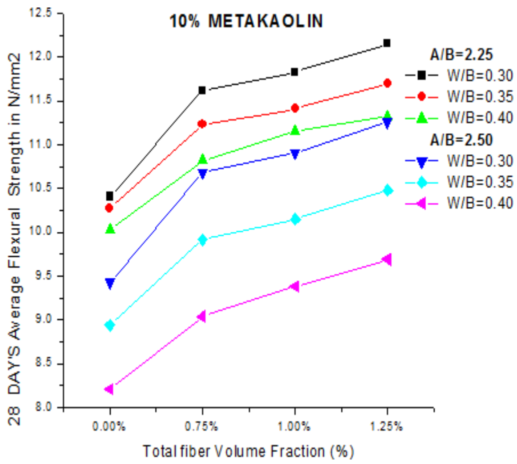
Table 4: Flexural strength at 28 days

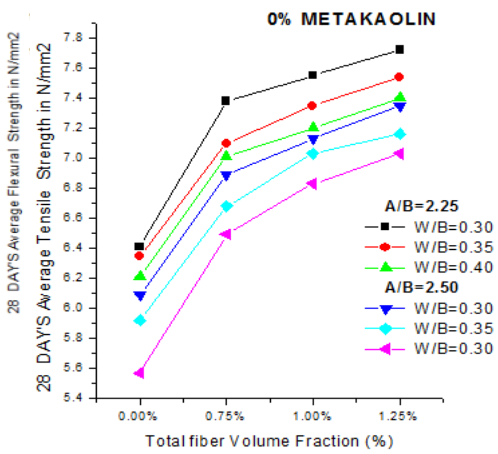
28 DAY'S Average Flexural Strength in N/mm2								
Mineral Admixture(%) by wt. of cement								
Sl.no	**A/B ratio**	**Total fiber Volume Fraction (%)**	**0% MK**			**10% MK**		
			W/B ratios			**W/B ratios**		
			0.30	**0.35**	**0.40**	**0.30**	0.35	0.40
1	**2.25**	**0.00%**	**8.91**	**8.85**	**8.71**	**10.41**	10.28	10.03
2		**0.75%**	**9.88**	**9.60**	**9.51**	**11.62**	11.23	10.82
3		**1.00%**	**10.05**	**9.85**	**9.64**	**11.83**	11.41	11.15
4		**1.25%**	**10.22**	**10.**	**9.90**	**12.15**	11.70	11.32

				0 4				
5	2.50	0.0 0%	7.3 2	6 . 9 4	6. 50	9.43	8.9 4	8. 21
6		0.7 5%	7.9 9	7 . 7 0	7. 42	10.6 8	9.9 2	9. 04
7		1.0 0%	8.3 6	8 . 0 9	7. 76	10.9 1	10. 15	9. 38
8		1.2 5%	8.5 8	8 . 1 3	7. 96	11.2 6	10. 48	9. 69

Graph 4: Flexural strength at 28 days with 0 % and 10% Metakaolin

There is an increase of 1.93% in Flexural strength at 28 days of 1.25% composite (Steel and PPF) fiber volume with 10% Metakaolin high performance concrete over plain high performance concrete without fibre and Metakaolin of A/B 2.25 & W/B0.3.





Impact Resistance test

To concentrate on the Effect Opposition of Cement an example of 150mm width and 60mm level is casted with concrete, coarse total, fine total, steel strands, polypropylene filaments and Metakaolin The effect test was completed utilizing drop weight hammer for round and hollow circle. In drop weight hammer test, the tube shaped circles of 150 mm distance across were put on the base plate of effect testing machine and afterward hit with rehashed blows. The effect load was applied with a 44.5 N hammer dropped more than once from a level of 457 mm onto the plates. In each test recording number of disasters for produce first break (N1) and extreme break (N2).

Fig 3: Testing of impact cylinders and Fracture pattern

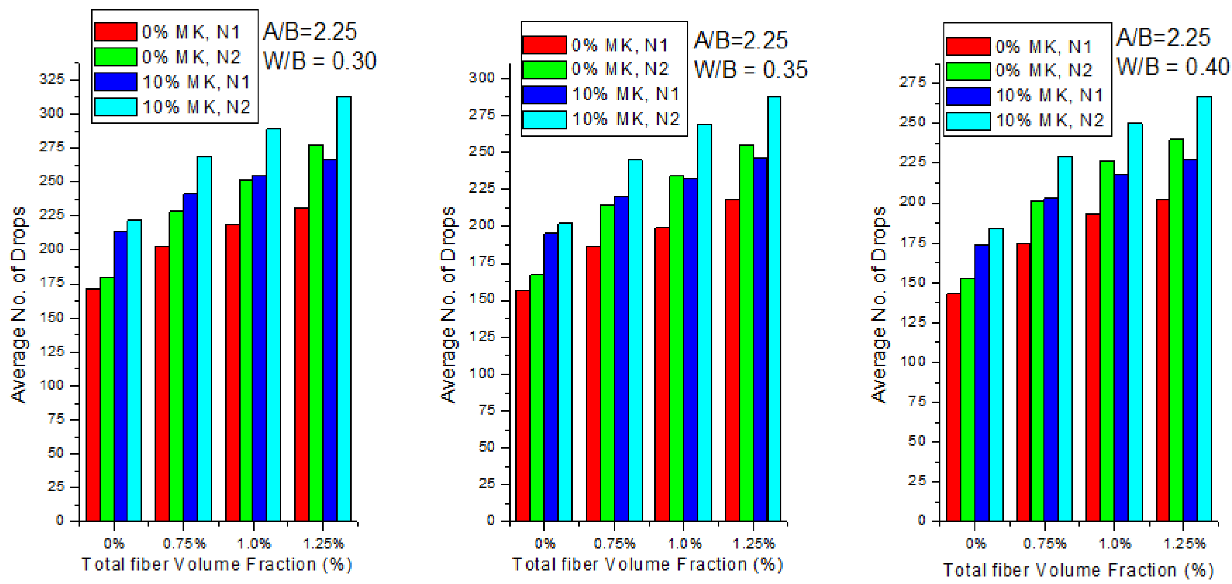
Fracture pattern of high performance concrete with different fibre volume fraction1.00%
.steel fibre, 0.75%steel fibre, 0.50% steel fibre, 0% steel fibre

Table 5: Impact strength for A/B ratio 2.25

A/B = 2.25											
Sl.no	Mineral Admixture (%) by wt. of cement	Total fiber Volume Fraction(%)	W/B ratios								
			0.300			0.350			0.400		
			(N1)	(N2)	N2-N1	(N1)	(N2)	N2-N1	N1	N2	N2-N1
1	0% MK	0%	171	180	9	157	167	10	143	153	10
		0.75%	203	228	25	186	214	28	175	201	26
		100%	219	251	32	199	234	35	193	226	33
		1.25%	231	277	46	218	255	37	202	240	38
2	10% MK	0%	213	222	9	195	202	7	174	184	10
		0.75%	241	269	28	220	245	25	203	229	26
		1.00%	255	289	34	232	269	37	218	250	32
		1.25%	266	313	47	246	288	42	227	267	40

N1 = Average Number of drops at first crack, N2 = Average Number of Drops at ultimate crack

Graph 5: Impact strength for A/B ratio 2.25



NOTE: N1 = Average No. of Drops at First Crack, N2 = Average No. of Drops at Failure Crack

It is observed that impact resistance of concrete increases with 10 % replacement of cement by Metakaolin. For

W/B ratio 0.30,
1.25 % Percentage of composite (Steel and PPF) fiber ,ability of concrete to taken up energy is high compared to W/B ratio 0.35& 0.40 W/B ratio increases, impact resistance of the specimen decreases.
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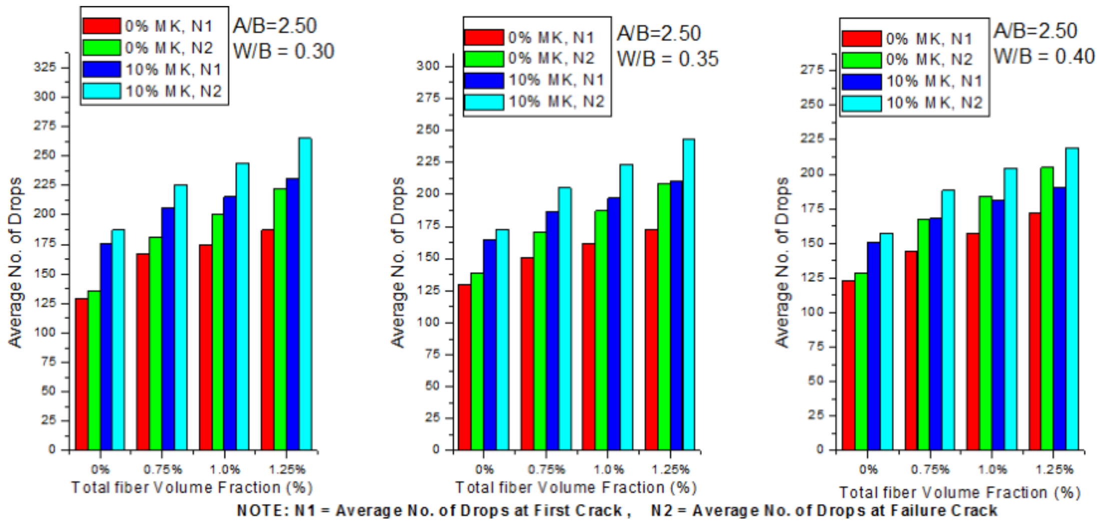
Table 6: Impact strength for A/B ratio 2.50

A/B = 2.50											
Sl .no	Mineral Admixture(%by wt. of cement	Total fiber Volume Fraction(%)	W/B ratio								
			0.300			0.350			0.400		
			(N1)	(N2)	N2-N1	(N1)	(N2)	N2-N1	(N1)	(N2)	N2-N1
1	0% MK	0 %	129	136	7	130	139	9	123	129	6
		75%	167	181	14	151	170	19	144	167	23
		1.00%	174	200	26	162	187	25	157	184	27
		1.25%	187	222	35	173	208	35	172	205	33
2	10% MK	0%	176	187	11	165	173	8	151	157	6
		0.75%	206	225	19	186	205	19	168	188	20
		1.00%	215	244	29	197	23	26	181	204	23
		1.25%	231	265	34	210	243	33	190	219	29

N1 = Average Number of drops at first crack, N2 = Average Number of Drops at ultimate crack

Graph 6: Impact strength for A/B ratio 2.50

For W/B ratio 0.30, 10 % replacement of cement by Metakaolin ability of concrete to taken up impact energy is high compared to remaining W/B ratio. Percentage of composite (Steel and PPF) fiber volume increases, Impact resistance increases, finally concluded that A/B ratio increases, Impact strength decreases.



CONCLUSION

The mineral admixture like Metakaolin are result of modern waste and they have no further use in any creation cycle, Which stays as waste and ought to be arranged off, Yet these items have high cementitious properties which can supplant concrete somewhat .Metakaolin sort of mineral admixtures is utilized which builds the strength at the early ages Utilized of steel and polypropylene filaments increments hardening pressure impacts and thus higher level of strands expands the Sturdiness in Metakaolin concrete ,Higher total fastener proportion will in general diminish in compressive strength of Metakaolin.

Tractable and flexural strength of substantial increments with an expansion of Metakaolin, lower water folio proportion with higher level of strands will in general have higher strength higher capacity to retain the effect energy Diminished rigidity because of expanded proportion of water fastener. Influence strength of composite fiber superior execution substantial increments as the level of strands increment and the quantity of blows expected to disappointment the example additionally increments. Hence influence strength increments with the increment of expansion of strands in the blend. When contrasted and controlled concrete the expansion in the effect strength with fiber volume& 10% Metakaolin elite execution concrete.

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Crash Insurance Design for Traveler Vehicles (Vehicles)

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ABSTRACT

The auto business is putting away additional time and cash to foster better vehicle security frameworks. They mean to further develop traveler security in the vehicle. More current gadgets are being utilized to diminish the impact moved to the traveler in the event of a crash. Our venture will examine around one such gadget. We will recognize various materials and plans to accomplish this while downplaying the expense. The principal part of the examination has been to track down the ideal development of motor energy during a front effect. We will introduce a thought of the gadget for a light engine vehicle. With the end goal that it tends to be fixed before the vehicle to diminish the impact gave to the frame consequently increment tenant security in the event of a crash.

Keywords: *Passenger Vehicles, Cars*

INTRODUCTION

The fundamental thought behind making the vehicles more secure for the tenants is to build the fold zone in the vehicle additionally called the smash zone. This zone has the property that it folds or twists in the event of a crash and less measure of energy is moved to the traveler lodge. Various kinds of plans are utilized to accomplish this which can incorporate casing fragments worked to twist in specific regions or breakdown onto themselves. Its application isn't the case basic, the designers need to keep different elements in psyches, for example, vehicle size and weight, outline firmness and the burdens the vehicle is probably going to be exposed to in an accident. Our model can be fixed on the front accident bar inside the empty space of the guard. It will go through twisting thus retaining a lot of energy in an accident.

This innovation is utilized in equation understudy vehicles with similar goal however its application isn't tracked down for a huge scope in the car business. We might want to advocate this thought so it tends to be utilized to make traveler vehicles more secure.

Our point here is to have greatest conceivable compressive strength however to limit how much material utilized thus restricting how much expense. For this, we will utilize honeycomb structures. These are varieties of empty cells framed between slender vertical walls. The cells are columnar and hexagonal giving it great out of plane compressive strength. These honeycomb structures are layered between two flimsy plates. This get together is known as a sandwich board.

MATERIAL SELECTION

Various considerations are to be kept in mind while selecting a material for the manufacturing of the product. They are as follows-

A. Structural Consideration

- Strength
- Stiffness
- Adhesive performance

B. Environmental Consideration

- Temperature
- Flammability
- Heat Transfer

C. Economic considerations

Material to be chosen for this application ought to have sufficient strength with the goal that it doesn't bomb quickly under influence stacking. Simultaneously, it ought to have moderate yield strength with the goal that it goes through plastic twisting expanding the fold zone before the vehicle.

Composite honeycomb has high solidness for extremely low weight on account of the moderately low shear modulus of the center material. This will assist us with postponing the plastic disappointment of the construction, expanding the general burden conveying limit.

Glue execution is likewise a significant component that should be thought of, center and face materials are consolidated with the assistance of the glues. Ensuring that the utilization of cement doesn't alter the mechanical properties of the center. Simultaneously, the cement ought to be sufficiently able to hold the center and face plate set up during influence.

As in any materials framework, the warm climate will assume a significant part in the choice of materials. The item should confront temperatures from - 40°C up to 100°C; the glues ought to have the option to work appropriately in this temperature range. The exchange of intensity through a sandwich board is reliant upon the essential standards of convection, conduction and radiation. Metallic centers with metallic facings amplify heat stream attributes.

After examining the above stated factors there are 4 materials we can consider for this application. These materials are following-

1) Steel
2) Aluminium Alloy
3) Carbon Fibre Reinforcement Polymer (CFRP)
4) Metal Foam

Material Properties	CFRP	STEEL	ALUMINIUM	Metal Foam
Density (g/cm^3)	1.55	7.7	2.7	0.1-0.2
Compressive Strength(MPa)	570	160	280	44
Poisson's ratio	0.23	0.30	0.33	0.25
Shear modulus (GPa)	5	78	26	0.7
Cost (Rs. per Kg)	9600	130	190	1200

Subsequent to looking at CFRP, Steel, Aluminum, metal froth we observed that CFRP is generally appropriate for this task however because of the significant expense and trouble to make we can't utilize CFRP. On the other hand, the following most ideal choice is aluminum composite, which is less exorbitant. It has great strength, effectively accessible on the lookout and it is not difficult to fabricate. Besides, its lower thickness than steel guarantees that it won't make any sense altogether to the heaviness of the vehicle.

Aluminum 3003, the most broadly utilized of all aluminum composites. Economically unadulterated aluminum with added manganese to expand its solidarity. It has astounding erosion obstruction, and usefulness. This grade can be profound drawn or turned, welded or brazed. A significant game changer of Al 3003 is that it doesn't seek impacted by heat treatment; this gives the maker freedom to warm treat the item and gives sufficient opportunity to the epoxy to settle.

SANDWICH PANEL

A sandwich panel consists of two stiff, strong skins separated by a light weight core. The core material can be made up of different types of materials and structures. The main aim here being, keeping the weight of the final productto a minimum. The outermost skins endure the maximum load which is then distributed into the low density core.

The simplest case of loading of the sandwich panel that we can consider here is of point loading in 3-pt bend. The geometrical constraints for the panel are as follows, the span of the beam is l, the width, b, the core thickness c, and the face thickness, t. The beam thickness is d where d = c+2t; we shall assume that t<<c and to a first approximation c~d. We shall denote the elastic modulus and density of the core as ρ_c^* and E_c^* where the * indicates a property of the hexagonal honeycomb core rather than the material it ismade from. The core density and modulus are a function of the density of the material the core it is made from. To afirst approximation these properties are given by

$$\boxed{\begin{aligned} E_c^* &= C_1 E_s \left(\frac{\rho_c^*}{\rho_s}\right)^2 \\ G_c^* &= C_2 E_s \left(\frac{\rho_c^*}{\rho_s}\right)^2 \end{aligned}}$$

E_s ρ_s

Where and are properties of the material. C1 (~1) and C2 (~0.4) are constants dependent on the type of loading.

The stiffness of the beam in bending is calculated from the equivalent flexural rigidity, (EI)eq, andthe equivalent shear rigidity, (AG)eq. Using the parallel axistheorem

$$\boxed{(EI)_{eq} = \frac{E_f b t^3}{6} + \frac{E_c b c^3}{12} + \frac{E_f b t d^2}{2}}$$

The first and second terms describe the stiffness of the two face sheets and the core while the third term addsthe stiffness of the faces about the centre of the beam. In a good beam design, the third term is substantially larger than the first two so if d~c then

When subject to a load, P, the deflection is the sum of the bending and shear components

$$\boxed{\delta = \delta_b + \delta_s = \frac{Pl^3}{B_1 (EI)_{eq}} + \frac{Pl}{B_2 (AG)_{eq}}}$$

Where B1 and B2 are constants dependent on the geometry of the plate and the type of loading. The compliance of the beam is

$$\boxed{\delta = \frac{2l^3 P}{B_1 E_f btc^2} + \frac{P\,l}{B_2 bcG_c^*}}$$

The above equation establishes a relation between the loading conditions, type of loading and the dimensional constraints to the total deflection of the sandwich panel.

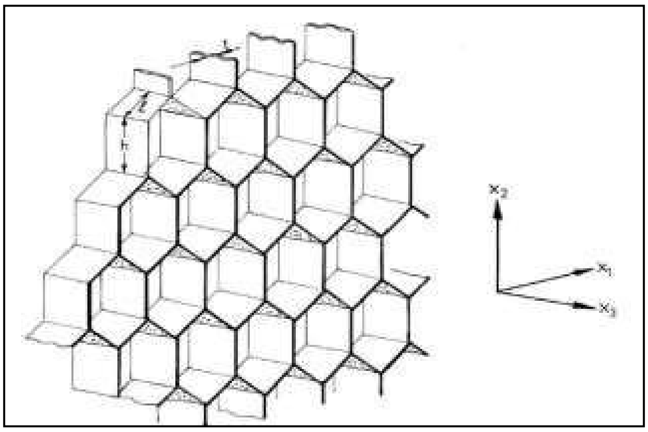
HEXAGONAL HONEYCOMB CORE

In this project we will focus on the regular hexagon honeycomb core while we can use non uniform hexagoncore as well but non-uniform hexagon study is out of scope for the course.

There are other unit cells structures that can be used such as triangular unit cell or rectangular unit cells. ButHexagon unit cell is more rigid and stiff as compare to the triangular and rectangular units.

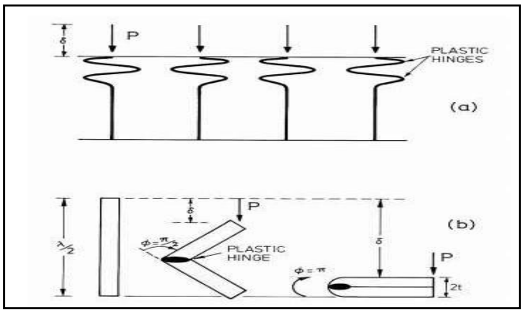
Hexagonal structures fulfil the requirement as they can absorb a larger amount of energy before failure thereby reducing the effect of impact on the car chassis and the passengers.

The hexagonal aluminium honeycomb core usedhere shows anisotropic properties, the properties of the material depend on the direction of loading.



By loading in the x3 direction each of the unit calls undergoes plastic collapse, plastic hinges start to form and itstarts to fold up as shown in the image. This keeps on going until a solid block is formed.

$$\boxed{(EI)_{eq} = \frac{E_f btc^2}{2}}$$



now we assume that we can have a maximum usable depth of 155mm.

Therefore the force exerted on to it will be equal to

=3, 97,058.823N

With the above calculation we have got the value of maximum force our product needs to withstand. We will now use the equations that govern the loading conditions ina honeycomb sandwich panel.

$$\boxed{\delta = \frac{P2l^3}{B_1 E_f b t c^2} + \frac{P\,l}{B_2 b c G_c}}$$

After the formation of solid block due to the folding up of the cells, the sandwich panel will start transferring any further load directly to the chassis member. And no further absorption of energy by the sandwich panel will take place.

ENERGY TRANSFER

At the hour of impact the dynamic energy of the vehicle will be changed over into different structures to carry it to a take. Larger part of this dynamic energy will be taken up by the accident security gadget and it will be changed over into strain energy to twist it. The aluminum honeycomb walls will disintegrate and the sandwich board will distort, expanding the fold zone before the vehicle.

DESIGN PROCEDURE

The product can be incorporated inside the hollow space of the front bumper. It can be mounted in front of the radiator on the anti-crash bar. Making sure that during a head on collision it takes the maximum load on itself before transferring it to the chassis members.

We need to determine the maximum load that the sandwich panel needs to withstand. For this we need todecide on the maximum speed that we will design it for.

Taking the maximum speed of impact to be 27kmphEnergy transfer at the time of impact

Kinetic Energy =Ek = 1/2 mv^2

= ½ * 1200 * 7.5 * 7.5

= 33,750 J.

The size of the product also plays an important rolehere; we don't have large area to incorporate it so we needto optimise the available area. The maximum available length in front of the car is about

800mmand a height of just 200mm. The depth possible for the product is 170mm but this depth can't be fully utilised by the sandwich panel as some of the thickness will be taken up by the end plates. Also during the collision some of the core will start to crumble and it will solidify. Taking these things into

In the above equation:

δ = Total deflection of the panel (0.155m)P = Maximum Load (397kN)

l = Length of the impact face (0.8m)

Ef = Elastic modulus of material (68.9 Gpa)b = Breadth of impact face (0.2m)

t = Thickness of top and bottom plates (1mm)c = Core thickness (0.162m)

GC = Core shear modulus - in direction of applied loadt_C= hexagon unit cell sheet thickness (80 micron)

ρ_s= Density of aluminium (solid property)

ρ_c= Density of core

$G_c = C_2 E_f(\rho_c/\rho_s)$ $\rho_c/\rho_s = (2/\sqrt{3})(t_c/L)$

B_1, B_2, C_2 = Constants based on the type of loading

G_C= $8057.371*10^3$

Edge length of hexagon unit cell (L) = 0.0058m

CONCLUSION

With this paper we reason that aluminum honeycomb sandwich board can be utilized as an accident security structure in traveler vehicles. We can have it with various aspects and consolidate it for higher velocities

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IC Engine in Cylinder Cold Flow Analysis

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ABSTRACT

A critical evaluation of the present in-cylinder flow analysis methods, their use with various engine types, and the study's findings. A critical examination of the airflow capturing techniques used in IC engines has not been carried out in the past ten years, despite the fact that there have been a number of innovative flow monitoring technologies introduced. The analysis techniques for engine in-cylinder flows during the intake and compression of air and fuel are briefly discussed in this review while significant findings from individual works are highlighted, highlighting the strengths and accuracy of these techniques. Explicit analytical formulations and schemes with the fewest errors in comparison to experimental results are recommended in light of the studies that have been evaluated.

INTRODUCTION

Engineers and scientists have attempted to optimize and increase fuel consumption and power output efficiency ever since the invention of contemporary internal combustion engines. These can be accomplished by changing a variety of engine and environmental parameters as well as operating conditions. The IC engine's in-cylinder flow parameters have a significant impact on both the combustion and air-fuel mixing processes.

Large-scale turbulence structures produced during the intake and compression strokes are excellent predictors of the spread of the flame and complete combustion inside a spark-ignition engine. This is crucial for the engine to perform as efficiently and smoothly as possible with the least amount of exhaust gases and pollutants that harm the environment and the engine itself.

This article's major goal is to give the reader a summary of the in-cylinder flow analysis techniques that have been developed over the last ten years. A critical comparison of these techniques is also provided as a road map for future study in the area.

After discussing various experimental and analytical flow motion measurement techniques, proper orthogonal decomposition (POD) is explored in this study along with its application to the extraction of meaningful data from the approaches' raw data.

In-Cylinder flow techniques

The air-fuel mixture just prior to the combustion stroke and in-cylinder flow propagation have seen significant advancement over the last few decades. Intake manifold flaps are the most popular way to re-direct the incoming air at a specific angle into the combustion chamber to generate tumble or swirl motion. Many methods have been used to obtain the desired results. According to researches' experimental work, the air-flow motion is also governed by the shape of the cylinder head and the piston crown. Numerous writers have investigated how airflow behaves when it interacts with intake valves, as well as their physical layout and timings.

Depending on various variables, a variety of turbulence models can be employed to forecast the airflow motion and in-cylinder interactions. The motion and behavior of a viscous fluid flow that may interact with other barriers in its path are described by the Navier-Stokes equations. To solve these equations for a challenging situation like the in-cylinder flow of an IC engine, however, would be highly difficult, time-consuming, and expensive. As a compromise between time efficiency and accuracy, approximation techniques and turbulence models are utilized for flow simulations inside combustion chambers.

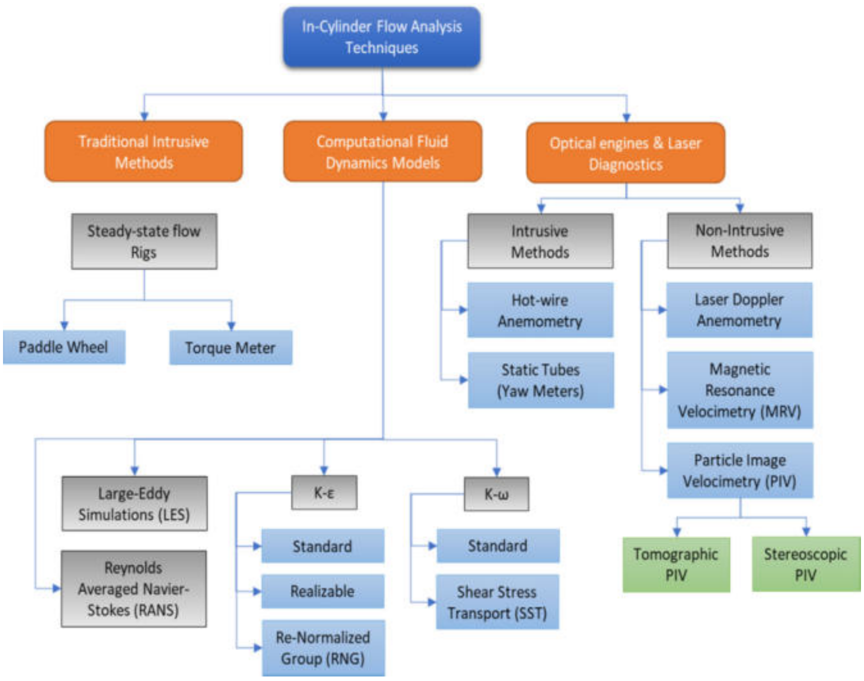

Figure 9 In-cylinder flow analysis techniques

Turbulence models in CFD analysis

The k-e model is one of the turbulence models used most frequently in IC engines. The standard model, the Re-Normalized Group (RNG) model, and the Realizable model are all included in this. Two transport PDEs with two variables—turbulent kinetic energy (TKE) and the rate of TKE dissipation—are used in the k-e turbulent model. The k-e model accurately predicts distances from boundary walls.

Another popular flow prediction turbulence model is large eddy simulations (LES). This approach was developed to address issues with Direct Numerical Simulations (DNS), which only solve the Navier-Stokes equations in the absence of a turbulence model, which can be difficult and expensive to use for complicated boundaries, geometries, and flows.

Experimental flow measurement techniques

Additionally, researchers have been working on an experimental investigation of flow analysis. Early scientists employed antiquated methods such pressure-based meters, such as the venturimeter, as well as mechanical flowmeters, such as paddle wheels, Pelton wheels, and hot-wire anemometry. However, since there is little to no external interaction with the flowing fluid, optical flowmeters are modern tools used to record exact and precise flow motion. An example of an optical flowmeter is particle image velocimetry (PIV), which is also one of the most used techniques for visualizing flows.

Other methods

Resonant Magnetic Field It is common practice in medicine to employ imaging to record bodily physiological processes. Engineers can collect flow fields inside enclosed equipment by using this phenomena. This is known as MRV stands for magnetic resonance velocimeter. The prevalence of this method is significant since it does not require an optical device access to moving water. Consequently, no seeding particle is in the fluid introduced.

Experimental analysis

This section discusses the experimental research done on the impact of different engine geometry parameters and operating conditions on the turbulent behavior. The turbulent variables include vorticity, turbulent kinetic energy (TKE), turbulent intensity (TI), cycle-to-cycle (cyclic) variance, tumble ratio (TR), swirl ratio (SR), and others.

Particle Image Velocimetry

In this paragraph the results of experimental research using Particle Image Velocimetry (PIV) are discussed. There are numerous PIV techniques used by different researchers, such as High-Speed PIV, Stereo PIV, or Tomo PIV. The optical access is provided via a transparent cylinder, and the number of cameras employed to record the flowing fluid defines the size of the flow particles. Stereo-PIV was used to examine a non-reacting flow in a 4-valve single-cylinder DISI optical engine. During the intake stroke, large-scale vortices and tumble structures were created. In the studies using a 2-valve single-cylinder engine, two high-speed cameras with metal oxide semiconductor sensors—Phantom v7.3 for high spatial resolution and Phantom v1610 for low spatial resolution—were contrasted.

Using tomographic PIV, in-cylinder flow structures in a 500 cc DISI single-cylinder engine were seen in 2D and 3D. The in-cylinder flow structures were viewed using four charged-couple cameras. The 3D flow fields in an optical DISI engine were investigated using high speed PIV, stereoscopic PIV, and tomographic PIV. For the motorized PIV test bed, the spark plug and fuel injectors were off. Measurements were taken at 90 CA BTDC during the compression stroke and at 270 CA BTDC during the intake stroke.

Effect of intake Ports, fuel injection & piston crown shape

Comparing elliptical and circular intake ports, it was found that the former produced vortex structures during early intake, and the latter had greater cycle-average tumble ratios and turbulence intensities. As a result, elliptical ports can be used to monitor intense flame propagation and full combustion with minimal exhaust emissions. The fact that the tangential port generates the majority of the large-scale swirl momentum is supported by the fact that the total swirl ratio falls when the tangential port throttles.

A single-cylinder DISI engine's in-cylinder flow structures were examined in order to evaluate the impact of fuel injection timings on them. The flow was then depicted on a swirl plane right below the TDC. POD was selected over spatial filtering of the flow fields, which was accomplished using both a fixed and mean flow speed scaled cut-off length. The timing of the injections had an impact on the direction and intensity of the tumbling flow because the second injection could interfere with the flow produced by the first injection. Comparing the flat head piston to the dome and dome-cavity capped pistons, the flat head piston has better average TKE and tumble ratio. Regardless of engine speed, the piston location strongly influences the in-cylinder tumbling action.

Comparing the flat head piston to the dome and dome-cavity capped pistons, the flat head piston has better average TKE and tumble ratio. Regardless of engine speed, the piston location strongly influences the in-cylinder tumbling action. When the tumble flow collapses, the turbulent kinetic energy is at its peak. With an increase in crank speed, the TKE rises linearly.

Effect of tumble/swirl flaps and guide vanes in manifold

A steady-state test-bed known as the tumbling optical test-bench was used to investigate the transient behavior through the intake port. Increased mass flow rate, closed tumble flaps, and decreased valve lift all contributed to higher fluctuations. Along with guide vane swirl and tumble, flow turbulence was also noticed.

Device (GVSTD) with 25%, 50%, and 75% vane heights R is the radius of the intake runner, while 25%, 50%, and 70% are denoted as 0.25R, 0.50R, and 0.75R, respectively. 0.25R the stream with the least amount of air resistance was the device. The longer the guide vanes, the more air resistance there will be.

As a result, during the combustion stroke, 0.25R GVSTD produced more in-cylinder velocity, tumble, swirl, and turbulent kinetic energy.

In a single cylinder engine, the properties of air flow utilizing tomographic PIV were investigated at various engine speeds, intake temperature, and valve deactivation (SPO & TPO). Because the downward piston movement takes more air from the intake valve, it was found that the intake stroke exhibited more energy dissipation and air velocity fluctuations than the compression stroke. quicker piston motion brought on by a quicker engine speed increases volumetric efficiency, vorticity, and turbulence. Compared to tumble port open, swirl port open (SPO) has increased air velocity and turbulence.

Effect of variation in valve Lift, crank angle and engine speed
With intake valve lift and engine speed, the radial and axial air velocity and turbulent kinetic energy increase. However, flow rate (engine speed) has no impact on the tumble ratio, which is significantly affected by intake valve lift. The inlet jet for Small valve lift and flow rate are seen to move in the direction of the cylinder's center while a huge and slow-moving jet. The direction of the valve lift is toward the cylinder head.The tumble ratio and tumble fluxes differ greatly with,not with the engine speed but with the crank angle. When the engine speed is increased, the TKEs rise. Large, When air is compressed and powered, velocity flows during charging break down into smaller spatial flow structures, strokes.

In the case of a rotary engine, large-scale swirls are produced at low engine speeds, but as engine speed is increased, they break down into small-scale tumbling. Additionally, as the rotational speed and intake angle grew, the rotary engine's volumetric efficiency rose, peaked, and then fell.The increase in engine speed also significantly thickens the whirling pattern. When it comes to engine strokes, compression is when vorticity and turbulence are at their highest. TKE increases during intake, increasing the in-flow velocity at 80° and 160° ATDC, whereas tumble increases cyclically during compression at 240° ATDC.

For a full understanding of the three-dimensional large-scale vortices, the spatial resolution of the in-cylinder flow is equally important. In a loop-scavenged engine, the in-cylinder flow features more significant tumble structures than the swirl. With a drop in compression ratio and an increase in engine speed, the TKE and tumble ratio rise, and vice versa.

Other experimental methods

Hot-wire anemometry
Using hot-wire anemometry, the airflow characteristics of a four-valve single-cylinder S320 test engine were investigated. Two wire probes were put on the FMC 921 hot-wire anemometer extension card, one at the piston squish surface and the other at the axis of the cylinder. The axis of the cylinder experienced the highest flow velocity at 30 BTDC, or 6 ms 1, and the maximum turbulent kinetic energy was 5 J/kg. The turbulence was a little less intense in the squeeze zone than it was near the cylinder's axis.

Magnetic resonance velocimetry
Using magnetic resonance velocimetry (MRV), in-cylinder turbulence during the intake stroke of a single-cylinder DISI polyamide engine model was carefully examined. While the underflow section, which included the recirculation zone, had reduced flow rates for entering fluid, the overflow region had the highest flow velocity. The cross-sectional area accessible for flow to enter the cylinder decreases as the intake valve design changes, considerably increasing the flow velocities. The MRV results and PIV results agreed on a lot of things.

Later, based on the impact of geometric modifications in the intake valve diameter and the intake ports, the same researchers compared the findings from MRV and PIV studies on a single-cylinder optical engine. Wall guided (WG) injection geometry was the name given to these two geometries.

Flow meter

In a 16-valve 4-cylinder SI Fiat cylinder head connected to a steady flow rig, the effects of intake valve delays and intake flow deflectors on in-cylinder turbulence behavior were explored. A rotating honeycomb swirl meter (AUDIE) was used for swirl and tumble testing, and a Super-flow SF-600 flowmeter with an accuracy of 0.5% was used to assess the flow characteristics inside the cylinder. Different lengths and angles of tumble and swirl deflectors were created, installed in the intake port, and tested.

According to the findings, greater swirl flows were produced as intake valve delay increased, however this led to a decrease in volumetric efficiency.

Torque meter

Direct fan blown air introduction into the cylinder was accomplished using a constant state flow bench attached to a 4-valve 125 cc engine cylinder head. A torque meter was used to measure the impact of two different pressure differences (300 and 600 mmH2O) across the intake valves on the in-cylinder flow structures.

TKE, turbulence length scale, and turbulent kinetic viscosity all significantly increased with increased valve lift and pressure drop in both horizontal and vertical planes. Increased homogenous air-fuel mixing and, consequently, a faster rate of flame propagation were the results of this.

Numerical analysis

The grid resolution has a significant impact on the quality of the Large Eddy Simulation (LES), and grid refinement results in an overall turbulent kinetic energy of in-cylinder flow that is highly resolved. Using two different mesh sizes, the incylinder flow was examined using the LES turbulence model, and the flow characteristics in terms of vortical structures were examined using the Q-criterion. A vortex with a linked fluid region and a positive second invariant of the velocity gradient tensor is said to meet the Q-criterion. The cyclic changes were the cause of the strong vortices of various sizes and orientations formed during intake. In the compression stroke, isotropic turbulence is seen to be increasing, but anisotropic structures are seen to be more prevalent in the intake stroke.

This is brought on by the flow's increased anisotropy, breakdown of the vortices, and significant velocity fluctuations. The mass average TKE is higher in the exhaust stroke than in the intake stroke, and the swirl ratio has a significant impact on the emissions and combustion performance.

Due to the complexity of the combustion chamber, it is challenging to examine the flow experimentally, hence rotary engines were also analyzed numerically for the flow fields. Due to the abrupt compression and expansion operations, the air velocity at the exhaust is significantly higher than that of the intake air. It is ideal to see a squish flow from the combustion chamber's leading to trailing side at the end of the compression stroke.

Effect of variation in intake ports

Analysis was done on the in-cylinder turbulence behavior brought on by the helical, spiral, and combination helical-spiral intake manifolds. The largest swirl structures were produced by the helical-spiral combined manifold, which also had the highest tumble ratio, TKE, and volumetric efficiency. It was suggested that helical-spiral manifolds be utilized in diesel engines since swirl flow is more significant in this application than volumetric efficiency. There is a noticeable difference in the size and strength of the intake tumble motion between the elliptical cross section inlet port and the circular intake port, and there is good agreement between simulation and experimental data.

The in-cylinder flow velocity components were produced by the piston movement in this investigation, and the convergence criteria were defined with residuals smaller than 10-4 for pressure and 10-3 for velocity, TKE, and dissipation rate. The application of the Navier-Stokes mass and momentum equations to a tumble engine bench resulted in a notable improvement in in-cylinder flow mixing over other benches. High valve timings resulted in high swirl but at the expense of a lower mass flowrate.

An engine adapted to run on bi-fuel, i.e. diesel and LPG, was fitted with an ideal filling geometry intake manifold for comparison. The ideal filling geometry intake manifold's brake power, brake torque, and brake thermal efficiency all rose, while the brake-specific fuel consumption decreased by 28%. In comparison to rotating port layout, which exhibits no discernible improvement in swirl, tumble, or TKE, inclined port configuration has a larger swirl ratio and more turbulence. The exhaust port is also altered by increasing the port radius for maximum mass flow out of the cylinder and smoothing the side profile to prevent flow detachment.

Effect of flow deflectors, cylinder head shape & fuel injection

The effects of several injection timings—9, 18, and 25 before TDC—on the flow's turbulent behavior and the combustion characteristics were investigated. The best results in terms of increased in-cylinder pressure, temperature, and turbulent kinetic energy were obtained at the commencing injection timing of 18 BTDC. The impact of the tumble device (GVSTD) and guiding vane of heights 0.25R, 0.50R, and 0.75R (R being the radius of the intake runner) on the air intake was noted.

The air resistance increases as the guide vanes' length increases, so 0.25R provided the least amount of air resistance to the air flow. Therefore, during the combustion stroke, 0.25R GVSTD displayed higher in-cylinder velocity, tumble, swirl, and turbulent kinetic energy.

In comparison to a normal flat-roof type head, the pent-roof type cylinder head offers improved engine performance in terms of heat transfer, fluid flow, and in-cylinder turbulence intensity during the intake stroke. A single-cylinder four-stroke DISI engine's in-cylinder engine performance is also impacted by differences in tumble ratios brought on by tumble deflectors. The flow velocity and TKE rose with tumble ratios after the installation of two tumble deflectors in the intake port. The flame propagation speed also increased as a result of the improved air and fuel mixing, which further raised engine IMEP.

Effect of variation in piston crown shape

The impact of various piston bowl shapes on flow's turbulent properties is investigated. In terms of increased Tumble ratio and TKE, the flat-piston head performs better than the flat-piston-center-bowl. Similar to the dome piston with center bowl, the flat-piston-center-bowl provides superior flow structures than the pent-roof piston with offset bowl. Utilizing the flat-with-center-bowl piston also caused an increase in the rate of fuel evaporation. Another study found that flat piston bowls produced the most engine pressure, which translates to the highest engine energy throughout the intake and compression stages.

The tumble vortex's location is influenced by the speed of the piston and the form of the piston bowl, and the spark plug significantly affects how the tumble flow develops during compression. When compared to a flat piston head, the swirl ratio for a double-lobed piston head increased by 66.67% during the intake stroke and by 91.47% during the compression stroke.

Effect of variation in valve lift, crank angle and engine speed

The larger disparity between valve lifts results in more swirl, but the volumetric efficiency is compromised. Low intake valve lifts, such as a minimum lift of 1.165 mm and a maximum lift of 8.275 mm, result in greater flow velocity, turbulence, and swirl intensity. Recirculation of exhaust gases inside the combustion chamber is decreased.

For maximum and minimal lifts, there are two reverse flows and no back-flow, respectively. The impact of the modification in the intake valve pressure drop on the turbulent behavior was examined for two situations, namely 300 and 600 mmH_2O.

An increase in flow velocity and vorticity was seen along with an increase in valve lift and pressure drop. The increase in pressure drop across the intake valves from 300 to 600 mmH2O had a considerable impact on TKE, turbulent length scale, and turbulent kinetic viscosity.

Due to tumble decomposition, TKE reaches its greatest values during intake and at the end of the compression stroke, both close to TDC . The tumble momentum and TKE are related to engine speed. With an increase in intake angle, intake pressure, and rotational speed, the large-scale swirl in a rotary Wankel engine transforms into a small-scale tumble.

With increasing rotating speed and intake pressure, the average TKE rises, but for crank angle, it peaks at 15 degrees. Additionally, compared to the normal k-e and realizable k-e models, the RNG k-e model produces values for in-cylinder flow that are more accurate. However, for low rpm computations, the traditional k-e model is preferred.

Cycle-to-Cycle (Cyclic) Variation (CCV)

Cyclic variation in experimental studies

To comprehend the impact of cycle-to-cycle variation on the in-cylinder flow fields, PIV experiments were carried out. In a study, the influence of cycle-to-cycle fluctuation on the evolution of cylinder pressure was shown to be relatively minor. Cylinder pressure measurements were measured over 100 engine cycles using pressure transducers. The compression stroke had the biggest relative variation following mean flow normalization, but the intake stroke had the highest absolute variance. Spatio-temporal coherence was investigated using a phase-invariant POD analysis on snapshots taken from PIV and high-speed (HS) PIV experiments.When the coherent energy of the flow is conserved, no improvement in KE fluctuations is seen. The cyclic variations close to TDC were reported to be responsible for about 30% of the varying KE. Additionally, it was suggested that flows with higher kinetic energy before the breakdown phase convey that energy to small-scale fluctuations during that period.

Cycle-like fluctuations in tumble structures are also brought on by interactions between the in-cylinder flow and fuel spray. Since a stratified charge engine requires thorough air-fuel mixing late during compression, multiple sprays per cycle are used to boost combustion efficiency.However, this causes turbulence to vary from cycle to cycle, particularly for tumble flows. Fuel droplets may move upward and bounce into the cylinder head near the fuel injector as a result of the subsequent injection interacting with the preceding spray particles, according to time resolved PIV and Mie scattering of fuel spray. As a result, the next fuel injections differ in terms of magnitude and position.

To investigate the impact of maximum variable valve lift on the turbulent behavior of in-cylinder flow, a cycle-resolved digital PIV (CRD-PIV) was conducted. The bulk tumble flow weakens, the cyclic variability of the vorticity, tumble ratio, and tumble center increases, and the turbulent kinetic energy intensifies as the maximum valve lift (MVL) falls. Similar to this, larger MVLs have the potential to generate bigger vertical flows toward the top of the piston, which leads to large tumble structures and higher tumble ratios. Due to larger velocity vectors produced by lower MVLs, higher kinetic energy values result, which in turn causes cycle-to-cycle fluctuations to rise. Larger tumble and swirl flow patterns are advised since the weakening tumble vortex is the cause of the rise in cyclic variations.

Cyclic variation in numerical studies

Maximum pressure and the in-cylinder flow fields serve as indicators of cyclic variations. After adjusting for mean flow, the intake stroke has the greatest absolute variation, while the compression stroke exhibits the greatest relative variation. Additionally, the impact of a changeable spray boundary condition is examined in relation to the cycle-to-cycle variability of in-cylinder flow during the compression and ignition strokes. The in-cylinder flow varies more frequently from cycle to cycle as a result of the increase in mean velocity brought on by combustion and the interaction of fuel jet spray with tumbling motion.

N_2 dilution is employed to lower the NO emissions in cases of unstable operating conditions, while CCV rises. Using an energy deposition model and a dynamic TFLES model, respectively, modeling of ignition and the interaction between flame and turbulence is carried out.

At various operating conditions, LES can accurately forecast the cyclic variations and distinguish between stable and unstable points. Additionally, moving the spark plug location can help to alleviate the poor flame propagation.

Proper orthogonal decomposition (POD)

A post-processing method called proper orthogonal decomposition (POD) is utilized to capture the basis functions with the highest energies. This leads to discarding the low energy and insignificant snapshots, which can be done because they don't add much to the data collecting process and save a lot of time. In essence, POD breaks down a set of k velocity distributions into a linear combination of M spatial basis functions represented as um, where m is the mode index and the sum of the modes is k, or $M = k(C_m)^k$. The time-dependent coefficients of the respective basis functions are denoted by $(C_m)^k$.

POD in experimental studies

On a variable portion of the experimental instantaneous velocity for flat piston crown, POD analysis was done. The findings revealed details about the structures other than the mean flow. It was found that the tenth mode's energy is 10% of the first mode's maximal energy.

As the piston comes closer to top dead center, the energy decay curve flattens out. This suggests that the amount of turbulence rose. The PIV experiment snapshots of mean flow, coherent flow, and turbulent flow underwent a triple POD decomposition. From 250 engine cycles, 250 consecutive PIV photos were collected.

According to the triple POD study, the coherent portion held 90% of the overall fluctuating KE whereas the turbulent portion had only 10%. As a result, the fluctuations from cycle to cycle are primarily caused by the coherent part. Depending on the length of the insertions, the tumble control flaps also have an impact on the cyclic changes in the fluid structures. This is due to the POD coefficients characterizing the cyclic fluctuations changing depending on the insertion lengths.

On PIV snapshots that were taken every 30 CA, phase variant and phase invariant POD analysis was done. The ensemble-averaged velocity field could be distinguished from the first POD mode, which possessed the maximum energy. The cyclic changes can be extracted from the flow dynamics using phase-invariant POD modes as long as the intake and compression strokes are taken into account. The quantity of engine cycles required to obtain converged POD modes rises with the number of modes. Using phase-invariant POD, velocity fields of 41 crank-angle degrees during the intake and compression strokes were examined from 200 consecutive cycles. Considering that they caught 80% of the total kinetic energy, the first three POD modes were the only ones examined.

As anticipated, the right side's intake flow (mode 2) was weaker than the left side's (mode 1) intake flow. Additionally, the large-scale eddies were in lower modes due to higher energy, whereas the vortical eddy structures were in higher modes.

As the tumble flap and baffle in the intake manifold are closed, the in-cylinder tumble strength and tumble ratio rise, the mean part's energy increases to up to 80% of the overall flow energy, and the coherent part's CCV falls.

In turn, this lowers the overall engine cycle fluctuation and enhances fuel efficiency and emissions.

POD correlation is also used to distinguish between spatial modes with strong coherent structures and those with weaker turbulence. According to the results of the post-processing, the TKE and swirl number rise as the MVL is reduced from 0% to 100% with 20% increments. The velocity vectors obtained from stereoscopic PIV experiments carried out on a FEV steady-state flow rig were applied with an explicit phase-invariant POD [34]. The region of interest was the central vertical tumble plane, and it was discovered that the first mode with repeated coefficients is sufficient to reconstruct the flow in recurring flow patterns.

If the ensemble average is removed from the vector fields, there will be RANS turbulence in the velocity vector fields.

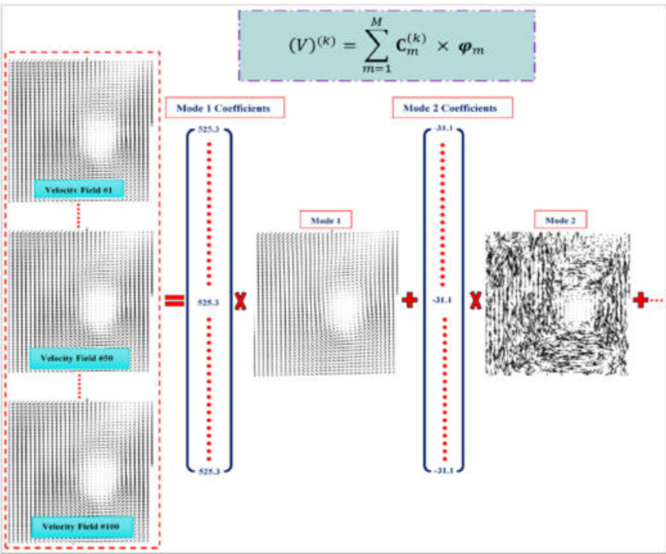

Figure 10 Schematic showing the main principle of POD

POD in numerical studies

The use of proper orthogonal decomposition (POD) on the velocity vectors obtained by LES was investigated. Using the datasets gleaned from the simulations, cycle-to-cycle flow variation (CCV) was detected and quantified. According to the results of the phase-invariant analysis, the ensemble average and the first POD mode closely resemble each other, and the cyclic variation may be computed using the standard deviations of the POD coefficients over engine cycles. Comparing the flow structures derived using the phase variant POD and phase invariant POD approaches was also done using LES.

It was discovered that the number of engine cycles required to achieve convergent modes varies with the piston position (crank angle) and rises with the mode number.

For reciprocating IC engines, a thorough understanding and process for implementing POD were given. The appropriate MATLAB code for the calculations was described together with a mathematical formulation. Two For directed flow, motored IC engine conditions were investigated. Undirected flow and (every cycle comparable to ensemble average) No cycle seems to be comparable to the ensemble average (via the intake spout). The researchers showed how to determine RANS average and RANS turbulence energies using POD. POD offers a method for contrasting two data samples that is, from experiment to experiment or from simulation to simulation. They also suggested a method to assess the number of needed to achieve mode convergence are snapshots. In contrast to LES, RANS provides ensemble-averaged flow motion. Cycle-to-cycle flow capturing of in-cylinder flow over several cycles variability.

The cycle-to-cycle variability with the tumble flap open and closed was investigated using CONVERGE_CFD software . The effects of the charge motion control valve on the evolution of the flow were investigated using both phase-variant and phase-invariant POD.

The combustion chamber receives more air when the tumble flaps are closed, and this increased air induction along the combustion chamber led to higher tumble flow development and higher tumble ratios, which in turn led to reduced cyclic variations in tumble structures. It is now possible to decompose velocity fields very effectively using the POD quadrupole approach. With a second order differencing scheme and PISO scheme for spatial and temporal discretization, respectively, multi-cycle LES was used on a single cylinder engine. On the same plane, it was seen that 2D and 3D POD findings varied. It was suggested that the multiplane POD scheme is more akin to and reflective of 3D POD modes. Table 16 lists the POD major findings from analytical studies together with the CFD setup, operating, and boundary conditions.

Research trend

In conclusion, numerous experimental and analytical methods have been used by researchers and engineers to examine the in-cylinder flow inside a range of engine types under a range of operating situations. These methods are capable of providing sufficient data and information about turbulent flows, including their intensities, kinds, magnitudes, and directions. However, each approach has its own shortcomings and constraints. By obtaining the results from one way and validating them using a different technique or analysis, the researchers have worked on these problems and attempted to reach a compromise in order to obtain accurate enough results from these trials. The quantity of studies conducted on a particular engine variable reveals its significance, sensitivity, and impact on in-cylinder flow.

Conclusion, critical findings and future recommendations

- Using visible laser light and high-speed cameras, particle image velocimetry, the simplest and most widely used flow visualization technique, provides extremely accurate up to three-dimensional flow velocity vectors. The addition of tracer particles to the seed flow does not significantly affect the flow distortion. But if the wrong kind of tracer particle is utilized, it's possible that the high-density particles won't accurately and faithfully follow the fluid flow. The charged-couple cameras also need to be correctly calibrated for precision postprocessing to produce velocity vectors and exact cross-relation of photographing pictures.
- Another technique for flow analysis that is only occasionally utilized is magnetic resonance velocimetry. Since MRV does not require an optical access to the flow, it has an advantage over PIV. Consequently, no additional fluid-seeding particles are added. This method only works with stable flows and can provide findings for flows inside complex, challenging geometries.
- Paddlewheel flowmeters and Hot-wire anemometers are two examples of the rather imprecise techniques. This is due to the fact that their experimental setup involves inserting real items into the flow of fluid. This changes the flow's size and direction, which causes readings to be off. Additionally, these techniques are unable to generate flow visualization for post-processing and turbulence analysis. Another rarely used approach is chemiluminescence, which involves illuminating the flowing flow as a result of a chemical reaction occurring during the experiment. As a result, the chemistry of the flow changes, which could lead to erroneous results for the fluid being studied. The applications for this technology are also somewhat limited.
- The most popular turbulence model is the standard k-e, which produces results that are reasonably comparable to those of the experiments, although there are other more precise variations of the k-e model. In comparison to the regular k-e and chen-kim k-e models, renormalized k-e is more accurate. When compared to k-e models for in-cylinder flow analyses, the k-x model is less accurate because it performs better near wall boundaries.
- Researchers have advanced in the field of numerical flow analysis employing computational fluid dynamics in addition to experimental studies. The optimal CFD code and turbulence model combination is applied for the specific engine circumstances. For the in-cylinder flow analysis, the most used CFD codes are ANSYS Fluent, CFX or ICEM modules, followed by KIVA, OpenFOAM, and CONVERGE. When compared to experimental findings, each of these algorithms produces results that are remarkably accurate.
- Because it directly solves Navier-Stokes equations after applying a low-pass filter, Large Eddy Simulations is a turbulence model that is fairly accurate. Therefore, LES can produce better

results during the intake stroke because the incoming flow creates enormous tumble structures, however during the compression stroke, the massive tumble fragments into multiple smaller structures, and LES produces results that are very unsatisfactory. Since RANS can only provide time averaged velocity fields, LES needs a smaller grid size to produce better results.

- On the basis of various engine settings and characteristics, a number of experimental flow visualization techniques and turbulence models are explored in detail and compared. Depending on the precision of experimental and numerical approaches and the clear results, people's interest has increased or decreased. In reality, this gives researchers new avenues to investigate in-cylinder flows using a variety of engine condition combinations. By going through the rigorous analysis presented in this study, engine performance and fuel efficiency can be enhanced in the future.
- The findings of all these experimental or analytical methodologies also apply to the various categories of slider-crank engines, such as rotary or radial engines, which have varied orientations. Future research projects should focus on analyzing the flow topologies produced by IC engines other than slidercrank engines, like toroidal engines. A thorough investigation and understanding are needed since these engines include a toroidal or curved cylinder for the combustion chamber, which could change the incoming fluid flow from the intake valves. In addition, it is suggested that a straightforward experimental technique be devised for the quick and effective viewing of fluid flow inside an IC engine.

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NUMERICAL MODELLING OF DIRECT COMBUSTION COOKSTOVES

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ABSTRACT

Around three billion people meet their cooking needs through biomass cookstoves. Emission from these stoves particularly leads 4.6 million premature deaths per year. It can be observed that there is a lack of understanding of physics in designing these cookstoves. Performance of the stove is completely dependent on a combination of the stove, pot, fuel, type, and mode of food cooked and operator's skill. Normally LPG stoves are provided with two burners of 1 and 3 kWth maximum capacity with operating efficiency (or thermal efficiency) of 65% and aim of stove designer should be to match the performance as that of LPG stoves.

This thesis constitutes computational studies on flaming mode combustion (or gas phase combustion) in a wood-burning stove. The main objective of this study was to increase the heat transfer efficiency of the existing rocket elbow direct combustion stove comparable to LPG stoves. Parametric analysis of design parameters of pot and skirt had been performed for a particular fuel (shape, size, and properties) and pot (flat bottom) diameters combination. Design and operating parameters includes $G_{pot}, G_{skirt}, D_{wood}, D_{pot}$ and H_{pot} *to maximize heat transfer efficiency. Here* $G_{pot}, G_{skirt}, D_{wood}, D_{pot}$ and H_{pot} *denotes pot gap, skirt gap, diameter of wood, diameter of cookpot and height of cookpot respectively. It was observed that increase in* D_{pot} and H_{pot} *results in increase in heat transfer efficiency up to 52% (for improved model 1 case) while increase in* G_{pot} and G_{skirt} *results in decrease in heat transfer efficiency (maximum heat transfer efficiency of 24% for baseline case). Increase in* D_{wood} *results in increased firepower up to a certain maximum value of 4.76 KW (Heat of combustion,* $\Delta H_c = 13.778\ MJ/kg\ of volatiles$*) due to choke in area because of large number of sticks. Improved model 1 was then incorporate some of the modification as secondary air stream, choke ring and sloped grate which results in increase in heat transfer efficiency from 52% to 67%*

INTRODUCTION

Around three billion people meet their cooking needs through biomass cookstoves. Emission from these stoves particularly leads 4.6 million premature deaths per year [1]. Biomass fuels that are widely used are cow dung, crop waste and wood, etc. Open Fire (Three Stone Fire) was the traditional method used for cooking. From last 30 years, awareness regarding social and environmental costs of using traditional fuels has grown [2].There are number of emissions like carbon monoxide, particulate matter, soot, elemental carbon, organic carbon, black carbon, etc released from these biomass cookstoves which has a significant effect on the health of people and the environment [3]. Respiratory diseases, lung cancer, etc due to inhalation of these pollutants. Exposure assessment for respirable particulates associated with household fuel use in rural districts of Andhra Pradesh, India [4]. Black Carbon generated from these biomass burning is the second largest contributor in global warming [5].

Combustion Efficiency of Open Fires was almost 90% but heat transfer efficiency of open fire (Three Stone Fire) was only 10% [2]. Improving heat transfer efficiency to pot can make a significant difference because specific fuel consumption can be reduced. Figure 1.1 shown below, tells about the annual mean optical depth of BC aerosols due to Black Carbon Emissions from biomass burning. Black Carbon is basically absorbing component of soot, often defined using elemental carbon and some condensed organics [5]. In this section, basic concepts like Definition of Biomass, Understanding Solid Fuel Combustion, Types of cookstoves, Definition of Efficiencies will be discussed.

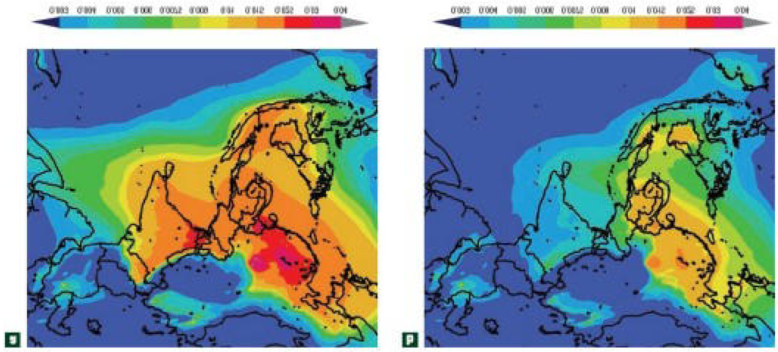

Figure 0.1 Annual mean optical depth of BC aerosols in 2004-2005 due to BC emission from a) biofuel cooking (with wood, dung, and crop residues), fossil fuels, and biomass burning and b) fossil fuels and biomass burning but not biofuel cooking [5]

Biomass

Biomass is the organic matter derived from living or recently living or recently living organism. Wood is basically a lignocellulosic material mainly composed of Cellulose, Hemicellulose and Lignin. Cellulose is a polymer glucosan and its proportion in wood is approximately 50%. Hemicellulose is a polysaccharide producing wood sugars and its proportion in wood is approximately 25%. Lignin is a multi-ring organic compound and its proportion in wood is approximately 25% [6]. Figure 1.2 describes the comparison between H/C atomic ratio and O/C atomic ratio for different grades of coal and biomass. Biomass having the higher O/C atomic ratio and H/C atomic ratio than grades of coal, but having lower heating value than grades of coal. Figure 1.3 describes the Variation of elemental weights between wood and grades of coal. It can be seen from the figure that volatiles, oxygen and hydrogen weights are higher in wood compared to coal while heating value is lower than coal.

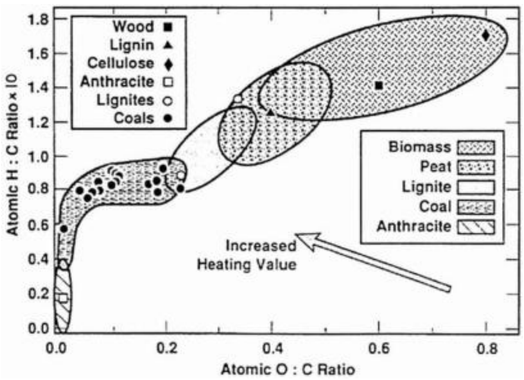

Figure 0.2 Van Krevelen Diagram [7]

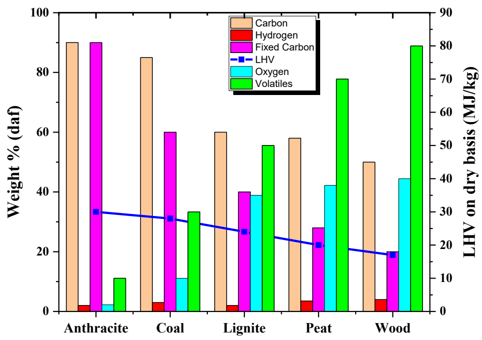

Figure 0.3 Comparison of Elemental weights between wood and grades of coal [8]

Understanding Solid Fuel Combustion

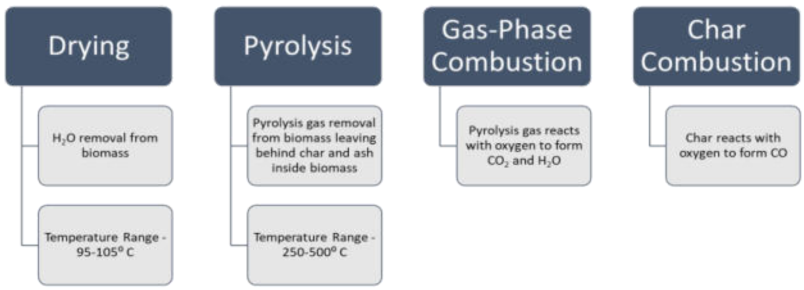

Figure 0.4 Four stages during combustion of solid fuel

Figure 1.4 represents different stages during combustion of solid fuel. Moisture is released from biomass in temperature range of 95-105ºC.This process is called drying process. After that when temperature is raised to 250-500ºC, pyrolysis gas (volatiles) released from biomass leaving behind char and ash [6]. This stage is called Devolatization or pyrolysis. Then the third main stage is called Gas-Phase Combustion in which pyrolysis gas reacts with surrounding air to form combustion products as CO_2 and H_2O etc. Finally, the fourth stage is called char combustion or char oxidation in which diffusive transport of oxygen to the char surface from gas phase occurs. Figure 1.5 describes burning of wood-sticks Combustion of wood and any biomass occurs in two stages-flaming combustion and char oxidation. The former occurs in the gas phase and the latter occurs on the surface. Ignition of wood needs a flame to heat up the material till the volatiles are released and a gaseous flame is initiated. After ignition, the sustained combustion occurs because the flame will transfer heat back to the surface to generate the volatiles that burn in the gas phase. The char oxidation occurs by diffusive transport of oxygen to the surface from gas phase. Both of these are diffusion controlled. Volatile Combustion occurs faster than char oxidation.

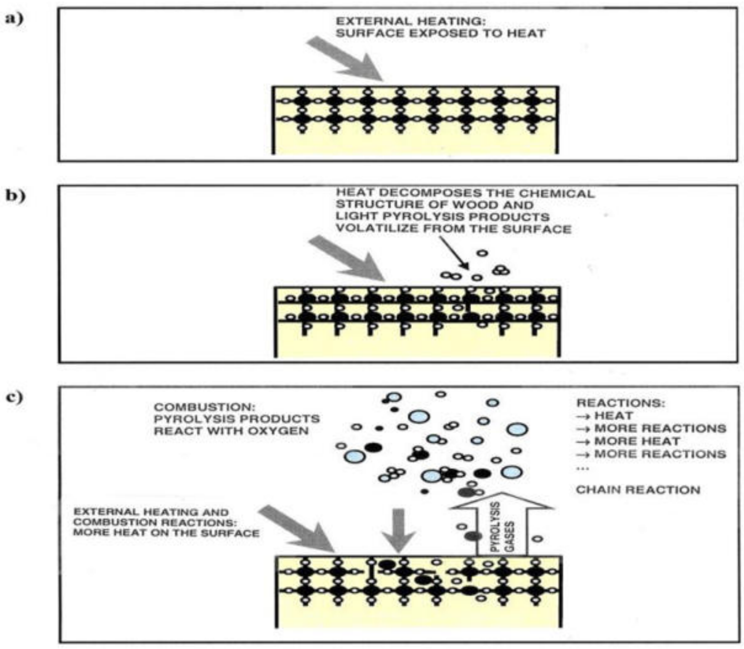

Figure 0.5 A schematic picture of pyrolysis and combustion of wood: a) External heating increases the temperature of wood. b) Pyrolysis starts and the chemical structure of wood is decomposed. Light pyrolysis products volatilize from the surface. c) Combustion starts. Pyrolysis products react with oxygen and produce more heat, causing a strongly growing chain reaction [9]Types of Cookstoves

1. **Batch-operated** refers to stoves that are operated on a single load of fuel at a time.
2. **Continuously fed stoves** require fuel to be loaded throughout the cooking process.
3. **Rocket (also known as side-fed) stoves** are fueled with wood sticks or biomass residues that are continuously fed (see “Fuel” section below) through the side of the stove, typically resting on a grate so that ash and charcoal can settle below. Air enters by natural- or forced-draft through the same opening as the fuel. (Examples: Grameen Greenway Smartstove, Envirofit G-3300, Ecozoom Zoom Stove)
4. **Gasifier stoves** are batch- or continuously fed using processed fuel (e.g., pellets, reduced size residues). Combustion occurs in two zones — the pyrolysis zone where fuel is heated to

produce combustible gases, and the combustion zone where pyrolysis gases are mixed with air and combusted to produce heat. (Examples: Awamu Troika, Mimi Moto, Philips ACE 1)

5. **Charcoal stoves** are batch-operated and fueled with charcoal or carbonized biomass, which is produced through pyrolysis to remove volatile matter leaving mostly carbon. (Examples: Kenyan Ceramic Jiko, Envirofit CH-2200, Burn Jikokoa)
6. **Forced-draft / fan stoves** have air that is forced into the stove using a fan or blower to enhance turbulence and promote cleaner combustion (Example: BioLite HomeStove).

(a)

(b)

(c)

(d)

Figure 0.6 Type of cookstoves (a).Envirofit G-3300 (Continuously-fed, rocket stove) (b).Philips ACE 1 (Batch-type, gasifier stove) (c).Burn Jikokoa (Charcoal stove) (d). BioLite (Fan stove).

Efficiency

1. Combustion Efficiency,

$$\eta_{ce} = 1 - \frac{[CO]}{[CO_2]} \tag{1}$$

2. Thermal Efficiency- can be measured by performing WBT and is given as

$$\eta_{th} = \frac{\left[\left(m_{w_i} - m_p\right) \times c_{p_w} \times \left(T_{w_f} - T_{w_i}\right) + \left(m_{w_i} - m_{w_f}\right) \times h_{fg}\right]}{m_{eq\,wood} \times LHV} \qquad (2)$$

3. Heat Transfer Efficiency (as used in this study)

$$\eta_{hte} = \frac{Total\ Heat\ Transfer\ to\ Pot}{Firepower} = \frac{HT}{FP} \qquad (3)$$

where, Heat Transfer is calculated using CFD tool for different cases.

$$FP = \dot{m}_{volatiles} \times (\Delta H_c) \qquad (4)$$

Numerical Study

In this study, geometry of two-dimensional computational model of wood-sticks rocket elbow direct combustion cookstove was made in ANSYS Design Modeller Software. Structured Mesh with inflation layers at walls was generated in ANSYS Meshing Software. Mesh Size was kept so fine that there was no need for Mesh-Independent Study. Computational Model was solved by using ANSYS Fluent Software.

Model was analyzed under steady state, species was modelled using species-transport approach, Reaction was modelled using Eddy-Dissipation Model. Turbulence was modelled by using RANS approach, flow was modelled by forced convection mode without radiation. First, set of governing partial differential equations describing flow, turbulence, energy, species in computational domain was presented. Then numerical solution procedure used to solve these equations was discussed.

Governing Differential Equations

Reynolds (Ensemble) Averaging

In Reynolds averaging, the solution variables in the instantaneous (exact) Navier-Stokes equations are decomposed into the mean (ensemble-averaged or time-averaged) and fluctuating components. For the velocity components:

$$u_i = \bar{u}_i + u_i' \qquad (5)$$

where $\bar{u}_i$ and u_i' are the mean and fluctuating velocity components $(i = 1, 2, 3)$.Substituting expressions of this form for the flow variables into the instantaneous continuity and momentum equations and taking a time (or ensemble) average (and dropping the overbar on the mean velocity, $\bar{u}$) yields the ensemble-averaged momentum equations. They can be written in Cartesian tensor form as:

$$\frac{\partial \rho}{\partial t} + \frac{\partial (\rho u_i)}{\partial x_i} = 0 \tag{6}$$

$$\frac{\partial}{\partial t}(\rho u_i) + \frac{\partial}{\partial x_j}(\rho u_i u_j) = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j}\left[\mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} - \frac{2}{3}\delta_{ij}\frac{\partial u_l}{\partial x_l}\right)\right] + \frac{\partial}{\partial x_j}(-\rho\overline{u_i' u_j'}) \tag{7}$$

Equation (6) and (7) are called Reynolds-averaged Navier-Stokes (RANS) equations. They have the same general form as the instantaneous Navier-Stokes equations, with the velocities and other solution variables now representing ensemble-averaged (or time-averaged) values. Additional terms now appear that represent the effects of turbulence. These Reynold stresses, must be modelled in order to close equation (7).

For variable-density flows, Equation (6) and (7) can be interpreted as Favre-averaged Navier-Stokes equations with velocities representing mass-averaged values. As such, Equation (6) and (7) can be applied to variable-density flows.

k- ε Turbulence Model

The Reynolds-averaged approach to turbulence modeling requires that the Reynolds stresses in Equation (7) are appropriately modeled. A common method employs the Boussinesq hypothesis to relate the Reynolds stresses to the mean velocity gradients:

$$-\rho\overline{u_i' u_j'} = \mu_t\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) - \frac{2}{3}\left(\rho k + \mu_t\frac{\partial u_k}{\partial x_k}\right)\delta_{ij} \tag{8}$$

In the case of *k*- ε model, two additional transport equations (for the turbulence kinetic energy, *k* and the turbulence dissipation rate, ε) are solved, and μ_t is computed as a function of *k* and ε.

Transport Equation for Standard k- ε model

$$\frac{\partial}{\partial t}(\rho k) + \frac{\partial}{\partial x_i}(\rho k u_i) = \frac{\partial}{\partial x_j}\left[\left(\mu + \frac{\mu_t}{\sigma_k}\right)\frac{\partial k}{\partial x_j}\right] + G_k + G_b - \rho\varepsilon - Y_M + S_k \tag{9}$$

$$\frac{\partial}{\partial t}(\rho \varepsilon) + \frac{\partial}{\partial x_i}(\rho \varepsilon u_i) = \frac{\partial}{\partial x_j}\left[\left(\mu + \frac{\mu_t}{\sigma_\varepsilon}\right)\frac{\partial \varepsilon}{\partial x_j}\right] + C_{1\varepsilon}\frac{\varepsilon}{k}(G_k + C_{3\varepsilon}G_b) - C_{2\varepsilon}\rho\frac{\varepsilon^2}{k} + S_\varepsilon \tag{10}$$

In these equations, G_k represents the generation of turbulence kinetic energy due to the mean velocity gradients, calculated as described in Equation (12). G_b is the generation of turbulence kinetic energy due to buoyancy, calculated as described in Equation (13) and (14). Y_M represents the contribution of the fluctuating dilatation in compressible turbulence to the overall dissipation rate. $C_{1\varepsilon}$, $C_{2\varepsilon}$, and $C_{3\varepsilon}$ are constants. σ_k and σ_ε are the turbulent Prandtl numbers for k and ε respectively. S_k and S_ε are user-defined source terms.

$$\mu_t = \rho C_\mu \frac{k^2}{\varepsilon} \tag{11}$$

where C_μ is a constant.

Model constants have the following mentioned values:

$C_{1\varepsilon} = 1.44$, $C_{2\varepsilon} = 1.92$, $C_\mu = 0.09, \sigma_k = 1.0$ and $\sigma_\varepsilon = 1.3$

$$G_k = -\rho \overline{u_i' u_j'} \frac{\partial u_j}{\partial x_i} \tag{12}$$

$$G_b = \beta g_i \frac{\mu_t}{Pr_t} \frac{\partial T}{\partial x_i} \tag{13}$$

where Pr_t is the turbulent Prandtl number for energy and its default value is 0.85 for Standard k-ε model and g_i is the component of gravitational vector in the i^{th} direction.

For ideal gas, Equation (13) reduces to

$$G_b = -g_i \frac{\mu_t}{\rho Pr_t} \frac{\partial \rho}{\partial x_i} \tag{14}$$

$$C_{3\varepsilon} = tanh \left|\frac{v}{u}\right| \tag{15}$$

Convective Heat and Mass Transfer Modeling in the $k - \varepsilon$ Models

$$\frac{\partial}{\partial t}(\rho E) + \frac{\partial}{\partial x_i}[u_i(\rho E + p)] = \frac{\partial}{\partial x_j}\left(k_{eff}\frac{\partial T}{\partial x_j} + u_i(\tau_{ij})_{eff}\right) + S_h \tag{16}$$

$$(\tau_{ij})_{eff} = \mu_{eff}\left(\frac{\partial u_j}{\partial x_i} + \frac{\partial u_i}{\partial x_j}\right) - \frac{2}{3}\mu_{eff}\frac{\partial u_k}{\partial x_k}\delta_{ij} \tag{17}$$

$$k_{eff} = k + \frac{c_p \mu_t}{Pr_t} \tag{18}$$

Energy Equation used for Species-Transport Model)

$$\frac{\partial}{\partial t}(\rho E) + \nabla.\left(\vec{v}(\rho E + p)\right) = \nabla.\left(k_{eff} \nabla T - \sum_j h_j \vec{J}_j + (\bar{\bar{\tau}}_{eff} . \vec{v}) \right) + S_h \tag{19}$$

where k_{eff} is the effective conductivity ($k + k_t$, where is the turbulent thermal conductivity, defined by according to the turbulence model being used) and $\vec{J}_j$ is the diffusion flux of species j. The first three terms on right-hand side of equation (19) represent energy transfer due to conduction, species diffusion, and viscous dissipation, respectively. S_h includes heat of chemical reaction, and any other volumetric heat sources you have defined.

In Equation (19),

$$E = h - \frac{p}{\rho} + \frac{v^2}{2} \tag{20}$$

where sensible enthalpy h is defined for ideal gases as

$$h = \sum_j Y_j h_j + \frac{p}{\rho} \tag{21}$$

where Y_j is the mass fraction of species j.

$$h_j = \int_{T_{ref}}^{T} c_{p,j} dT \tag{22}$$

Inclusion of pressure work and kinetic energy work is neglected in equation (20) for incompressible flows. The value used for T_{ref} in the sensible enthalpy calculation depends on the solver and models in use. For the pressure-based solver T_{ref} is 298.15 K except for PDF models in which case is a user input for the species. For the density-based solver T_{ref} is 0 K except when modeling species transport with reactions in which case is a user input for the species.

Species Transport Equations

$$\frac{\partial}{\partial t}(\rho Y_i) + \nabla.(\rho \vec{v} Y_i) = \nabla.\vec{J}_i + R_i + S_i \tag{23}$$

where R_i is the net rate of production of species i by chemical reaction and S_i is the rate of creation by addition from the dispersed phase plus any user-defined sources. An equation of this form will be solved for $N - 1$ species where N is the total number of fluid phase chemical species present in the system. Since the mass fraction of the species must sum to unity, the Nth mass fraction is determined as one minus the sum of the $N - 1$ solved mass fractions. To minimize numerical error, the Nth species should be selected as that species with the overall largest mass fraction, such as N_2 when the oxidizer is air.

Mass Diffusion in Turbulent Flows

$$\vec{J}_i = -\left(\rho D_{i,m} + \frac{\mu_t}{Sc_t}\right)\nabla Y_i - D_{T,i}\frac{\nabla T}{T} \tag{24}$$

Here $D_{i,m}$ is the mass diffusion coefficient for species i in the mixture, and $D_{T,i}$ is the thermal (Soret) diffusion coefficient. Sc_t is the turbulent Schmidt number ($\frac{\mu_t}{\rho D_t}$ where μ_t is the turbulent viscosity and D_t is the turbulent diffusivity), the default Sc_t is 0.7. Note that turbulent diffusion generally overwhelms laminar diffusion, and the specification of detailed laminar diffusion properties in turbulent flows is generally not necessary.

Eddy-Dissipation Model

Reaction rates are assumed to be controlled by the turbulence, ignoring the effect of chemistry timescales, which avoids expensive Arrhenius chemical kinetic calculations. The model is computationally cheap, but, for realistic results, only one or two step heat-release mechanisms should be used. This approach should be used only when the chemistry timescales of interest are known to be fast relative to the turbulence timescales throughout the domain. For mixed-is-burned approximation, ANSYS Fluent provides a turbulence-chemistry interaction model, based on the work of Magnussen and Hjertager, called the eddy-dissipation model. With this model, the net rate of production of species i due to reaction r, $R_{i,r}$, is given by the smaller (that is, limiting value) of the two expressions below:

$$R_{i,r} = \nu'_{i,r} M_{w,i} A \rho \frac{\varepsilon}{k} \min_{\mathcal{R}}\left(\frac{Y_{\mathcal{R}}}{\nu_{\mathcal{R},r} M_{w,\mathcal{R}}}\right) \tag{25}$$

$$R_{i,r} = \nu'_{i,r} M_{w,i} AB\rho \frac{\varepsilon}{k} \frac{\sum_P Y_P}{\sum_j^N \nu''_{j,r} M_{w,j}} \tag{26}$$

Y_P = the mass fraction of any product species, P

$Y_{\mathcal{R}}$ = the mass fraction of a particular reactant, $\mathcal{R}$

A = an empirical constant equal to 4.0

B = an empirical constant equal to 0.5

In Equation (25) and (26), the chemical reaction rate is governed by the large-eddy mixing time scale ,$\frac{k}{\varepsilon}$, as in the eddy-breakup model of Spalding. Combustion proceeds whenever turbulence is present ($\frac{k}{\varepsilon} > 0$), and an ignition source is not required to initiate combustion. This is usually acceptable for non-premixed flames. The eddy-dissipation model requires products to initiate reaction (see Equation (26)). When you initialize the solution for steady flows, ANSYS Fluent sets all species mass fractions to a maximum in the user-specified initial value and 0.01. This is usually sufficient to start the reaction. However, if you converge a mixing solution first, where all product mass fractions are zero, you may then have to patch products into the reaction zone to ignite the flame [23].

Numerical Solution Procedure

Coupled Scheme for Pressure-Velocity Coupling was used. In Spatial Discretization Least Square Cell-Based approach for Gradients, Second Order approach for Pressure, Second Order Upwind Scheme for momentum, species, and energy was used. First Order Upwind Scheme for turbulent kinetic energy and turbulent dissipation rate was used. Option for Pseudo-Transient and High-Order Term Relaxation was also enabled.

Pseudo-Transient Explicit Relaxation Factors were kept the default. The time factor for all species was increased to 10 under the advanced solution control panel.

Solution Initialization was done using Hybrid Initialization. The calculation was performed (fluid timescale factor increased to 5) and the solution would converge within 1000 iterations.

Result and Discussion

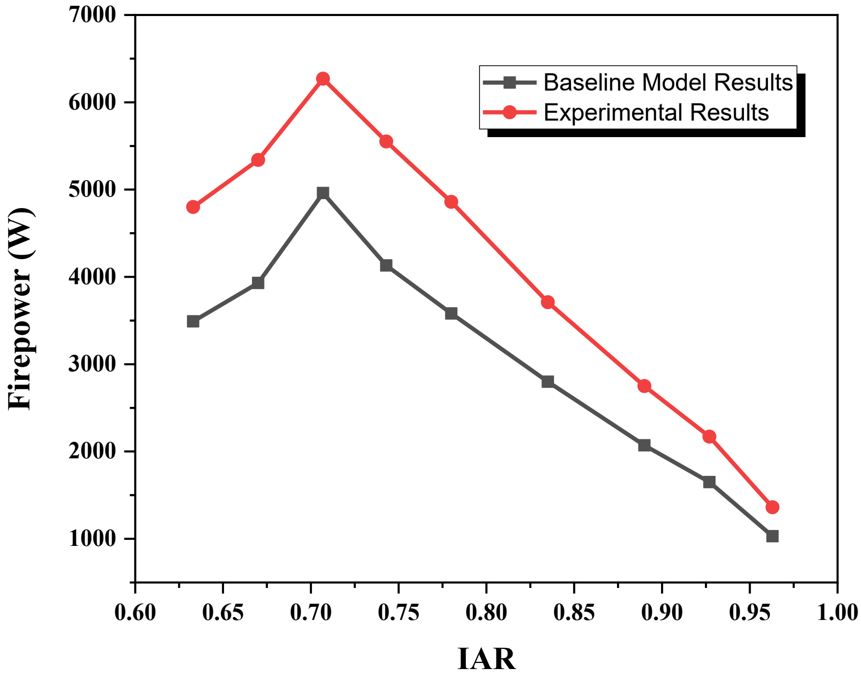

Figure 0.1 Variation of firepower with inlet area ratio for experimental and baseline model case.

Figure 4.1 shows the variation of firepower with Inlet Area Ratio. It can be observed that increase in firepower with increase in number of sticks and maximum occurs at certain fuel stick diameter due to choking, after that firepower will not increase with IAR. Figure 4.2 shows the variation of temperature inside the combustion chamber at two locations (y=125 mm and y=250 mm) for experimental and baseline case. It shows a similar trend for both experimental and baseline model results. Uncertainty is due to thermocouple probe used for measuring temperature at a particular location in experiments. Temperature of flame increases with decrease in IAR (as more volatiles will be released from wood sticks).

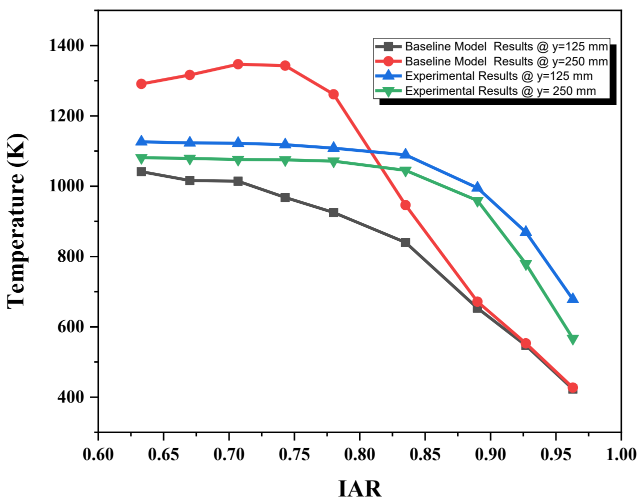

Figure 0.2 Variation of temperature inside combustion chamber at two locations (y=125 mm and y=250 mm) for experimental and baseline case.

Figure 4.3 shows the variation of mass fraction of CO_2 at outlet with Inlet Area Ratio for Rohan, et.al model and baseline model case. It shows increase in mass fraction of CO_2 with decreasing IAR because more fuel will be burnt producing more amount of CO_2. Figure 4.4 shows the variation of heat transfer rate at pot bottom and heat transfer efficiency with Pot gap (considered flat bottom pot) for baseline case (pot diameter =100 mm). It shows both decrease in heat transfer rate and heat transfer efficiency with increase in pot gap.

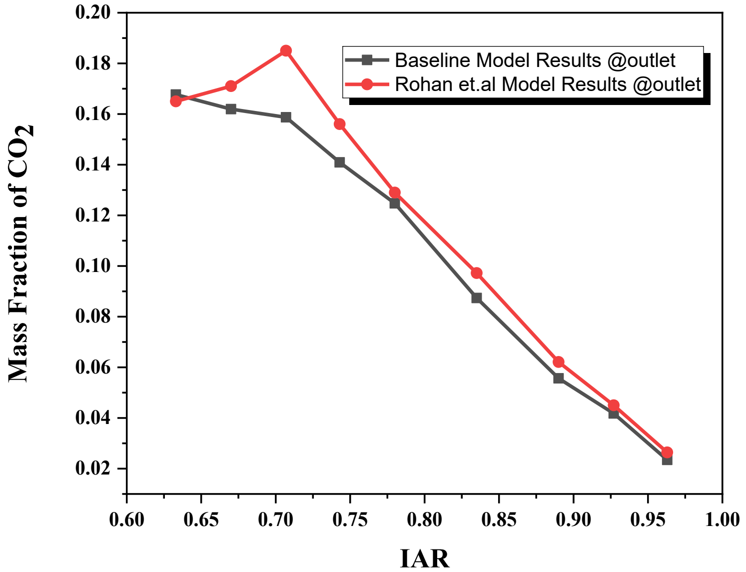

Figure 0.3 Variation of mass fraction of CO_2 at outlet with inlet area ratio for Rohan, et.al model and baseline model case

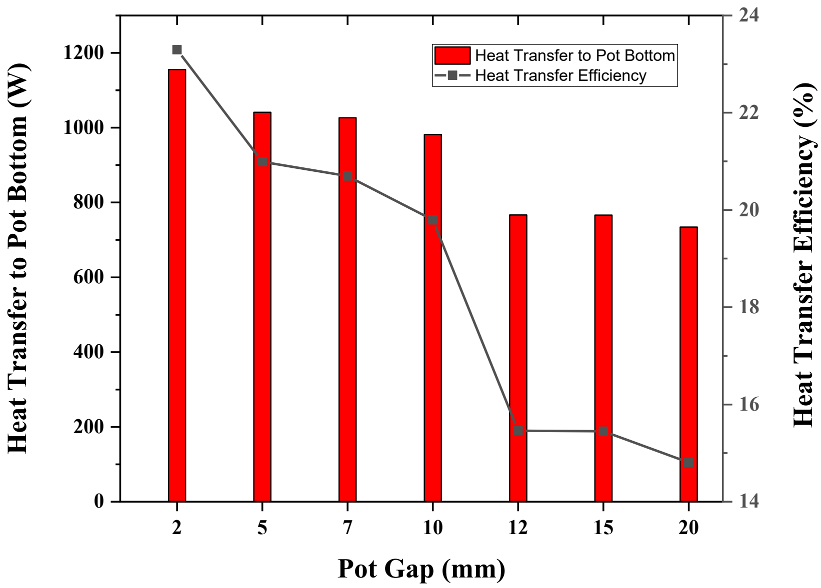

Figure 0.4 Variation of heat transfer rate at pot bottom and heat transfer efficiency with pot gap(considered flat bottom pot) for baseline case (pot diameter =100 mm)

Figure 4.5 shows variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency with pot diameter (considered flat bottom pot) for improved model 1 case (pot height= 50 mm, pot gap and skirt gap =10 mm). It shows both increase in heat transfer rate and heat transfer efficiency with increase in pot diameter due to increase in heat transfer area of pot bottom.

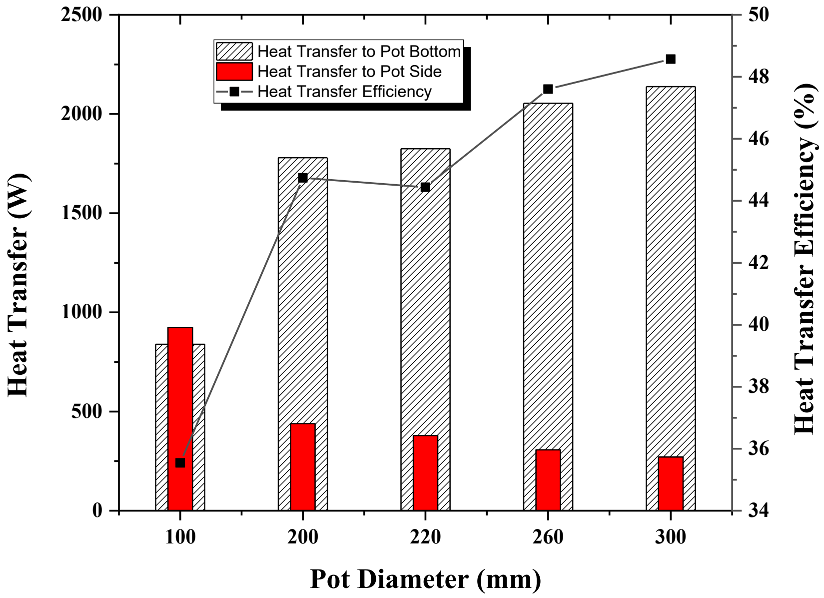

Figure 0.5 Variation of heat transfer rate at pot (bottom and side)and heat transfer efficiency with pot diameter (considered flat bottom pot) for improved model 1 case (pot height=50 mm, pot gap and skirt gap =10 mm)

Figure 4.6 shows variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency with pot height (considered flat bottom pot) for improved model 1 case (pot diameter =200 mm, pot gap and skirt gap =10 mm). It shows both increase in heat transfer rate and heat transfer efficiency with increase in pot height due to increase in lateral surface area of cookstove. Figure 4.7 shows the variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency with pot skirt gap (considered flat bottom pot) for improved model 1 case (pot diameter =200 mm and pot height =50 mm). It shows both decrease in heat transfer rate and heat transfer efficiency with increase in pot gap due to decrease in contact of high velocity flue gases with the pot side

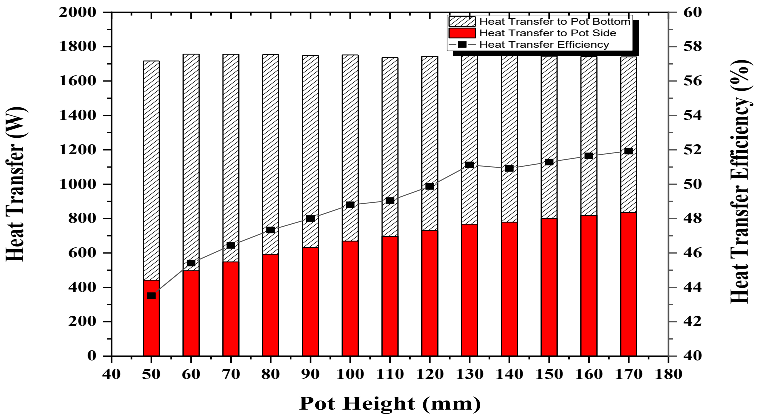

Figure 0.6 Variation of heat transfer rate at pot (bottom and side)and heat transfer efficiency with pot height (considered flat bottom pot) for improved model 1 case (pot diameter=200 mm, pot gap and skirt gap =10 mm).

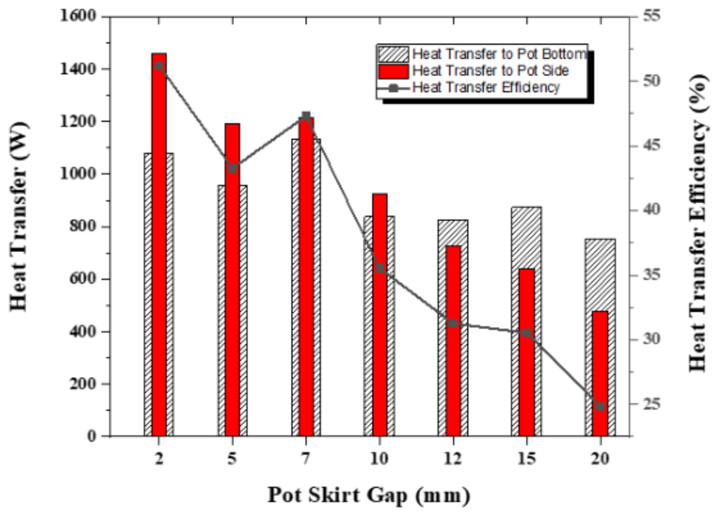

Figure 0.7 Variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency with pot skirt gap(considered flat bottom pot) for improved model 1 case (pot diameter =200 mm and pot height =50 mm)

Figure 4.8 shows variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency for five different improvised cases. These changes in design have significant changes in heat transfer at pot bottom than pot side because of turbulence and recirculation zone created by choke ring and stagnation point created at pot bottom. Sloped grate also contributes in enhanced turbulent mixing. Figure 4.9 shows variation of wall heat flux at pot bottom for five different improvised cases. It can be seen that maximum peak temperature can be shifted to mid of pot bottom by using double choke ring and two secondary air stream case. Figure 4.10 and 4.11 shows the temperature and CO_2 species contours for five different cases. Flame shape of volatile burning for these five cases can be observed. There was asymmetry in design due to which maximum flame temperature is not passing through centreline of stove. Insertion of annular ring and choke ring help in shifting maximum heat flux to the centre of pot and helps in increasing overall heat transfer to pot and heat transfer efficiency.

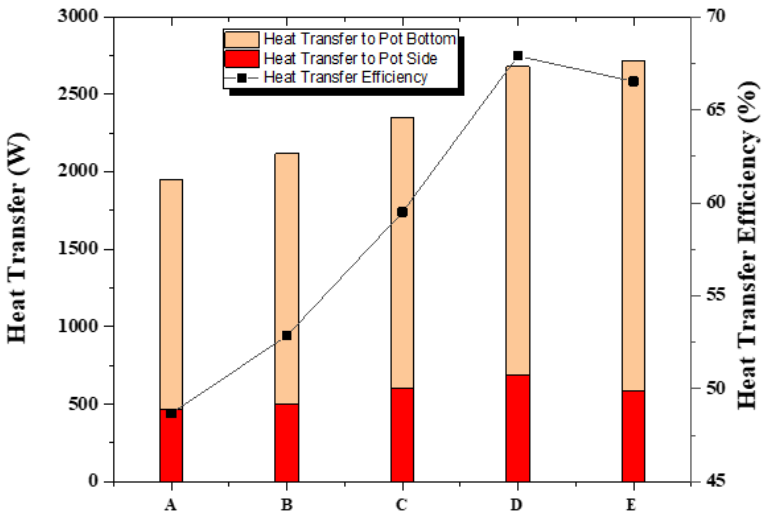

Figure 0.8 Variation of heat transfer rate at pot (bottom and side) and heat transfer efficiency for five different improvised cases

Case A- One secondary air stream, Case B- Single choke ring,
Case C- Slopped grate (slope of 7.59° from horizontal), Case D- Double choke ring case,
Case E- Two secondary air stream case

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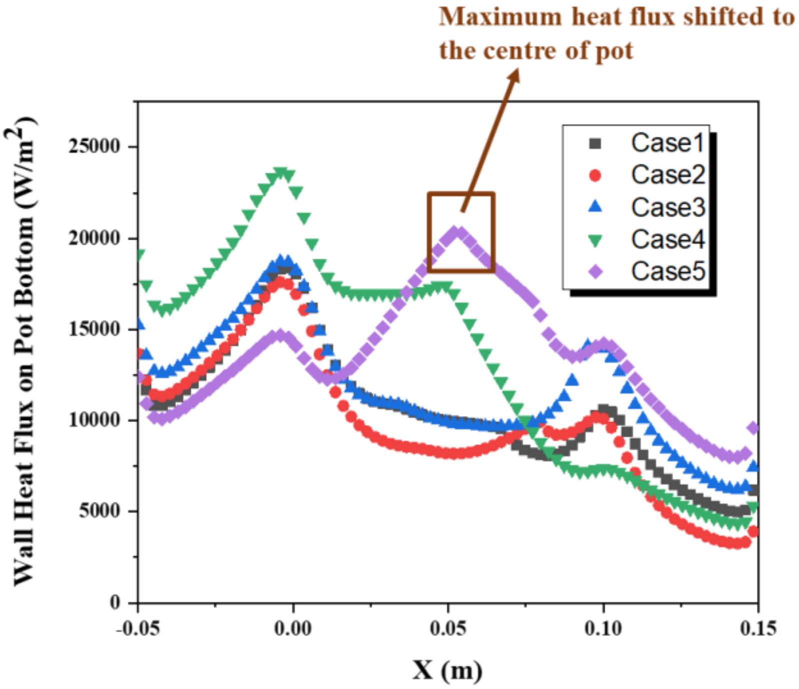

Case 1- One secondary air stream, Case 2- Single choke ring,
Case 3- Slopped grate (slope of 7.59^o from horizontal), Case 4- Double choke ring case,
Case 5- Two secondary air stream case

Figure 0.9 Variation of wall heat flux at pot bottom for five different improvised cases.

CONCLUSION

1. A simplified numerical model of flaming combustion of wood in direct combustion cookstove has been considered in which steady flow was modeled using RANS equation, standard k-ε model was used for turbulence, species transport equation was used and reaction was modelled using eddy-dissipation model.
2. Baseline model is validated from existing experimental data presented in Rohan, et al paper and Baseline model have maximum heat transfer efficiency of 24%.
3. Parametric analysis of design parameters of pot and skirt have been performed, and it can be concluded that increase in pot diameter, pot height results in increase of heat transfer efficiency and increase in pot gap and skirt gap results in decrease of heat transfer efficiency. Maximum heat transfer efficiency observed in Improved model case 1 was 50-52%.

4. Modification in Improved model 1 resulted in increase in heat transfer efficiency from 52 % to 65-67%.

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Item Turning Utilizing Transport lines

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ABSTRACT

In present day time for motivation behind stepping value, assembling and termination date, examination sign on base, top or different surfaces of the item, the mechanical arm or human undertaking is utilized to accessory the referenced movement and afterward lifting it from one transport to other transport. In this undertaking we will change a framework that can turn the item on "Single Transport Framework" without utilizing mechanical arm, which help to make framework smoother and lessen cost as well as season of bundling process. This framework is less expensive, more dependable, low upkeep and protected than ongoing automated framework.

Keywords: *Conveyor Belt, Belt Transmission, Product Rotation, Product Printing*

INTRODUCTION

These days, huge quantities of enterprises changing to Robotization, It is worried about the greater part of assembling and naming or stepping process. Transport frameworks are utilized by a large portion of the ventures due their advantages. Transports can securely ship item in industry, without transport framework it required more laborer for manual material taking care of would be exceptionally sluggish and exorbitant. In this undertaking, we are centered around the conceivable change in plan of transport line for motivation behind simple, quick and programmed revolution of item on transport for stepping or marking of item on any face of item even at base face without assistance of any automated arm component.

Moreover, we will change a framework that can turn the item on single transport framework without utilizing mechanical arm, which help to make framework smoother and lessen cost and season of bundling framework. A transport framework helps us for quick bundling and proficient transportation for different materials or item in bundling enterprises.

OBJECTIVES

- Empowering consistent and quick change and pivot of items on transport line.
- Disposal of item turning robots or labor supply, thus lessening the general expenses of creation.
- Quick marking framework analyze than existing framework.
- Programmed item turn through transport line.
- Computerization in naming.
- Diminish manual item taking care of.

LITERATURE REVIEW

We have read some patent and research paper related to our project requirement and basics about conveyor system to broaden our understanding about said project.

A. e-ISSN: 2278-1684, p-ISSN: 2320-334X, Design and

Development of Automated Conveyor System for Material Handling, Abhijit Gaikwad, Yogesh Raut, Jitendra Desale, Akshay Palhe, Govinda Shelar, Prof.Shreekant Pawar. IOSR Journal of Mechanical and Civil Engineering

In their examination paper they have done estimation for transport lines for material dealing with over significant distance for example 30-50km. Additionally they have likewise recorded benefits and bad marks of long transport lines framework over show material taking care of techniques. They effective consummation of this undertaking work is help to the improvement of a robotized belt transport framework which is speedy, protected, solid and proficient. Their concentration to lessen human association and tries simultaneously increment the efficiency and exactness levels that can't be accomplished by manual cycle.

B. Patent Number – Us3960640, Bottom LabelingApparatus, Paul R. Mort, Jr Robert A. Cleary

In this patent they have examined about marking at the lower part of items with a criticism circle, which guarantees more prominent precision in printing name. It is being achieved utilizing numerous sensor to get criticism about items marking. The principal sensor is utilized to be aware on the off chance that the name has applied or not. Second sensor guarantees the situation of the mark and third name guarantees that right position of name on right item is applied. In the event that some misleading mark has applied criticism circle sends data to framework to send it on an alternate way.

C. Patent No. : US6823981B2, Conveyor system for anautomatic accumulation system, Richard Jogle, Neenah, Steven A. Hellmann, Oshkosh.

This development is connected with flip the item and use to gather free bundles so that can be effectively send for additional cycles. In this development transport framework, rollers, guide plates, slider plate are utilized. Slider plate is utilized to gather free bundles. Guide plate is plan so that it can flip the bundles on transport.

We have discover that we can contort or flip the item with just two transport line, which running concurrent. We can curve item without contorting table, timing screw and other instrument. Additionally we can curve item without utilizing automated arm and specialist.

This development can all the more really and all the more productively give a handling framework fit for changing over free bundle into a design that can be naturally organize it in bundling framework.

Some Exploration papers which assists us with figuring out existing technique and adjust the current bundling framework for better marking or stepping on transport. It assists us with seeing all conceivable strategy to turn the item on transport or stepping.

DESIGN OF SINGLE CONVEYOR SYSTEM.

We are achieving item pivot We will change a framework that can turn the item around 90 degree to 180 degree without assistance of mechanical component, on single transport framework for stepping or marking, which help to make framework smoother and decrease cost and season of bundling framework and naming interaction. This framework is less expensive, more dependable and protected than ongoing framework. Also, this venture most extreme valuable for miniature, little, medium undertaking business, since this sort of enterprises.

Utilizing two transport lines commonly opposite to one another, by changing the hub of pivot of transport lines from even to vertical as well as the other way around. In our model we have shown how belts are lined up with one another for effectively pivoting the item.

Fig. 1 Product rotating conveyor belts

Fig. 1.1 Working Model

DESIGN METHODOLOGY

The basics of the Calculations of Conveyor Belt DesignParameters

A. Belt tension:

Owing to motion of electric motors and load of conveyed materials, the belt of conveyor usually experience a tensile load and stress. The belt tension can be calculated by this method.

Tb = [2*mi+ (2*mb + mm)*cos (δ)] 1.37*f*L*g*+ (H*g*mm).

Where,

Tb is in Newton. f = Coefficient of frictionL = Conveyor length in meters.

g = Acceleration due to gravity = 9.81 m/sec^{2}mi = Load due to the idlers in Kg/m.

mb = Load due to belt in Kg/m.

mm = Load due to the conveyed materials in Kg/m.δ = Inclination angle of the conveyor in Degree.

H = vertical height of the conveyor in meters.

Load due to idlers (mi): This can be calculated as below:mi = (mass of a set of idlers) / (idlers spacing).

B. Power at drive pulley:

The power required by the driving pulley can be calculatedas below.

Pp = (Tb*V)/1000

Where,

Pp is in KW.

Tb = steady state belt tension in N.v = belt speed in m/sec.

C. Sizing of the motor:

The minimum motor power can be calculated as: Pm = Pp/Kd
Where,
Pm is in Kw.
Pp = the power at drive pulley in KwKd = Drive efficiency.

D. Acceleration:

The acceleration of the conveyor belt can be calculated as: A= (Tbs – Tb)/ [L*(2*mi + 2*mb+mm)]
Where,
A is in m/sec2
Tbs = the belt tension while starting in N. Tb = the belt tension in steady state in N.
L = the length of the conveyor in meters. mi = Load due to the idlers in Kg/m.
mb = Load due to belt in Kg/m.
mm = Load due to the conveyed materials in Kg/m.

CONCLUSION

Item revolution can be accomplished utilizing transport line frameworks which is way less expensive and reasonable, such framework doesn't need automated support. While considering todays strategies for turn utilizing complex machines and costly

arrangements.

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Studying the Performance of Different Cast Iron Fins Computationally

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ABSTRACT

In the current work, heat transport through various fin designs installed above an engine cylinder is computationally analyzed. The analysis gives the forecast for the fin's overall heat flux and temperature distribution. To test the impact of internal heat generation, the temperatures of the cylinder's inner wall have been changed. For a specific scenario, the effectiveness of the different fin geometry has been compared. It was discovered that the fin with wavy geometry performs better than the other. It was also mentioned that adding curved edges to the rectangular fin can improve its performance.

Keywords:- *Fins; heat flux; cast iron; wavy fin; performance.*

I. INTRODUCTION

Internal combustion engines are subjected to extreme heat stress and temperature change. To cool the cylinders, fins are supplied, increasing the engine's surface area and speeding up convectional heat transfer. There are several different fin geometries that could be used in the car industry. From an economic standpoint, the weight of the fins is also significant. Based on the optimization of fin performance, a lot of studies on fin materials can be found in the literature, including those by Illan et al. (1), Wang et al. (2), and Azarkish et al. (3). Aluminum Alloy 6082 is the best, according to research by Harish P. et al. (4) on the impact of fin material and geometry on heat flux

. considering that cast iron is the primary component, curved and wavelike fins. Circular and rectangular fins have been discussed in the majority of the literature. Rectangular fins that have had their edges adjusted with curves have been considered in the current case study. Optimizing the fin performance for a typical range of temperatures is the main goal of the comparison study. Also expected are the temperature distribution and overall heat flux. To evaluate the economic optimization, the fin's weight is also taken into account as a variable parameter with respect to fin type.

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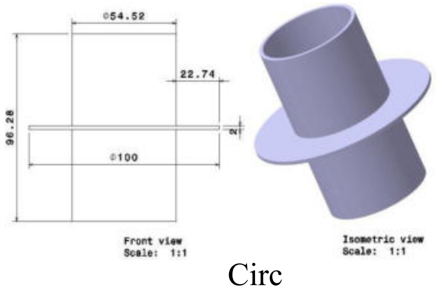
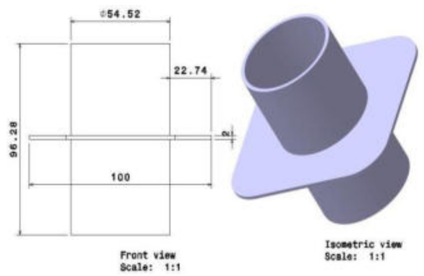
2. SUMMARY OF THE CASE STUDY

The experiment will use a 100 cc engine with a cylinder bore of 54.52 mm, a stoke length of 96.28 mm, fin length of 22.74 mm, and fin thickness of 2 mm.The fin utilized in this instance is made of cast iron, which is both a popular and affordable fin material. Cast iron has a melting point of

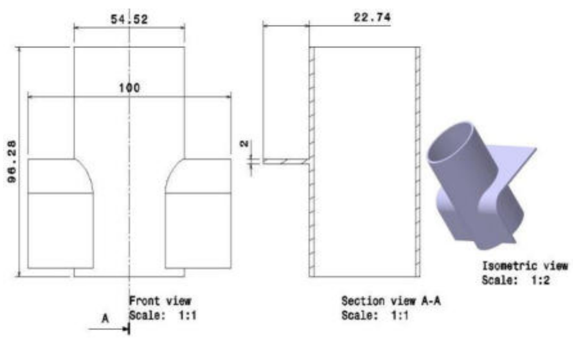
1180°C, a density of 7.5 g/cm2, and thermal conductivity of 46 W/m-k. Due to internal combustion, the engine cylinder reaches a temperature of between 2000 and 2500 °C. In this inquiry, analysis is carried out to determine the temperature distribution for 1000°C, 1500°C, and 2000°C for the different fin shapes. It is presumed that all of the cylinder's components experience heat transfer except for the inner part because



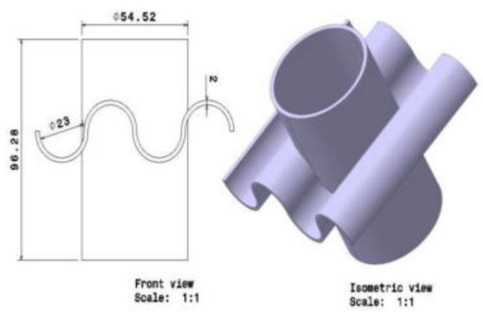
Circular Fin



Rectangular Fin



Curved Fin



Waved Fin

Fig 1:- Models of various fin geometries (All dimensions are in mm)

	CircularFin	RectangularFin	CurvedFin	WavyFin
NODES	654595	705004	702972	842900
ELEMENTS	419870	452820	451746	540985
Orthogonal quality	0.94	0.96	0.95	0.92

Table 1. Mesh Metrics for different cases

RESULTS AND DISCUSSION

A. Comparison of Temperature distribution

The analysis shows that the temperature drop for circular fins at 1000°C is around 22.72°C, rising to 34.3°C at 1500° and 45.9°C at 2000°C. In all fin kinds, a similar tendency was seen. The temperature drop, however, was greater for rectangular fins, measuring 40.66°C, 61.4°C, and 82.2°C, respectively. Similar to curved fins, wavy fins had a more pronounced effect, with temperature drops of 71.32°C, 107.8°C, and 144.2°C, respectively, whereas the temperature drops for curved fins were 47.36°C, 71.6°C, and 95.8°C. The relationship between the temperature reduction in all fin configurations and the inner cylinder temperature was clearly seen. Though it was discovered that wavy fins worked best with temperature dips that were the greatest.

B. Comparison of Total heat flux

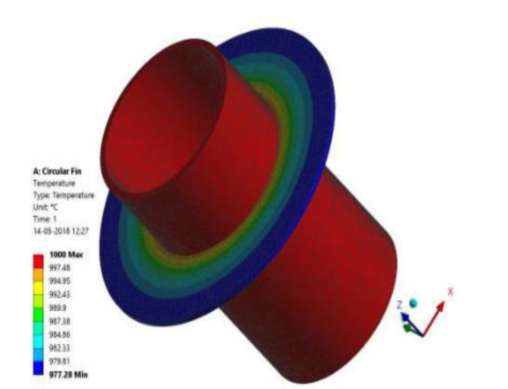
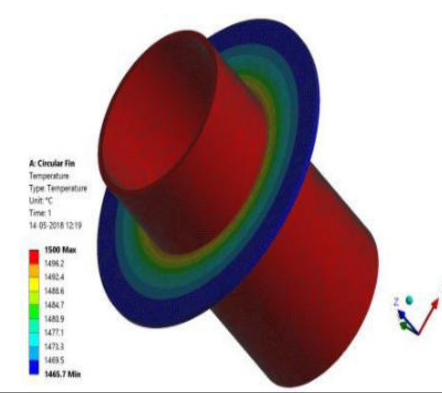
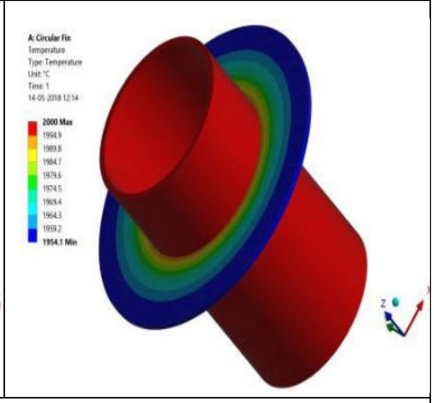
The maximal heat flux is 2.3068 105 W/m2 for circular fins, 2.5564 105 W/m2 for rectangular fins, 2.6072 105 W/m2 for curved fins, and 4.6486 105 W/m2 for wavy fins. As the cylinder's temperature rises, the heat flux also rises. Figure 3 shows that the overall heat flux significantly decreases along the length of the fin, with highest flux near the cylinder and minimum flux.

C. Variation of temperature with length

. The temperature change along the length of the fin is depicted in Fig. 4. For all fin configurations, it can be seen that temperature varies linearly with fin length. The slope of the line representing the wavy fin is maximum, whilst the slope of the line representing the circular fin is minimum. This means that the temperature is lowering more along the length of the wavy fin than along the length of the circular fin. The temperature distribution for both of these fins is essentially same since the slope of the line in every graph showing a rectangular fin and a curved fin is almost identical.

D. Effect of temperature on total heat flux

The relationship between total heat flux and temperature is seen in Fig. 5. The graph clearly shows that the total heat flux changes linearly as the maximum temperature rises. The total heat flux for wavy fins increases significantly as the temperature rises, which is a desirable quality in a fin. Due to the nearly same behavior of rectangular and curved fins, both are almost equally affected by temperature. Circular fins have the least variance in total heat flux as temperature rises.

1000°C	**1500 °C**	**2000 °C**
		
Circular Fin		

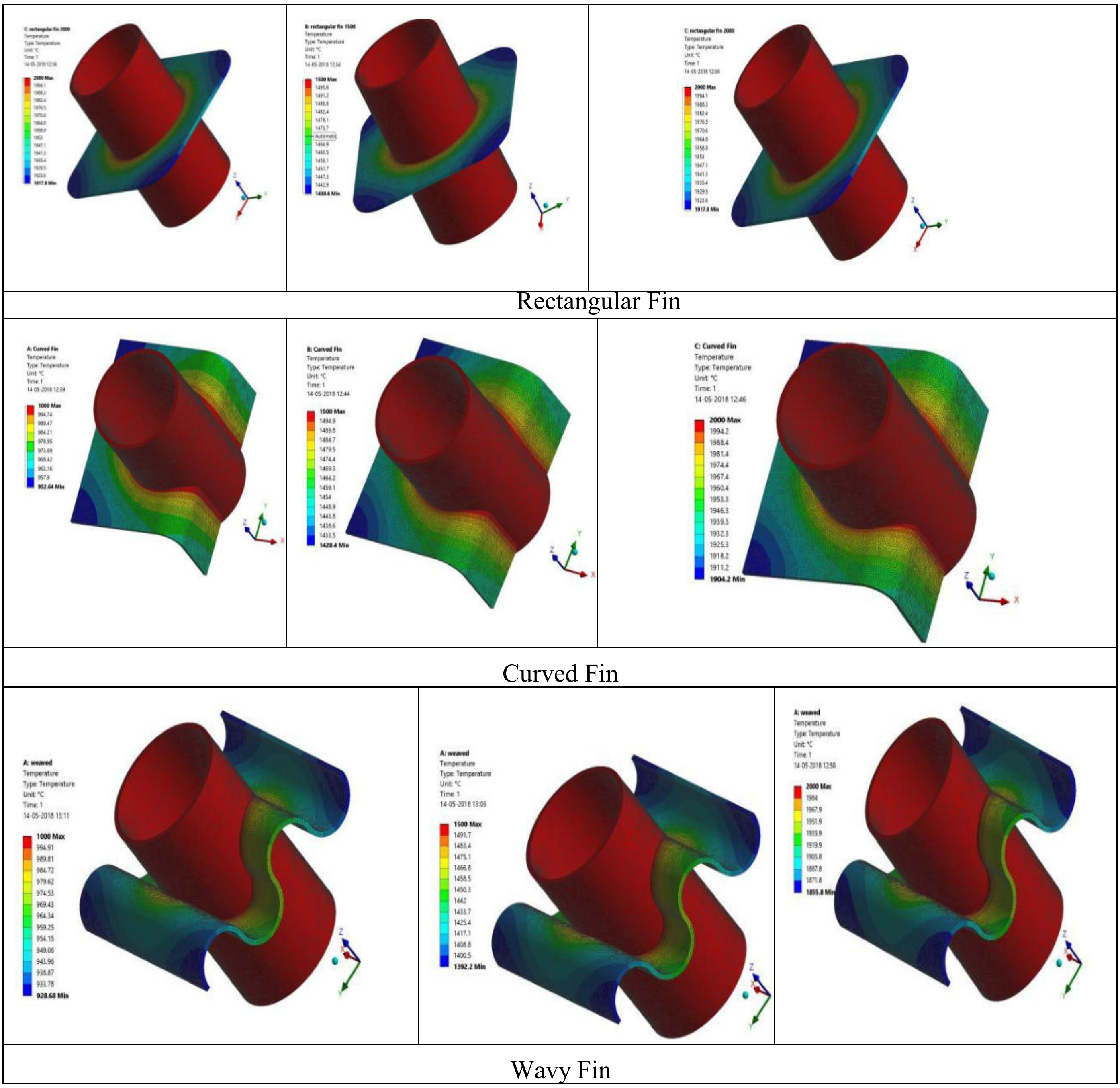


Fig 2:- Comparison of temperature distribution in fin geometries for different temperatures

Circular Fin	Rectangular Fin

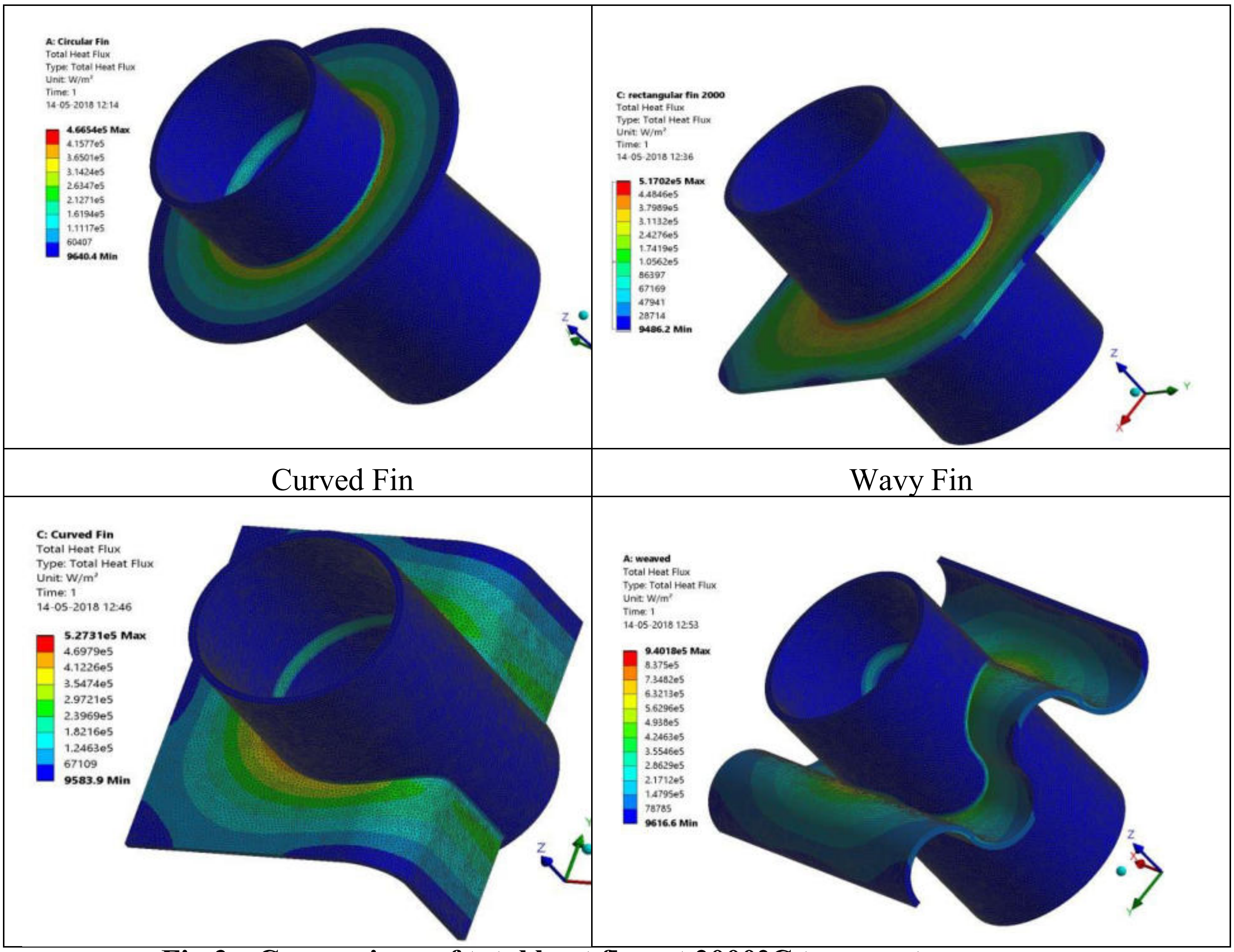


Fig 3:- Comparison of total heat flux at 2000°C temperature inside Cylinder

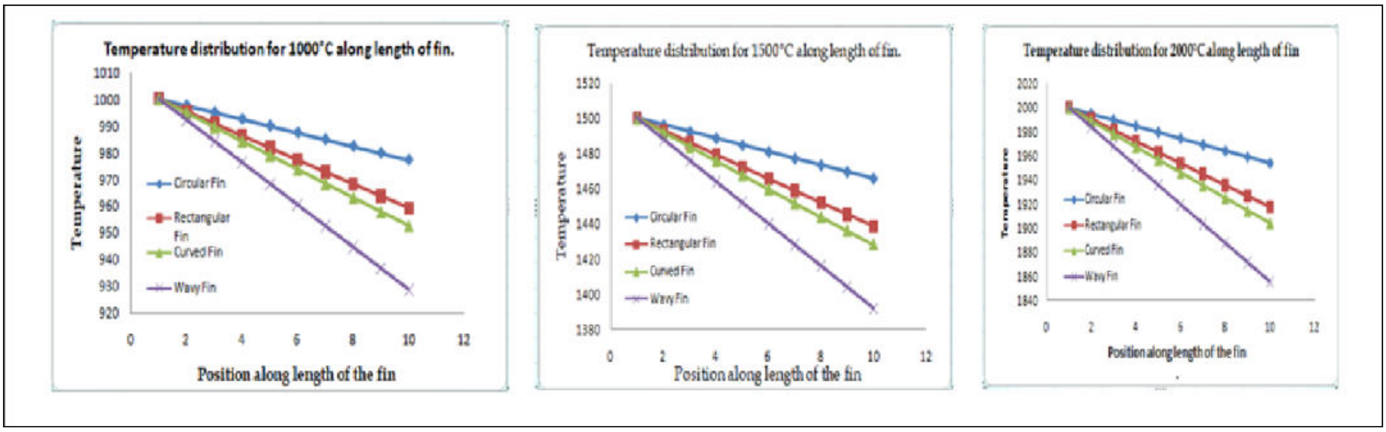


Fig 4:- temperature variation according on the length of the fin

When the maximum temperature inside the cylinder is 285.03°C, Gupta et al. (5) discovered that for rectangular fins without slots, there is a temperature decrease of 19.03°C and with 75mm slots, the temperature drop is of 25.28°C. Al 2014 alloy was the material utilized in the experiment, although in the current work, the temperature drop for rectangular fins with curved edges is significantly greater. Similar findings were reached by Rao et al. (14) for rectangular Al-alloy A204 fins, who found that a fin thickness of 2.5 mm results in a temperature drop of 43°C with circular orientation. A dip of 84.044°C with a maximum temperature of 558°C was observed.

Because of the increased turbulence and convection in the surrounding outside air, the temperature around this sort of greater of a drop for a rectangular fin with curved edges. As a result, it is clear that the curved edges are crucial to enhancing the temperature drop in the fin. In the study by Mehul et al. (7), different fin types, including square, circular, and wavy fins, were subjected to a CFD analysis. Similar findings were made using computational prediction in the current inquiry for the case under investigation. In all cases, it was discovered that heat transport is essentially a function of inner wall temperature at steady state. However, when comparing performance, the wavy fin case fully dominates.

CONCLUSION

From the aforementioned example study 100 cc engine, it is clear that wavy fins outperform alternative fin geometries in all temperature ranges investigated. Similar trends are predicted to persist at greater temperatures. But the wavy fin weighs more than the others, adding to the engine's overall weight. It adjusts for the stress on the engine coolant at the same time by transferring the most heat possible. Both the rectangular and the curved fin exhibit nearly identical traits. More temperature reductions occur in a rectangular fin with curved edges than one without. Despite having the lowest capability for heat transfer, the round fin is favorable due to its reduced weight.

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Design and fabrication of corn peeling and cutter machine

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ABSTRACT

Globally, maize is the most productive seed crop. In the past, the leaf was manually removed or the corn was chopped with a wooden rod to extract the seed. The biggest issue with these machines is that they are beyond of reach for farmers who have smaller farms and don't need such large threshing machines. Additionally, the production rate was lower and the kernels were being destroyed throughout this process. Many Indian farmers cannot afford to utilize these machines, despite the fact that they have straightforward mechanical designs. The sole grain separation performed by the corn de-seeding equipment currently in use in the agricultural sector. However, another equipment is needed to make maize flour, and farmers cannot afford it.Therefore, with these factors in mind, we created a novel concept that combines three operations—seed separation, seed paste, and cob crushing—into a single assembly. There is no requirement for an additional attachment with this notion. Using AutoCAD software, the machine's concept model was created, and the necessary calculations were made.Concept was initially frozen before being transformed into a 3D model using CATIA software.

INTRODUCTION

In India, one of the most significant crops is corn, which is also a major source of many industrial products in addition to being used as food and animal feed. The grain, leaves, main crop stalk, tassel, and cob may all be utilized to make a wide range of food and non-food goods, hence every component of corn has economic worth. Following sickle harvesting and manual cob plucking, the cob is manually de-husked to remove its outer sheath. Additional grain is then obtained by shelling the cob conventionally, which involves smashing the de-husked cobs with sticks, fingers, sickles, etc. This machine was created to solve the issue of removing the cobs' outer coat and dehusking them.The machine primarily consists of a motor (2 HP), collection tray, shelling chamber, and threshing chamber.

These components are arranged in a belt and pulley mechanism. The majority of farmers in India shell corn using one of three methods: beating the corn kernels with a stick, using a hand-operated corn sheller, or shelling the cob by hand. People employ a variety of ways, two of which are discussed below, to remove corn shells and deseed corns with the least amount of damage to the corns.

Manual shelling and threshing

There is a need to move to a mechanical motorized system for maize shelling and threshing because it is currently done manually in many parts of India. Although this approach is traditional, it has low productivity and output.

Mechanical shelling and threshing

Mechanized machinery corn a sheller and thresher produces better outcomes than the traditional manual process of shelling and threshing maize. It generally results in time and financial savings. The usage of inexpensive corn shellers and threshers is preferred for cost-effective operations and to boost output.

Large-scale maize shelling is not supported by conventional procedures, especially when done for profit. Locally, it was noted that the majority of maize shelling was done by hand in Nigeria, where the northern half of the nation produces the most maize. Even with some hand-operated, basic tools, shelling by hand requires a lot of time. The majority of mechanical shellers in the study region, Nasarawa State, were found to be built for multi-grain threshing or shelling, which significantly damages the maize seeds in addition to shattering the cob. The local shellers that were readily available had rotating threshing drums with beaters or teeth that hurt the seed.

Figure 10 Actual fabricated model of corn peeling and cutter machine

LITERATURE SURVEY

The paper gives a brief history of the corn peeling and cutting machine in this part. The phrase Design and Fabrication of Corn Peeling and Cutter Machine calls for a thorough comprehension of scientific principles. As a result, conducting research is required to gather all relevant and available information. The material or literature reviews found are mainly useful for helping to build and specify this senior project. With these foundations in place, the project may move forward with confidence and boldness in order to hit the desired objective.

1. In his study, Mr. Anant J. Ghadi concentrates on various maize dehusking techniques. The corn is grown in many varieties throughout central and southern Mexico, and the Aztecs and Mayans developed methods to prepare or ground it. These procedures helped the crop expand throughout the rest of the planet. In the agricultural sector, the dehusking of maize was traditionally done by hand or with the use of heavy machines. Therefore, techniques are ineffective in emerging nations like India where farmers have little capital to invest. Therefore, there is a need for a creative idea or product that is practical, secure, economical, and fruitful for Indian farmers.
2. Mr. J.N. Nalghare concentrates on a number of sources to raise farmers' net profits. Designing, building, and testing a low-cost maize shelling machine for Nigerian farmers were the goals of the project. These methods involve gathering farmer opinions regarding their Sheller requirements. Due to these communication techniques, they may also identify shelling issues from the appropriate materials they chose and apply theories of failure to calculate the acceptable shear stress on the bearing support. Comparing machine performance to human performance index for shelling, the system found that human mechanical efficiency throughout put capacity and grain handling capacity is 45% in commercial methods. The capacity of handling grain by machines is 86%.
3. The author, Mr. Praveen Kiranthe, discussed the needs and restrictions of Indian farmers. For Indian farmers, the threshing machine has been built in a way that makes it cost- and utility-effective to produce. Both men and women can easily operate the gadget, which was made to mimic a pleasant sitting position. The materials that are readily available locally can be used to build the proposed machine.
4. According to Mr. Anirudha G. Darudkar, a corn sheller is a significant issue with corn production. This essay briefly discusses the design of several corn sheller machine components. It entails the process of designing various components of this shelling machine while taking human forces and ergonomics into account. The major goal of this project is to develop a novel idea for a corn shell that is portable and easier to thresh. We are attempting to create a new idea for a powerful machine.
5. For farmers in rural areas, Dr. C.N. Sakhale concentrates on human-powered machinery. Due to the fact that different PTO-operated machines used in the developing world to thresh maize require continual electricity as an energy source, which is not feasible in India's rural areas. The survey of the system demonstrates its affordability and viability. The pedal-operated, energized flywheel motor has been incorporated into various designs during the past 20 years for rural applications. For turning wood, a process machine powered by human pedals has recently been designed.

EXISTING APPROACH

The main goal of designing and developing a machine, which uses the Pedal, operated energized flywheel motor as an energy source, consisting of a bicycle mechanism, use of non-conventional energy as source Non availability of power in Interior areas and large-scale unemployment of semi-skilled workers led to the development of pedal-powered process machines for wood turning (Modak and Bapat, 1993), washing (Dhakate, 1995), and brick making (Modak and Moghe, 1998). This machine is non-polluting and good to the environment. Agriculture engineering will benefit from innovation and mechanization as a result. Women without skills may also get employment. the creation of an energy source with such great potential for powering numerous rural-based process units in areas with poor electric energy supply.Any manufacturing process that requires more than 75W and can be run sporadically without damaging the final product can likewise be powered by a human being. This idea can serve as the foundation for such a man-powered manufacturing process. A flywheel is employed as a power source in these procedures.

It is practical for a man to employ manpower to energize the flywheel at an energy input rate. After the flywheel has stored the maximum amount of energy feasible, the energy is supplied to a shaft that drives the process unit using an appropriate drive and gearing system (Gupta, 1997). The rate of flywheel deceleration depends on the torque of the load greater the, greater deceleration will result from torque resistance. Therefore, theoretically, this man-flywheel system might overturn a load torque of even infinite magnitude. The aforementioned idea underlies how the pedal-driven maize thresher functions. Farmers in rural areas will benefit greatly from the development of such a machine because it doesn't require traditional electricity. The machine is environmentally friendly.

STATEMENT OF THE PROBLEM

Even with some hand-operated, basic tools, shelling by hand requires a lot of time. The majority of mechanical shellers in the study region, Nasarawa State, were found to be built for multi-grain threshing or shelling, which significantly damages the maize seeds in addition to shattering the cob. The local shellers that were readily available had rotating threshing drums with beaters or teeth that hurt the seed. A low-cost technology had to be developed in order to boost threshing efficiency while minimizing harm to the seed because the price of such shellers was prohibitive for the poor rural farmer.

Problem Formulation

1) Given that corn is a popular food among Indians, particularly in the Maharashtra region, the de-seeding equipment should be developed and manufactured with consideration for the needs and limits of Indian farmers.
2) There are numerous expensive and time-consuming machines and equipment available for de-seeding maize.

3) Different cuisines can be prepared using corn paste; these features can also be designed while machines are being built.
4) Corn powder can also be utilized as cow feed in rural areas, which is beneficial for gradients.
5) Technically, a machine can be designed that will save time, money, and create jobs as a tiny, small business producing a bakery item.

METHODOLOGY

The process is as straightforward as a thrasher. The roller's shear line applies shear force to the seeds. Because of the high speed rotation, the impact of force is very high. The cob's seeds are removed as a result.

The separated seeds are allowed within the cutter casing after the separated cobs have been sent to the cob crusher. Both surgeries were conducted out simultaneously. A device for adjusting the size of the casing in accordance with the size of the cob is located at the top of the shellar drum. On the adjuster casing, various slots are available for adjusting the sheller casing's size.

CONSTRUCTION AND WORKING

Construction

Simple to use, the maize de-seeding machine's construction is built of mild steel angles, bars, and plates to withstand the machine's load. The steel frame that both mechanisms are installed on. On the top of the frame is where the peeling mechanism is located. While the cutter mechanism is located at the frame's bottom. The corn is fed safely into a hopper at the top where it will be peeled. The Sheller shaft and the cutter shaft are positioned on the motor's pulley, which transmits motion from the motor to them through a belt, causing the shaft and cutter to rotate. First, maize can be readily deseeded by manually feeding it through the hopper where the corn grains are separated from the cob. The separated seeds are then chopped into small pieces and combined to create paste.

Following the peeling process, the corn must be appropriately fed into the cutter mechanism. The cob enters the cob cutter area where it is split into little pieces after being stripped of its corn seed. HSS plate strips make up the seed cutter. Sharp-edged strips with these strips being fused to the bush. The bush is fixed to the cutter mechanism's internal shaft. Cob crushers come with two different kinds of blades: moving blades and stable blades.

Working

The rollers begin to rotate as soon as the machine is turned on. The corn is then fed into the hopper. This system is easy as a thresher, for example. the roller that applies shear stress to seeds through its Sheller line. Due to the center roller's high speed rotation, which serves as both the feeding rollers and aids in the peeling of the shell, the impact of force is quite great. Corn is being pushed along parallel spiked rollers.

It results in the separation of the seed from the cob, allowing the seed to be placed within the cutter casing while the separate cobs are sent to the cob crusher. Corn cobs are fed through the feeding hopper while the corn cutter machine is operating. Both operations were conducted out simultaneously. There is a device that regulates the size of the casing in accordance with the size of the cob at the top of the sheller drum. On the adjuster casing, various slots are available for adjusting the sheller casing's size. Corn kernels flow out of the grain discharge exit after falling through the sieve.

Figure 11 CAD Model of corn peeling machine

CONCLUSION

The limits and needs of Indian farmers have been taken into consideration throughout the design and construction of the maize peeling and cutting equipment. The maize peeling and cutting device was put through its paces in the machine shop before being sent to the field. This machine produced 432 kg per hour and performed well in field conditions. Due to its versatility, it can carry out extra tasks. Additionally, it can de-husk corn and deseed a variety of culinary items, including rice, chile powder, potato paste, and potato paste. The teeth and drum can be changed to perform this additional operation.

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Manufacture of Root Harvest Washer

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ABSTRACT

Washing of roots is vital prior to accepting it as food so it will tidy free and synthetic free roots. Pull cleaning machine for cleaning the roots with the goal that they shouldn't hurt person at the hour of having it. By cleaning the roots with new water every one of the destructive synthetics can be isolated from the roots. Washing is a significant essential interaction unit activity, which lessens the surface microbial burden, while eliminating the field soil, residue and, surprisingly, hurtful pesticides, hence prompting the worth expansion of the produce at the homestead level. The computer aided design model of root cleaning machine and every one of its parts was created. In test results we found that this can assist the ranchers with tidying up to 70 kg of root in only 4 to 5 hours.

Keywords: *Roots, water, washing, CAD*

INTRODUCTION

Washing of roots is a not avoidable cycle. There are number of cycles by which root washing should be possible, by showers and splashes or the best by consolidating two cycles. In India the ranchers are involving some conventional technique for cleaning the roots crops. They are involving their hands and legs for cleaning the root crops. This cycle is exceptionally tedious and it required numerous endeavors. Despite the fact that there are numerous choices accessible to supplant this conventional strategy however every rancher can't bear the cost of it. So there is a need of root crop washer which each rancher can bear.

WORKING / FABRICATION

It comprises of a drum made of punctured gentle steel sheet with which the polluted water streams out in the gatherer. A little opening is given on top face of drum from where the yields are stacked/dumped. The steel drum runs with the backing of strong shaft and the strong shaft is turned by chain component. The drum is shut from opposite side so the harvests can't drop from drum while turning and the water is likewise provided from pipe for cleaning the root.

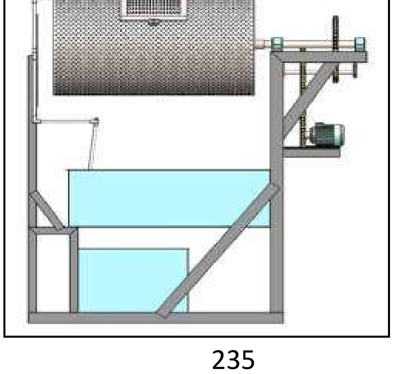

Fig. 1: Cad model of root cleaning machine

I. DESCRIPTION OF PARTS

Drum is made with 0.0787 inch punctured gentle steel sheet. Its width is 11.811 inch and Length is 35.984 inch. Area of sheet utilized is 96 inch. Drum is upheld toward one side with shaft and having the entryway at another end. MS level 0.984x0.118 inch is moved to frame a drum shape. The limit of the drum for containing roots all at once is 5kg to 7kg. The engine is one of the fundamental part of unit and the drum is fueled by 0.5HP or 240V engine and further it is turned with the chain drive system. The shaft moves the movement from engine to little sprocket. Its length is 12.992 inch and distance across of the shaft is 1 inch. The bearing utilized is of number 6201. The chain component is additionally utilized for moving the movement to sprocket for turning the drum. There are 2 little sprocket and 2 major sprocket utilized for moving the movement as displayed. The stand upholds the gathering of root crop washer including water tanks on it, crops present in drum. The progression of water is constant and sprinkled with some tension so it can clean the mud or residue particles appended to crops without any problem. This shaft is fixed among course and the heading are locked fully supported by section. We get the water supply through the water siphon which is kept inside the water repository. One side of the siphon is dunked in repository and opposite side is associated with the drum with the line for water supply. On the opposite side of the drum a high force engine is connected which turns the drum with dependable speed. A 0.5HP electric engine is connected to the frame of the cleaning machine.
Genuine level of the machine is 60 inch. The water for cleaning is provided from the repository with the siphon. The siphon ought to be in supply for giving the water expected in cleaning the roots. The water is furnished to the drum with the straight and elbow pipes. The absolute length of line is 39.64 inch from the siphon to the last end arranged in drum. The siphon is worked with the power it can likewise move water up to 48 inch.

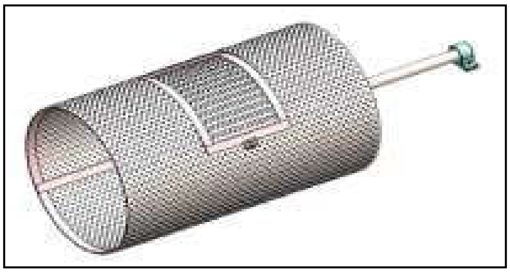

Fig. 2: Cad model of Drum

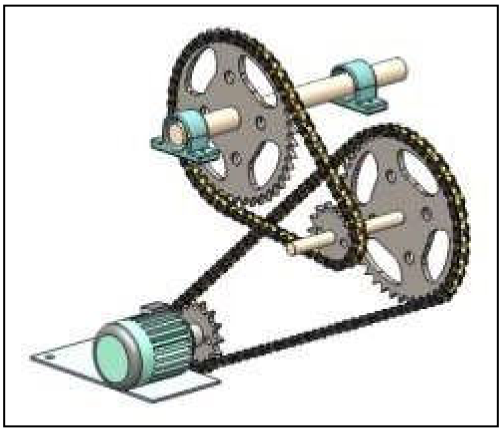

Fig. 3: Cad model of chain Mechanism

II. CONCLUSION

By this venture, Ranchers will be straightforwardly benefitted. In ranches when the roots, for example, potato, carrot, beetroot and so on are eliminated from the dirt, these roots convey a great deal of residue particles and pesticides from the dirt which is hurtful for people whenever taken as food. So to eliminate these ranchers are washing that roots manually and this require some investment. So root cleaner is made with the goal that it will save the time as well as save the human endeavors. This root cleaning machine assists the ranchers with cleaning or to wash the roots appropriately with extremely less time as well as less water.

III. APPLICATION

Root cleaner is used to wash roots especially roots which aregrown underground in soil to remove all dust particles as well as pesticides.

IV. FUTURE SCOPE

- Driving arrangement of the framework can be changed to expand the proficiency.
- By utilizing plan, the limit of the framework can be expanded.
- Supporting casing of the framework can be changed.

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Concentrates On The Precious Stone Development, Optical And Mechanical Properties Of Natural Material: Hexane 1, 6-Diaminium Hexane-1, 6-Diyl Bis

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ABSTRACT

Hexane 1,6-diaminium Hexane-1,6-diyl bis (Hydrogen Phosphonate) (HDHD) was incorporated and single gems were developed by sluggish dissipation method. Glasslike flawlessness was interperated from HRXRD examination. UV-Apparent conveyance was performed to appraise the conveyance rate; its bandgap energy was acquired. Laser incited harm edge study was performed on the developed precious stone. Third request nonlinear optical boundaries of HDHD precious stone were assessed by Z-check test. The Mechanical hardness of the developed precious stone was examined by Vicker's hardness technique and hardness boundaries were assessed.

IndexTerms - Nonlinear optics; Crystal growth; Optical property; Laser damage threshold; Mechanical strength

INTRODUCTION

concentrated research has been completed on natural nonlinear optical materials because of their striking optical gadget applications like optical switches, optical modulators, optical interchanges, optical information stockpiling and so on. While many exploration bunches have quickly incited to search for promising materials which offers bigger and quicker optical nonlinearities contrasted with their inorganic partners [1-3]. Materials containing organophosphonate anions and natural cations are greatly worried in the field of supramolecular science and gem designing. Strong fascination have been displayed on the planning of amino subordinate

mixtures and among the investigated crossover intensifies natural phosphates framed because of the response between inorganic oxy acids (H3PO3), (H3PO4) and natural amines, while natural mono, di and trihydrogen phosphate based materials are proficient to have various applications in the fields of biomolecular sciences, catalysis, fluid gem improvement, ferroelectrics, non-straight optics [4-7]. Guido et al announced the construction of HDHD [8]. Be that as it may, this paper reports interestingly the development of natural single precious stone of Hexane 1,6-diaminium Hexane-1,6-diyl bis (Hydrogen Phosphonate) and thus the developed gem was portrayed by single gem XRD. Optical, Laser actuated and Mechanical portrayal studies were performed on the developed material. .

I. EXPERIMENTAL

2.1 Synthesis and Crystal growth

For the preparation of the title compound, equimolar quantities of Hexane-1, 6-diamine and

Hexane- 1, 6-bisphosphonic acid were dissolved in methanol, separately. The two solutions were amalgamated and stirred well for three hours in double distilled water to get homogeneous saturated solution. Then the prepared saturated solution was filtered, covered with a perforated cover and finally was kept in constant temperature bath for evaporation process. Within several days, transparent crystals with dimension 1.9 x 1.2 x 2 mm3were obtained by slow evaporation of the solvent. The synthesis scheme and photograph of grown crystal is shown in fig. 1 and 2.

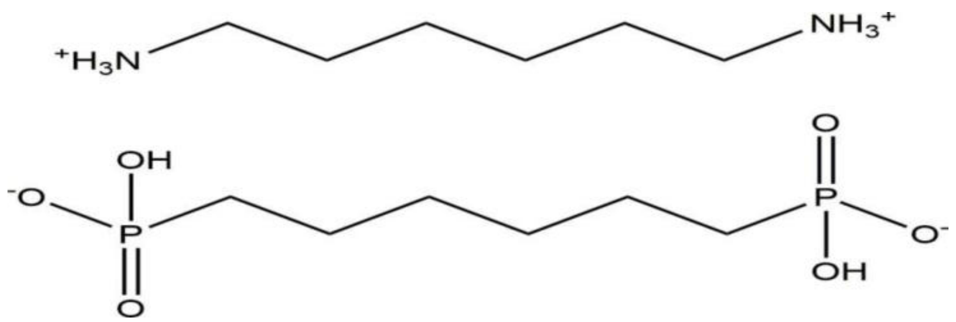


Figure 1. Synthesis scheme of HDHD

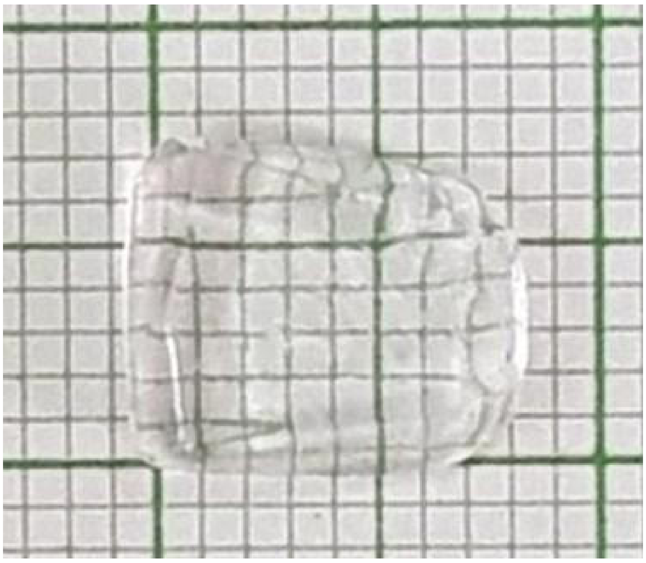


Figure 2.Photograph of as-grown HDHD crystal

II. RESULTS AND DISCUSSION
3.2 Single Crystal XRD

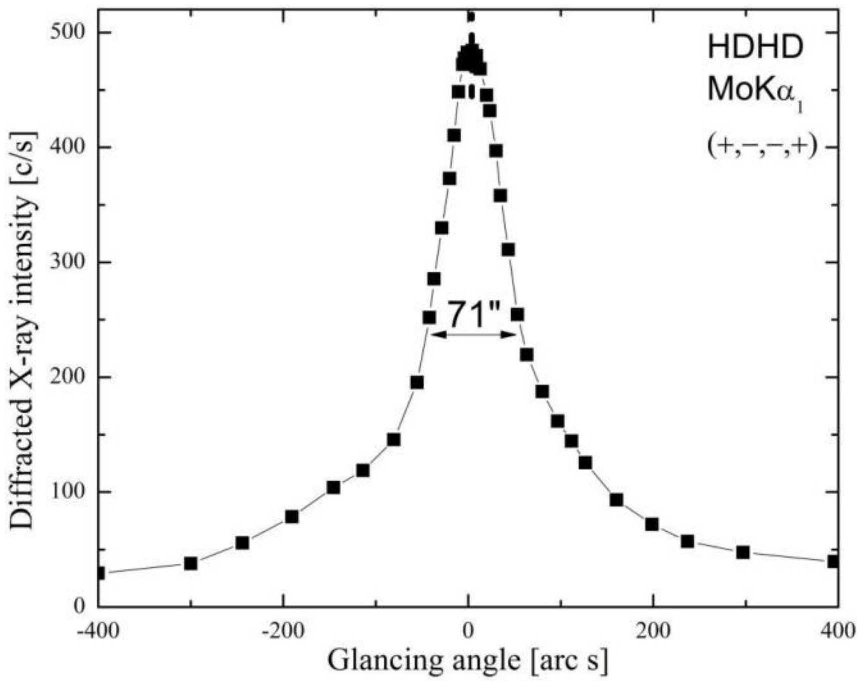
Single crystal X-ray diffraction study was used to obtain the accurate cell parameters of the grown Hexane 1, 6- diaminium Hexane-1, 6-diyl bis (Hydrogen Phosphonate) (HDHD) crystal. The grown crystal belongs to monoclinic system with centrosymmetric space group $P2_1/c$. The estimated cell parameter values are a = 5.849 (9) Å, b = 20.208 (5) Å, c = 7.768 (3) Å, $\alpha = \gamma$ = 90°, β = 97.09° and V = 918.15 (2) $Å^3$ and are close agreement with the reported data.

High Resolution XRD studies

High goal X-beam diffraction bend was recorded involving MoKα1 radiation for a normal HDHD single precious stone example as displayed in Fig.3. On close perception, one can understand that the bend is single pinnacle. The FWHM (full width at half limit) of the fundamental pinnacle is 71 curve s. The somewhat low upsides of FWHM of the grains in correlation with that of the genuine precious stones portrays that the translucent flawlessness is genuinely great [9]. It very well might be referenced that such low point limits could be

identified in the diffraction bend simply because of the great goal of the diffractometer utilized in the current examination.

Figure 3. HRXRD Spectrum of HDHD

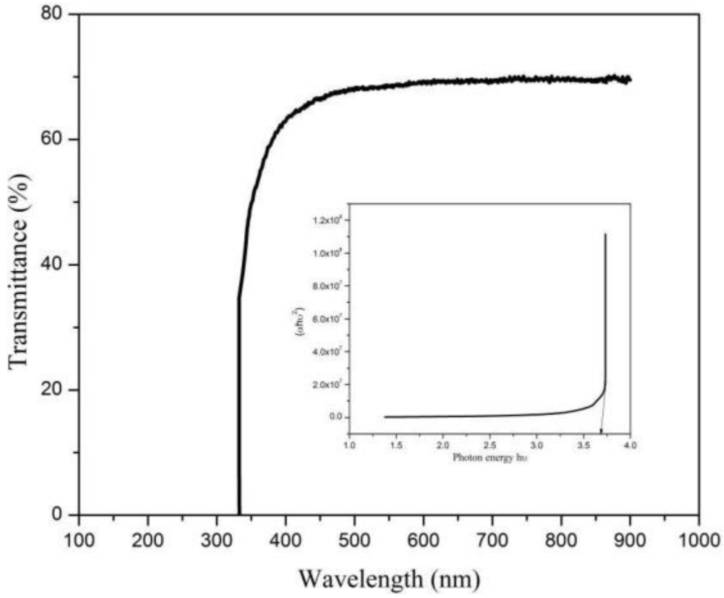


UV Vis Transmittance

UV-Apparent phantom examinations are useful in the examination of NLO materials to find NLO reaction and spectroscopic absorbance in the fitting frequency range. Bright noticeable conveyance studies was performed on the 2mm thick HDHD precious stone example and the range recorded is in the frequency range 190-900 nm as displayed in Figure 4. The lower cut-off frequency was viewed as 332 nm and the material was straightforward up to

70%. Optical band hole was determined by drawing a plot among $(\alpha h\upsilon)2$ and $h\nu$ [10] as displayed in Fig.4 (Inset) and the got bandgap was viewed as 3.70 eV. The wide band hole of the HDHD gem affirmed the huge conveyance and less imperfection focus in the developed material [11].

Fig.4 Uv-Visible transmission spectrum of HDHD; (Inset) Bandgap energy of HDHD crystal



Laser Damage Threshold

Nonlinear optical materials should tolerate high laser intensity which possesses its suitability in laser application. Laser damage threshold measurement was carried out for HDHD crystal by using Nd:YAG laser system, which delivered laser pulses at1064 nm with pulse width 6 ns and repetition rate 10 Hz. The surface LID threshold of HDHD crystal was calculated using the relation,

$$P\ (d) = E/\tau A \qquad \text{Eq. 1}$$

where E is the intensity of the irradiant laser beam (mJ), τ is the pulse width (6 ns) and A is the area of the circular spot size (cm^2). For HDHD crystal, the multiple shot laser damage threshold energy density obtained from the Q-switched Nd:YAG laser was found to be 3.68 GW/cm^2 compared to KDP reference crystal (0.20 GW/cm^2).

Third-Order Nonlinear Optical Studies

Third request nonlinear optical properties not entirely settled by using Z-examine strategy which is considered as key portrayal concerning both open gap for nonlinear ingestion (NLA) and shut gap for nonlinear refraction (NLR). Concerning the optical materials, open and shut gap Z-check techniques have its abrasive highlights [12,13].

In the Z-filter estimation, the 632.8 nm monochromatic laser light with force of 20 mW bar from He-Ne laser was utilized to quantify the third-request nonlinear optical boundaries. Optically cleaned 1 mm thickness of HDHD single gem was utilized for this estimation. The conveyance change between the pinnacle and valley in Z-examine is ΔTp-v = Tp - television where Tp and television are the standardized pinnacle and valley conveyances as portrayed in Figure 5(b). From the Z-filter information, the contrast between the pinnacle and valley conveyances (ΔTp-v) can be determined utilizing the connection,

$$\Delta T_{p\text{-}v} = 0.406\ (1 - S)^{0.25}\ |\Delta\phi_0|$$

where $\Delta\phi_0 = 2\pi/\lambda\ n_2\ I_o L_{eff}$

$L_{eff} = (1-e^{-\alpha L})/\alpha$, and $S = 1 - \exp((-2\, r_a^2) / (\omega_a^2))$, is the transmittance of the hole in the absence of a sample. $\Delta\Phi_0$ is the on-axisphase shift at the focus and I_0 is the intensity of the laser beam at the focus (Z=0) respectively. The sign of $\Delta\Phi_0$ and n_2 was determined from the relative positions of the peak and valley with Z as shown in Figure 5 (a). If the induced optical path length changes due to the nonlinearity, then for an aperture transmittance, use of S = 0.9 is a good compromise having a large signal which averages the possible beam non-uniformities, thus reducing the background signals and loss of sensitivity.

Closed aperture for NLR (n_2)

To find out the amplitude of phase shift, the transmittance change through small aperture at the far field position is monitored incisively. From the obtained closed aperture Z scan data, nonlinear refractive index (n_2) is estimated.

$$n_2 = \Delta\phi_0 / (k\, I_o L_{eff})$$

where k is the wave number ($k=2\pi/\lambda$). From the Figure 5(b), the pre-focal transmittance peak is followed by post-focal valleys which clearly indicates the negative nonlinearity for the grown material.

Open aperture for NLA (β)

Intensity dependent absorption of the sample can be assessed by moving the sample through the focus and without placing an opening at the detector. From the obtained open aperture Z scan data, nonlinear absorption coefficient (β) is estimated, and Figure.5 (a) indicates the two photon absorption,

$$\beta = (2\sqrt{2}\,\Delta T) / (I_o L_{eff})4$$

where ΔT is the difference between the normalized transmittance at Z = 0 and $Z \to \infty$ of the open aperture Z-scan. I_0 isthe radiation intensity at the focal point, which is 3.12 W/cm^2. From the experimental data, nonlinear absorption coefficient (β) value of the sample was calculated as 7.614×10^{-3} cm/W. Then, the effective third-order NLO refractive index (n_2) of grown crystal was found to be $3.76 \times 10^{-7}\ cm^2/W$.

Real and Imaginary parts of 'χ³'

The real and imaginary parts of the third order nonlinear susceptibility (χ^3) were estimated using the relations,

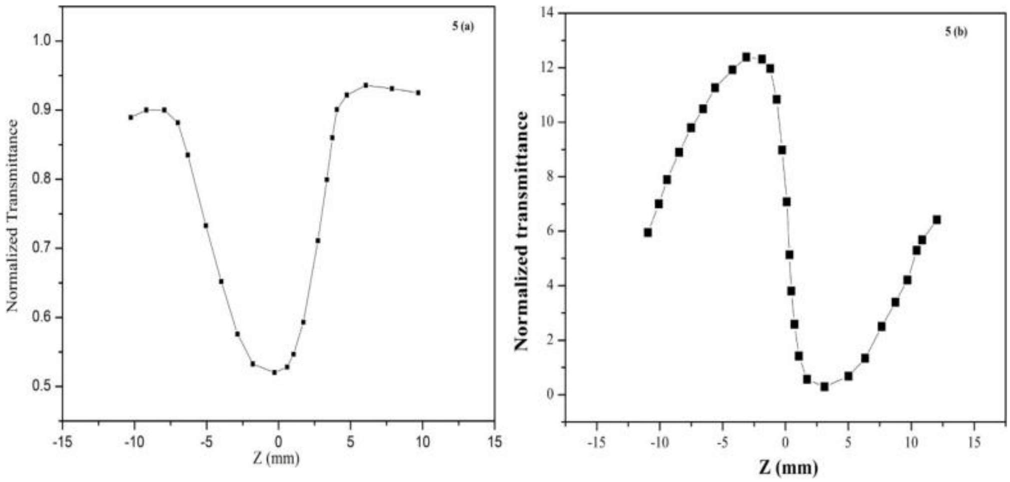
$$Re\,\chi^3 = (10^{-4})\,(\varepsilon_o c^2 n^2 n) / \pi \text{ esu} \quad \text{Eq. 5} \quad Im\,\chi^3 = (10^{-2})\,(\varepsilon_o c^2 n^2 . \lambda\beta) / (4\pi^2) \text{ esu} \quad \text{Eq. 6}$$

where ε_0 is the vacuum permittivity, n_o is the linear refractive index of the sample and c is the velocity of light in vacuum. Thus, the accurate value of χ^3 can be easily obtained from the following relation,

$$\chi^3 = \sqrt{((Re\,\chi^3)^2 + (Im\,\chi^3)^2)} \text{ esu} \qquad \text{Eq. 7}$$

The third order susceptibility (χ^3) of HDHD was found to be 2.837×10^{-6}esu. The Z-scan measurement revealed that the grownHDHD crystal exhibits third order nonlinear optical property.

Fig.5 Z-scan plots of HDHD crystal in (a) Open aperture mode (b) Closed aperture mode



Mechanical Study

The construction and nature of holding of the glasslike solids have effect on their mechanical hardness. Hardness of a material is impacted by different boundaries like cross section energy, Debye temperature, intensity of development and interplanar dividing and pressing component. The smooth and level surface of precious stone was oppressed for space test utilizing Leitz-Wetzlar hardness analyzer

fitted with a precious stone indenter and the estimations were made at room temperature. The heap (P) of various sizes 25, 50, 75 and 100 g were applied.TheVicker'smicrohardness number (Hv) was determined utilizing the connection,

$$H_v = 1.8544P/d^2 \quad kg/mm^2 \quad \text{Eq. 8}$$

where P is the applied load in g, d is the diagonal length of the indentation impression in mm and H_v is hardness number in kg/mm^2. The plot of Vicker's hardness number (H_v) against various loads is shown in Figure 6 (a). The Meyer's index number was calculated from the Meyer's law, which relates the load and indentation size.

$$P = k_1 d^n \quad \text{Eq. 9}$$

where k_1 is the standard hardness constant and n is the work-hardening coefficient. A plot of log P with log d was drawn (Figure 6 (b)) and it is in good agreement with Meyer's law.

The value of 'n' from the slope of the graph is found to be 2.15. According to Onitsch [14] and Hanneman [15], 'n' should lie between 1 and 1.6 for comparatively hard materials, whereas it is above 1.6 for softer ones. Thus, the grown HDHD crystal belongs to the category of soft materials. Hays and Kendall's [16] theory of resistance pressure was used find the relationship between indentation test load (P) and indentation size (d) of HDHD by the relation,

$$P - W = k_2 d^2 \quad \text{Eq. 10}$$

Where W is the Newtonian resultant pressure, which represents the minimum load (P) that causes an indentation and k_2 is another constant. Using the equations, the Newtonian resultant pressure W was calculated,

$$W = k_1 d^n - k_2 d^2 \quad \text{Eq.11}$$

The elastic-stiffness constant (C_{11}) was calculated using Wooster's

empirical formula [17].

$$C_{11} = (H_v)^{7/4} \quad \text{Eq.12}$$

This gives information about the bonding stiffness with neighbouring atoms in HDHD crystal. From the hardness value, the yieldstrength (| |$_v$) of HDHD material was calculated using the relation [18].

The calculated Hardness value (H_v), Meyer's index, elastic stiffness constant (C_{11}) and yield strength (| |$_v$) are given in Table 1.

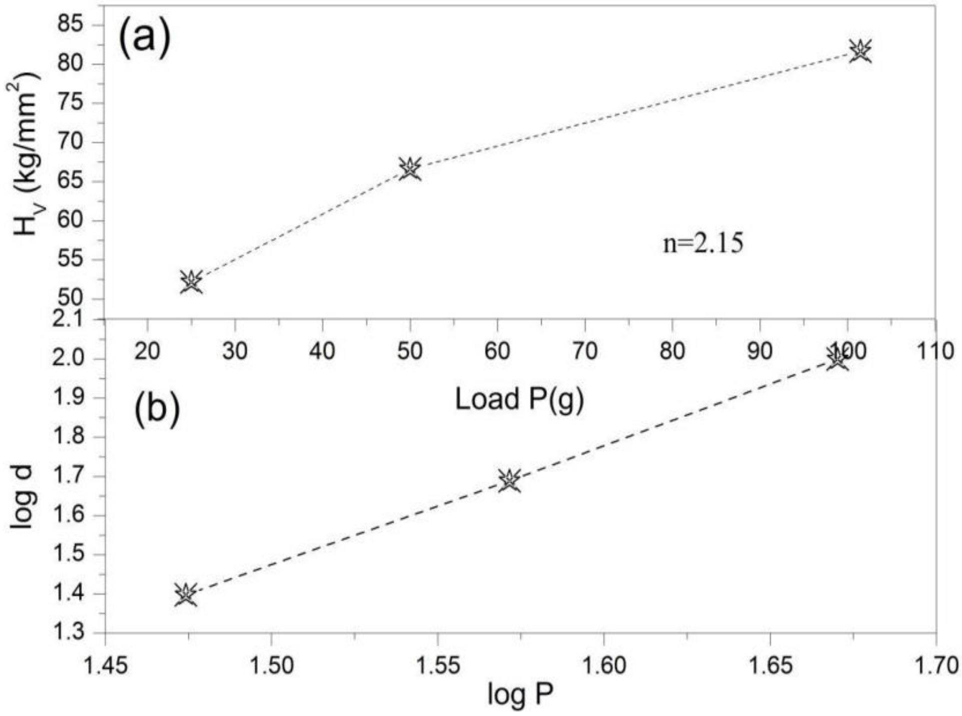


Fig. 6 (a) Plot of Hardness number (H_v) Vs. Load P of HDHD crystal (b) log P Vs. log d of HDHD crystal

Table 1: Hardness parameters of HDHD by using Vicker's hardness test

Load(g)	**H_v (kg.mm^{-2})**	**Meyers index(n)**	**C11 (GPa)**	**$\mid\,\mid_v$ (GPa)**
10	88.99	2.15	1.12	0.210
25	98.76	2.15	2.40	0.318
50	109.05	2.15	3.99	0.389
100	93.50	2.15	1.56	0.305

CONCLUSION

Single precious stone of HDHD was effectively developed by the sluggish dissipation arrangement development technique. The developed precious stone has been affirmed by utilizing single gem X-beam diffraction investigations and discovered that it has a place with the monoclinic framework with space bunch P21/C. The glasslike flawlessness was inspected from HRXRD. The cut-off frequency of HDHD from the conveyance otherworldly examination was viewed as 332 nm and the relative bandgap was acquired at 3.70 eV. Laser instigated harm edge esteem (3.68 GW/cm2) of the HDHD precious stone was assessed. Third-request nonlinear refractive record (n2 = 3.76 x 10-7 cm2/W), nonlinear retention coefficient (β = 7.614 x 10-3 cm/W) and third-request nonlinear optical defenselessness (χ3 = 2.837 x 10-6esu) were assessed by Z-check estimation. Mechanical hardness boundaries of the developed HDHD precious stone were assessed.

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Improvement in Material Dealing with in the Concrete Business: A Case Study

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ABSTRACT

Concrete industry is a significant job for fast development and advancement of the development exercises. To give higher creation and gainful to organization earnings and wellbeing and security program led (nobody can hurt during the concrete creation activity).The reason for this undertaking to legitimate treatment of materials with no aggravations and injury. Wellbeing and more secure work rehearses, to appropriate control the material dealing with process. At the point when unrefined substance is move starting with one spot then onto the next place during the transportation cycle in the concrete business exercises. To limit the gamble and improvement in material taking care of cycle by utilizing risk evaluation techniques, legitimate record keeping will likewise kept up with to generally creation. Five stage to direct gamble with appraisal to appropriate control the treatment of materials and legitimate security, safe work practices of materials. Following are moves toward lead to generally creation process. Take a gander at the dangers, distinguishing proof of perils, legitimate examination, assessment of risks, appropriate assessment of chance to legitimate treatment of material and to limit the dangers, recordkeeping will likewise kept up with, appropriate documentation is important to command over all material giving cycle, idea in regards to legitimate execution and to expand the productivity of creation stages and furthermore give wellbeing control measures to give safe work taking care of practices by utilizing five essential strides of hazard evaluation methodology to limit the gamble and improvement in material dealing with process.

Key words: *Safety, Material Handling, Risk Assessment, Safety in Manufacturing, Safety Management*

INTRODUCTION

From limestone stacking (mining industry) to dispatch of concrete. Different perils and hazard occur by unfortunate treatment of materials and supplies. During the transportation cycle, heedlessly to treatment of material they make tremendous issues influences human wellbeing and to diminish the efficiency. Transportation of materials starting with one spot then onto the next spot to legitimate gear control and everyday safe work rehearses gainful for modern reason.

A. Aim of project –

1) Eliminating or reducing handling
2) Improvement the efficiency of handling
3) Make the correct choice of material handlingequipments.

B. Process

Major operation are carried in the cement plant:-

1) Crushing of raw materials
2) Storage section and proper blending of raw materials
3) Raw mix preparation
4) Grinding of raw materials and proper homogenizationprocess.
5) Material pyro- processing
6) Cooling and storage of clinker activities
7) Grinding with clinker, gypsum and fly ash
8) Storage and packing of cement

C. Factors affecting material handling equipments are asfollows:

1) Problem of production activities.
2) Human activities and human element involved
3) Capabilities of handling equipments

D. Various types of material handling equipments:

1) Conveyors (transferring of materials)
2) Cranes, elevators and hoisting (loading of materials)
3) Industrial trucks (material transportation system)
4) Auxiliary equipments

E. Control Performance the production activities to increase the

1) Movement
2) Quantity
3) Time
4) Control

F. Advantage of good flow pattern:

1) Production efficiency increases.
2) Better utilization of floor space.
3) Handling activities simplification way.
4) Better equipment utilized.
5) Process time should be reduced.
6) Process inventory should be reduced.
7) Efficient utilization of work space.
8) Product damage should be reduce.
9) Walking distance should be reduced.
10) Minimize accident hazards.
11) Efficient layout maintain.
12) Proper and faster supervision required.
13) Production flow be smooth.
14) Better housekeeping.
15) Legal requirements from the company taking action.
16) Improving scheduling procedure.
17) Logical work sequencing activities performed.

G. Hazard faced in transportation of materials

1) Untrained drivers- Drivers are not properly trained theyare carelessly in driving position.
2) Inadequate brakes- Lack of maintenance possibility.

3) Rough access roads- Levelling of road is not proper.
4) Lack of visibility- Lack of all-around visibility from thedriving position.
5) Exposure to dust- when transferring of material from oneplace to another place.
6) Material handling equipment failure- during the transportation process material handling tools andequipments failure.
7) Unsuitability- unsuitable loading of material.

H. Hazard faced in material storage and material transportation system

1) Transportation problems- carelessly from vehicle driving position.
2) Unclean platforms- To do work in presence of unclean surfaces high risk should be created by poor handling ofraw material.
3) Exposure to dust- Transferring of material as well as storage of material excessive dust create major problem.
4) Poor supervision required- Travelling over and under thetransportation system without any supervision passages

I. Methods

1) Look at the hazards
2) Risk identification
3) Consequence analysis
4) Estimation
5) Evaluation
6) Record and finding

By poor handling of raw materials various types ofrisk as follows cause major and minor accidental problem

Likelihood	High	Risk Medium
Consequence	Low	
Likelihood	Low	Risk Medium
Consequence	High	
Likelihood	High	Risk High
Consequence	High	

.Five steps to conduct risk assessment on the basis of materialhandling.

1) List the work task

a) Location
b) People
c) Work activity
d) Equipments

2) Identify the risk

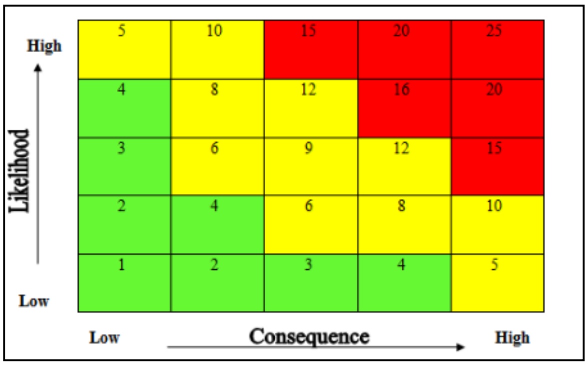
a) What are the hazards?
b) Who might be harmed?
c) How might they be harmed?

3) Estimate the risk

a) How likely is that something go wrong? (possibilityof risk)
b) Which type of serious outcome be? Risk= Likelihood × Consequence

Elimination
Substitution
Isolation

4) Evaluation process of the risk



1-4 Low risk (It is acceptable acceptable) 5-14 Medium risk (tolerable for little work)
15-25 High risk (Take immediate action required)

5) Record and findings

a) Location, activity and equipment
b) Being assessed
c) Hazard and risk levels by proper evaluation
d) Risk controls
e) Assessor details
f) Date and time
g) Review date

Record is very beneficial for our future course of action. Companies past record to proper maintain to overall production process. To see the past record data such as safe and unsafe acts, accidental problems etc. In present some newtechniques to improve past records.

Control Measures J.

1) Safety precautions
2) Standard operating procedure maintained
3) Personal protective equipments
4) Full body harness maintain
5) Legal requirements
6) Records and findings

LITERATURE REVIEW

Witt, Clyde makes sense of that protected work rehearses for appropriate controls instruments and supplies. Transportation of materials starting with one spot then onto the next place be protected and dependable.
Gould, Les makes sense of that in concrete assembling process different occur while poor working condition and dangerous demonstrations handle in working condition make wellbeing related issue and furthermore to diminish the efficiency.

Kulweic Beam makes sense of that for oversee different wellbeing safeguards, security control measures, legitimate prerequisites and appropriate documentation process is important to give reasonable result.
Hussain, I., makes sense of that for limit the gamble and improvement in material taking care of cycle by utilizing PPE, organization controls, designing, disengagement, replacement and end. Tichon, J., makes sense of that usage of best assets, legitimate arranging is important to control the exercises, use of better types of gear to control the material taking care of in concrete industry, better housekeeping to appropriate control the material dealing with process.
Paquet, v., punnett makes sense of that risk evaluation based on material dealing with system, for example,
recognizable proof, assessment and legitimate assessment and documentation process figured out how to give work rehearses in working state of devices and types of gear.

RESULT

Suggestions regarding to provide safety control measures, safety precautions, to maintain documentation process.
Suggestion regarding proper review is necessary from time totime to proper control the production process.

CONCLUSION

In concrete industry treatment of materials ought to be reasonable way to limit the gamble and execution of concrete assembling process. Appropriate treatment of devices and types of gear and apply wellbeing control measures to legitimate control the treatment of material and furthermore give best safe practices to expand the efficiency.

FUTURE SCOPE

The administration to take on accepted procedures to eliminate the misuse of the general interaction. Appropriate upkeep is expected to expand the efficiency and give safe work practices to treatment of materials.

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Sunlight based Dryer with Discontinuous Toppler

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ABSTRACT

The unusual ascent and regular shortage of petroleum product sped up the consistent quest for an elective power source. Sun oriented is one of the inexhaustible and supportable wellsprings of force that pulled in a huge local area of specialists from everywhere the world. This is generally because of its bountiful in both immediate and aberrant structure. As such the advancement of effective and economical hardware for the drying of farming and marine items utilizing sun-based power developed in this way working on the nature of the items as well as working on the personal satisfaction. The utilization of sun-based dryers in the drying of agrarian items can essentially decrease or dispose of item wastage, food contamination and at the at some point improve efficiency of the ranchers towards better income determined. A sun-oriented crop drying framework doesn't exclusively rely upon sun powered energy to work; it consolidates fuel igniting with the energy of the sun, in this manner lessening petroleum derivative utilization. In this paper a survey of the sunlight-based dryer is introduced. The different plan of the sun-oriented dryer is accounted for in the writing hitherto is introduced.

Keywords: *Solar Dryer, Gear Box Shaft*

INTRODUCTION

A. Sunlight based drying is by and by since the time im-critical for conservation of food and farming yields. This was done especially by open sun drying under open the sky. This cycle has a few inconveniences like decay of item because of unfavorable climatic condition like downpour, wind, wet, and residue, loss of material because of birds and creatures, crumbling of the material by disintegration, bugs and parasite development. Additionally, the cycle is exceptionally work serious, tedious and requires enormous region. With social and modern advancement fake mechanical drying came in to rehearse. This cycle is profoundly energy concentrated and costly which at last increments item cost. Hence sun-oriented drying is the best option as an answer of the relative multitude of downsides of regular drying and counterfeit mechanical drying.

B. Sunlight based dryers utilized in agribusiness for food and harvest drying, for modern drying process, dryers can be ended up being most helpful gadget according to energy preservation perspective. It saves energy as well as save part of time, involving less region, works on nature of the item, make the interaction more productive and safeguards climate too. Sun powered dryers bypass a portion of the significant detriments of traditional drying. Sun powered drying can be utilized for the whole drying process or for enhancing counterfeit drying frameworks, in this manner decreasing the aggregate sum of fuel energy required.

C. Problem Statement:

D. Traditional dyer framework in direct passing on just has a container that contains the seeds or material to be dried, where in the material is dried in a range of eight hours, irregular checking will be need to notice the quality or keep the seeds from consuming. Consequently labor supply required is more, efficiency is low subsequently another sort of framework for sun powered drying is required.

E. Objectives:

1) Better Quality of Products can be maintained.
2) It Reduces Losses and Better market price to the products.
3) Products are protected against flies, rain and dust; product can be left in the dryer overcome in rain, hence solar dryer are waterproof.
4) Prevent fuel dependence and Reduces the environmentalimpact
5) It is more efficient and cheap.

F. Methodology:

- Study of various configuration micro wind turbine usingvarious Handbooks, United State Patent documents, Technical papers, etc.
- Literature gap
- Problem statement
- Solution
- Working
- Design and Calculation
- Result
- Conclusion

G. Scope:

Arrangement should be provided to expand the scope of workin future. Such as to convert the machine motor operated; thesystem can be easily configured to required one. The die & punch can be changed if required for other shapes of notchesetc.

LITERATURE REVIEW

In this section, a detail survey of writing on the improvements in the space of bridling sun-based energy for application like sun powered food dryer is introduced. The current review has been completed for plan and created of the Emptied Cylinder Sunlight based Grape Dryer framework, work done in the space of sun powered food drying predominantly centered around grape drying by specialists have been entirely audited with respect to approaches utilized and devices and procedures utilized. The push of the continuous examination and constraints of existing methodologies are featured. The survey of writing has been classified as follows:

1) Design and advancements of level plate sun-based dryer with normal and constrained convection heat move.
2) Design and advancements of Cleared Cylinder Sun based Gatherer for food drying and water/air warming applications.
3) Pre-treatment used to further develop the water penetrability, to build Drying Rate.
4) Drying energy investigation of the great dampness content food item like grape to anticipate numerically the drying peculiarity.
5) Mathematical displaying of Emptied Cylinder Sun based Gatherer.

CONSTRUCTION

The mechanism of the auto side stand comprises of thefollowing parts:

A. Motor:

Motor is a 12 volt DC motor, with following specification:Voltage: 12 Volt DC
Speed = 800 rpm Mounting: Foot mounted

CALCULATIONS

A. Design of Worm and Worm Wheel (Worm Gear Box)

The pair of worm and worm wheel used in the machine isdesignated as 1/55/10/1
The worm is made of case hardened steel 14C6 whereas theworm wheel is made of Cast iron.
Z1 = 1
Z2 = 55
q= 10M=1
I = z2/z1 =55N = 800 rpm
N2 = 800/55 =14.5 rpm D2 = m x z2 =1 x55 =55
tanU =z1/q = 5.71 ^{0}
F = 2m sq.rt (q+ 1) = 9.94Da1 = m(q+2) =12
C= 0.2mcosU = 0.3
Lr ={ da1+2c} sin-1[F/(da1+2c)]Lr = 632
For case hardened steel Sb =28.2For BRASS, Sb =6.2
Xb1 = 0.25
Xb2 =0.48
Mt1 = 17.65 Xb1 Sb1m lr d2 cosU

= 4.694 x 10^6N-mm
Mt2 = 17.65 Xb2 Sb2m lr d2 cosU

= 1.98 x 10^6 N-mm
The lower value of torque is on the wheel = 1.98 x 10^6 N-mmKw = 2Π n2 Mt/60 x 10^6
Kw =7.46 Kw
As the drive is capable of transmitting 7.46 Kw and we intendto transmit 0.08Kw the drive is safe.

B. Design of Gear Box Shaft

DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm^2	YEILD STRENGTH N/mm^2
EN 24	800	680

MATERIAL SELECTION: -Ref: - PSG (1.10 & 1.12) +(1.17)

C. Working

1) Contents to be dryed are placed in the box
2) Protective glass lid is closed
3) Gear box is started using motor
4) Stirrer shaft is moved by the gear box.
5) Mixing will churn the content and expose the new layerto drying.

D. Advantages and Disadvantages

1) Advantages

1) Solar energy is used that reduces cost of energy.
2) No fossil fuel is used.
3) Less cost
4) Low infrastructure cost

2) Disadvantages

1) Depends on solar power…not useful in rainy season
2) Limited capacity of drying

CONCLUSION

In this report, sunlight based drying of different item, (for example, food, vegetables, rural iotas, spices and so on) is one of the most possible utilization of sun powered energy.

In non-industrial nations, such drying practices are being completed utilizing regular drying strategy like open sun drying, old style drying and others. Yet, this strategy are caught for certain extreme disadvantages as far as quality, exactness, limit, economy and taking care of these reason loss of items during the drying which is assessed 30 to 40 percent of the all out creation in agricultural nations. The best choice to defeat the bottleneck of conventional drying technique is the improvement of sun powered dryer.

In this report, the condition of workmanship advances of sun based dryer has been introduced has follows:

| | Exhaustive survey on the plan improvement and pre-execution assessment of different sorts of sun based dryer has been introduced.

| | Different sorts of sunlight based dryer, for example, immediate and circuitous

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Programmed Food Feeder in Cow Ranch

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ABSTRACT

Computerization is the utilization of mechanical and electronic hardware to lessen the requirement for human work. It has been utilized for doing different ranch activities like programmed ID, taking care of, draining, and birth discovery, egg assortment, working out, horse shelter cleaning, animal cooling, earth-controlled lodging in the domesticated animals' homesteads and brushing lands. The most striking trait of animal's ranch robotization framework is the amazing chance to fit activities to the necessities of every individual animal. This is just conceivable in the event that there are subsystems fit for perceiving the creatures as they cooperate with the mechanized frameworks. Robotization saves time, requires less work, and further develops item quality and FCR, increments creation, effectiveness, exactness and wellbeing. Nonetheless, computerization requests high establishment and fix costs; subsequently is more reasonable for business and institutional ranches. With the computerization of ranches animals, the executives is moving from being a craftsmanship to an application. A belt type dairy cattle feeder having a capacity container toward one side, a mobile perpetual belt for moving material from said container, and a transitionally versatile range part that passes horizontally across the belt when a windrow of cows feed has reached a preselected position corresponding to the container, and to in this manner drive the material from the belt into a feed bunk or a taking care of area.

Key words: *Automatic Feeding, Dairy Cattle, EnergyConsumption and Working Time*

INTRODUCTION

A study is completed on 18 homesteads in Switzerland, Germany and Denmark demonstrates the latest things in cows taking care of an expanding no. of ranches are handing-off on programmed taking care of to simplicity to a responsibility, save time and accomplish adaptability. The homesteads studied were down to earth client of programmed taking care of frameworks. There are different frameworks which grant the robotization of taking care of frameworks. At present rail directed field carts are the best settled practically speaking yet transport lines and impelled feeders are additionally utilized. the no of feed parts utilized different similarly however much the time prerequisite the functioning time estimations of the programmed taking care of frameworks show that by utilizing AFS it is feasible to save time and accomplish more prominent adaptability. While the taking care of is conveyed with a robot or a belt feeder, the refuse and potential microorganisms that hardware conveys in the wheels stays where it ought to, away from the creature feed. Comparably during cold winter spells there is compelling reason need to open larges entryways and let drafts and abrupt temperature changes influence the animals. The down to earth issue of apparatus windscreen clouding when the machine is driven from hard ice to damp animals shed is likewise dispensed with. By programming the right measure of feed for each gathering you can guarantee that the past feed has been eaten before new feed is conveyed. This keeps the feed quality high and furthermore dispensing with the need to physically eliminate the old feed.

WORKING OF THE FEEDING SYSTEM

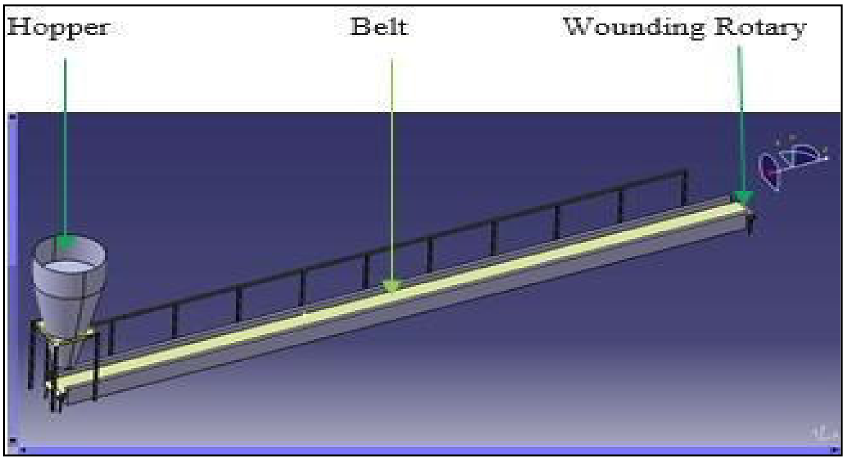

Fig. 1: CAD Model food feeding system

Prior to examining the better subtleties of the framework and mechanization. We should investigate the significant parts of an ordinary framework and how it works. Taking care of framework comprise of round and hollow shape container having cone shaped opening, pvc glass support belt, base design having C shape, two injuring rotors, wire rope for pull the belt in hub bearing, bidirectional servo engines, microcontroller for time change and supply the ability to engine.

I. WORKING STEPS OF SYSTEM

1) When the taking care of timing coordinates with regulator time framework will be start. Container valve open by screw-valve, subsequent to opening the valve engine runs in forward bearing.
2) Motor is combined with injuring rotor. Due to turning movement of rotor belt is un-wound. Pull force act by the wire ropes structure far edge on belt by this component belt move in one highlight next point then, at that point, end.
3) When the belt heads out highlight point explicit measure of food material is drop from container.
4) In this way one boat of food taking care of is consummation happen.
5) For next boat of taking care of engine runs backward heading and belt injuring is happen on the rotor.

CASE STUDY

Volume of cylinder $=\frac{\pi}{24\tan(\theta)}$ $[D^3\text{-}d^3] + \frac{\pi}{4}$ D^2 H.D= 2H

Fig. 2: Case study of feeding system

MDF cows farm at RURAL areas. Case study consideration is system design to feed the food for 10 cows. Daily in two times. Capacity of hopper is 1700kg, length of belt is 14 meter. Number of food drop point is 10.

II. DESIGN CALCULATIONS

Our design is based on the above case study

A. Hopper

Mass storing capacity of hopper is 1700kgm=1700kg
We store the maize food in the hopper,Density of maize food is 700kg/m^3
Calculation for Volume of hopper = mass/density
= 1700/760 = 2.2368 m^3

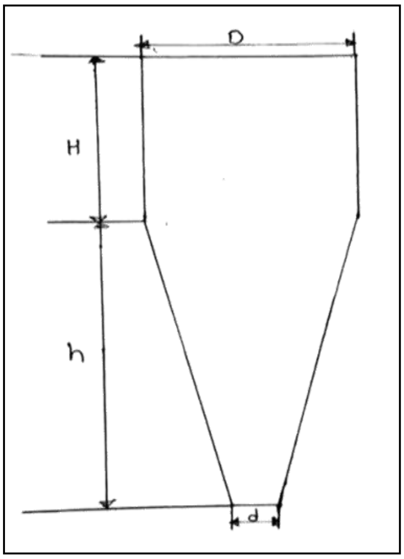

Fig 3: Hopper Nomenclature
Where,
d = opening dia. Of hopper,
h = height of conical shape, D = dia. Of cylindrical shape,
H = height of cylindrical shape.
We required Opening dia. of conical hopper (d) = 457.3 mm.
Semi inclined angle (θ) = 30^0 h= 2+ θ/60 =2+0.5 = 2500 mm.

Where, d = 457.3 mm, θ = 30^0, put the value in above equation, we getD= 1539.1 mm.H = 769.5 mm.

B. Selection of motor

Power required to pull the belt (P) = F.Vf1=force due load consideration
f2=force due to friction between belt and base surfaceF = f1+f2 =1200 +720 =1920 N
V= 1 m/sec.
P = 1920* 1 = 1920 watt.
Hence we selected 3 Hp motor.

c. Selection of wire rope:-

Tensile load acting on rope = 1920 N.FOS = 4.
Selection of dia of sheave.D= 24 d.
To determine the dia. of wire ropeFt = 4*1920 =7680 N.
Ft = p*D*d /2
Sheave material = cast iron.For cast iron p= 6.20 mpa. d= 10.16 =~ 11.
Selection of wire rope = 11(6 x19).Where, 6= strands
19=no. Of wire in each strand.

D. Selection of belt

Velocity of belt=1m/sWidth of belt=500mm

E. Advantages

1) No labor is require
2) Lower Misuse of Feed.
3) Maintain Creature Wellbeing.
4) Never Miss a Taking care of.
5) Reduce Expenses.
6) Save Time with Programmed Taking care of: Up to 6 Times each Day Utilizing Pre-modified Taking care of Times.
7) Feeds Up to 10 Head of Cows all at once, More If Taking care of a Calf or More modest Creature.
8) Increase In general Activity Effectiveness and Adaptability.

CONCLUSION

The paper presents another system for taking care of food in cow ranch. It enjoys benefits of being worked without manual impedance, high burden conveying limit, high velocity, long life. The framework is basic in development and simple to make. Utilization of robotization time will be decrease. Use in where less region is accessible.

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OVERVIEW ELECTRIC POWER SCENARIO

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ABSTRACT

Power section is one of the key sectors contributing significantly to the growth of our country's economy. Being highly technology intensive, role of the equipment manufacturers in the development and up gradation of the power sector is crucial for speedy development of the sector as well as for its efficient functioning. In spite of all efforts, growth in demand for power has always exceeded the availability. The goal 'power for all' has to be achieved not only for different sectors of economic activity but also to the common man and to the remotest places at least to meet his/ her meager needs in terms of basic lighting and other primary requirements. Our country largely depends on thermal power generation and a right fuel mix based on well diversified portfolios of indigenous and imported fuel would be required. The future technology trends are being driven by main two criteria via-efficiency and environment. Main thrust area in the future would be integrated resources planning for optimal utilization of resources, technology driven by efficiency, environment and economics, application-oriented research for achieving higher productivity and energy efficiency and energy conservation. Electricity Act 2003 is a significant step forward to mitigate the gap between demand and supply.

Keywords: *Electrical Power, Generation, Transmission, Energy Demand.*

INTRODUCTION

Power section is one of the key sectors contributing significantly to the growth of our country's economy. Growing demand for electricity poses before the planners and strategists the twin challenge of on the one hand making available affordable and reliable power to the consumer and on other hand to address environmental concerns arising due to the increase production of power. These challenges can be met by developing a basket of various generation technology options i.e. fossil fuels, hydro, nuclear, renewable, taking ito account the resource base and relative economics. While in the short and medium term the environmental concerns can be addressed by increasing the efficiency of power generation from fossil fuel and deployment of pollution abatement technologies, in the long run the answer lies in progressive de-carbonization of electricity generation systems.

1. **Growth in power sector**

Pre independence, power development in India started with number of small stations owned by private industries, local bodies or government establishments. A small beginning was made when the first stream power plant of 1000 kW set up by Calcutta Electric Supply Corporation near Calcutta in 1899 ushered in the era of thermal power in the utility power supply system. The hydroelectric project at Sivasamudram was commissioned in 1902 to harness the potential of the Cauvery River with an initial installation of 4 MW by early 1930s. the Tata power company, a private utility, built its first large power station of 50 MW at Khopoll in 1914 followed by two more station to provide electricity to the Bombay-Poona area. Beside these, a large number of small diesel, thermal and hydro plants came up in town of princely states. Notable power plant additions during the fifties were 30 MW at mulajore (Calcutta), Basin Bridge (30 MW), Khaperkheda (30 MW), korba (2 x 30 MW) and Bokaro (3 x 40 MW). During the sixties important additions include a number of 40, 50, 60/62.5 MW sets at neveli, korba, hardunganj, barauni khotangudern, ennore, obra, trornbay, satpura, taicher, and delhi. The power development during 1940s was mainly aimed at meeting the requirements of second world war efforts. The power development efforts continue to remain individual province/utility centered till 1950. When India got independence in 1947, the total installation capacity was 1363 MW.

The planne4d and structured growth of the power sector in India started immediately after independence with the enactment of the erstwhile electricity (supply) act 1948 which also paved the way for constitution of the state electricity boards. In December 1950, the installed generating capacity in the country was only 1,713 MW, comprising of 559 MW hydro and 1154 MW thermal, and 29271 Ckt kms of all India transmission and distribution network. Gross electricity generation was about 5 BU. Only about 3000 villagers were electrified whereas the per capita consumption was a merge 15.6 KWhr. National plan-based power development started with the commencement of the country first five-year plan in 1951. Electricity (supply) act 1948 was enacted, entrusting the responsibility of development of the individual states. Creation of organizations (state electricity boards) to develop power under a national power policy (NPP) was provided for in these legislations. Twelve electricity boards were constituted during the first decade after 1950s, remaining bard coming thereafter. Seventies was the decade of major policy initiatives. In 1975 the amendment to the electricity supply act paved the way for the setting up of organization under central government into power generation field to supplement the efforts of the states. Later development has shown that this initiative has led to significant expansion of the power sector.

2. Regulatory and structural reforms

Government of India has making continuous efforts to move away from the regime of ‘business as usual ‘to a more pro-active, market oriented approach. Significant changes over the past decade has been entry of private sector in the power generation, un bonding of the vertically integrated business of generation, transmission and distribution and opening up of transmission as well as distribution sector for private participation thereby imitating the process of a quantum jump toward making available and quality power at reasonable rates to all including rural households.

Enactment of electricity act 2003 is gaint step forward in the direction. This act ushers in a new regulatory paradiagram for the power sector in india and hold promise to fundamentally transform the economics of this sector. The act provides an enabling framework conductive to development of the sector in an open non-discriminatory, competitive, market driven environment, keeping the intrest of the consumers as well as of power supplies of power. The act also provides for specific dispensation for power development in rural areas. Concept such as rular distribution through cooperative and arrangement of franchisees are being envisaged so that reliability and quality of power supply to these area are improved. Trading is recognized as a distinct activity. With a view to propagate competition, the act envisages open access in transmission at the outset in distribution in phases, to be monitored by the respective regulatory commissions. Anti theft legislation has be made stringent with penalties for each offence being clearly spelt out so that electricity theft / misuse projected as social evil. However, we must remember that the act merely provides an enabling framework, but success in meeting its objectives would hinge entirely on timely implementation of the act in keeping with its true spirit.

Distribution has emerged as the weakest link in the chain of power supply, manifested by poor financial health of SEBs. Hence, distribution reforms have been identified as the key area of focus with interventional strategy at the various levels starting from national level, percolated downwards to state level, distribution circle, feeder level and ultimately consumer level covering all aspects of policy and legal frameworks, accountability, reliability and metering to enhance consumer satisfaction.

From a state owned monopoly with administrated prices, the power sector is now moving towards private ownership and market controlled pricing. Many new players have entered the scene. Many international consultants, leading agencies and equipment manufacturers have come to India; regulatory commissions have been set up and they have started having public hearing; consumer organizations and other civil society installations have increased their role in policy discussions.

Ministry of power and central electricity authority (CEA) are responsible for formulation of national power policy, overall panning and coordinating power development at the national level. central electricity authority (CEA) has been originally established under the section 3 of electricity supply act 1948 and continuous to exercise such function and perform duties are assigned to it under the electricity act 2003. CEA is responsible for overall planning and development of the power sector in the country. CEA is technical organization to advise and assist central government on matters of relating to generation, transmission, distribution, trading and utilization of electricity. Linkages with other ministries/departments in the central government, planning commission and the state governments are also essential for the overall development of the power sector. The erstwhile regional electricity boards (REBs), now regional power committees (RPCs) are non-stationary bodies under the government of india, which coordinate and formulate policies and guidelines for integrated operation of the regional power grids.

3. Resources for power generation

The Indian power sector is one of the most diversified in the world in the term of generation sources, ranging from agriculture and domestic reuse, solar and wind power to 90 called commercial sources-coal, lignite, oil, natural gas, hydro liquid fuel and nuclear energy. The basic requirement of different primary energy sources are their accessibility, availability, acceptability and affordability. The indigenous energy sources may not be adequate to meet the power demand even if the improved efficiency of their use is accounted for. Import of coal and gas seems to be a necessity. Therefore a 'right fuel mix' based on a well diversified portfolio of indigenous and imported sources of power would be required.

4. Hydropower development

India is the largest number of rivers and as these rivers flow from their sources in mountain and hills, they provide plenty of scope for large scale hydropower development. In the peninsular rivers there is a very wide disparity between the discharges in the rivers in the monsoon period and the non-monsoon period, with the variations being as much as 25 times. Therefore in the case of hydropower projects on these rivers, large storage capacity is required to balance the out flow in order to increase the firm benefits of hydroelectric power. The Himalayan Rivers being snow fed have more equitable distribution of water flow and therefore run of the river type or small storage capacity hydroelectric projects yielding substantial firm power are feasible.

Central electricity authority undertook an extensive assessment of hydro-electric potential of the country and has placed the potential at 84,044 MW at 60% load factor. A total of 845 H.E. schemes have been identified in the various basins with estimated yield of 442 billion units of electricity. The hydro potential of 84,044 MW at 60% load factor when fully developed would result in an installed capacity of about 1,50,000 MW. With the objective of expenditing hydro development in a systematic manner CEA undertook a ranking study of the balance hydro potential sites for all the basins in the country.

Thermal power forms a dominent part of the total generation of the country and will continue to do so in the future as well. Various fuels are available for thermal generation and the techno- economics of each fuel type needs to be establishedd on a case to case basis depending on factors such as availablity of fuel, location of fuel, and load center etc.

As per the estimates of geological survey of india, the coal reserves of India stand 286 billion tones with more than 81% of these being of the non-cokinggrade. The production of is likely to be 554MT by the end oof 2011.12 This includes production by coal india Ltd., SCCL, Captive coal mining and others. Captive coal blocks have been allocated to public and private sector developer in order to augment coal production. The total import of coal during 2003-04 was 9.5 MT and it has been growing steadily. The total coal requirements for power sector by the end of 12th plan i.e. 2016-2017would be about 840 MT, and the likely import of coal would be about 230 MT. Use of imported coal with high caiorific valueand low ash content may be the prefered choice for coastal thermal power plants in Tamil Nadu, Karnataka and Maharastra depending upon competitive pricing. Blending of imported and domestic cual would be a preferred option in case of short supply of indeginious coal. The feasibility of entering into long term contractes with the companies supplying imported coal would be a worthwhile proposition.

The geological reserves of lignite have been estimated to be about 35.6 BT. Lignite is available at limited locations such as Neyveli in Tamil Nadu, surat, Acrirnota in Gujrat, and Bar singer, Palana, Bithnokin Rajsthan. Over 86 % of the resources are located in the states of Tamil Nadu alone, where the rest 14% are distributed in other states .

Naturas gas is the best fuel for power generaion from the environmental angle and hence it is being increasingly used in combined Cycle Gas Turbine power stations in view of the very high efficiences with advanced technology gas ……… Natural Gas owing to its non ……………and ease of use as compared to oil, is expected to gain significance and have a greater share in the primery mix for power generation. However limited gas resources of 660 billion cubic meters is available in the country. The National oil companies viz, Oil & Natural Gas Corporation Ltd. (ONGC) and oil India Ltd. (OIL) have made significant Hydrocarbon discoveriesin the recent years Private/joint Venture companies have also made 27 hydrocarbon discoveries. The recent Gas production from KG 06 field resulted in significant contribution from gas based generation in the country. Currently, there is a shortage of gas and demand –supply gap is projected to increase with strong growth in demand vis-à-vis slower growth in domestic production.

To supplement the gas availability, import of natural gas in the form of Liquefied Natural Gas (LNG)from other countries is also being resorted to. There is also possibality of import of natural gas ….. neghbouring countries namely Bangladesh, Myanmat , Iraque and Turkmenistan through pipelines, LNG based CCGT plants are best suited for coastal ares since afterre-gasification, transportation of gas for peaking may not be economical over long distances unless the quantumof gas transported is large.

Coal bed methane (CBM) is found in a number of coalfields in the ountry. This CBM reserve has been estimated to be 486.55billion cubic meters. The exploitation of CBM in auddition to being a viable fuel option for power generation could also reduce the methane emission in the atmosphere. However , its use would largely depend on its economic viability.

Nuclear power has an increasingly important role to play in electricity generation and in providing energy security while ensuring sustainable developmrnt. Nuclear power generation is environment friendly, a compact source of energy, technologically power and economically viable. Nuclear energy also needs to be harnessed for power generation an a larger scale by addressing the cost and public sensitivity issues effectively so as to increase the non-carbon component of electricity generation portfolio.

At present, nuclear capacity totallingto 4,780 MW is in operation in the country and there is a programme to add 2690 mw in th 12^{th} plan periodand about 18,000 mw in the 13^{th} plan period. As per the vision 2020 of Department of Atonik Energy (DAE),efforts are being made to create 20,000MW nuclear generating capacity in the country by adding 700MW to 1000 MW unite size. Nuclear Power is hoped to provide energy security of the country. Besides the above, fuels commercially used for power generation, use of renewable sources also need to be encouraged.

It has become very important to develop alternate New and renewable sources of enrgy on the fast trackin view of the developing conventional energy sources like coal, gas and nuclear and also to face the twin challenges of sustainable growth and and climate change. Renewable energy sources have the potential to give boost to economy while meeting the emission constraints. Our country has felt the need to tap the vast potential and need of new and renewable energy sources such as wind, small Hydro, BioMass and solar energy. Limited availability of fossil fuels like coal and gas has further highlighted the importance of power from these sources. In audition, these sources provides a particularity attractive solution for meeting requirement of powers …….. locations, in cases where it is not feasible to extend the grid. All efforts are therefore being made to tap these resources for generation of power to supplementpower from conventional sources.

The share of instailed capacityof Renewable energy sources is about 1……which is a significant incrase during 11^{th} five year plan from 5.8% at the end of 10^{th} five year plan. The total estimated medium term potential (2032) for power generation from renewable energy sources such as wind, small hydro, solar waste to energy and bio mass in the country is about 1,83,000MW. The instalted capacity based on Renewable energy sources at the end of the 10^{th} Plan was 7,760 Mw considering the progress made during the 10^{th} plan, ahiger target of 14,000MW was proposed during 11^{th} plan and so far around 11,000 mw has already been commissioned taking installed capacityfrom Renewable energy sources to 18,1455MW. As per MNRE (Ministry of New & Renewable Energy)'s perspective plan, a capacity auddition of 49,000 MW is envisaged during the 12^{th} and 13^{th} plan periods (18,500Mw during the 12^{th} plan and 30,500MW during the 13^{th} plan period). Out of all the non- conventional resouces of power generation, solar energy is the most readily available and abundant sunshine, social energy could be easily harnessed for power generation. It is especially advantageous while considering power options for rural electrification both as grid connected power and distributed power option.

A national social mission has been lunched under the national Action Plan for climate change (NAPCC) to significantly increase the share of solar energy in the total energy ….. while recognizing the need to expand the scope of other renewable and non-fossil options such as nuclear and wind energy and biomass. India gets plenty of sunlight due to its proximity equator. About 5,000Trillion KWh energy is incident over india's land area with most parts receiving 4-7 kWh per sq. m Per day. As a thumb rule, 1 MW of solar capacity without storage facility produces 1.6 MU of electricity per annum. In india Potential of solar energy is available in the states which are rich in sunshine,particularly in the states of Rajsthan, gujrat, Andhra Pradesh, Tamil Nadu and Ladakh. A mapping of the solar potential is available which could be utilized for while setting up solar installations.

Though solar energy is abundantly available but the technologies to tap this vast amounts of energy are still very few and costly, therefore making this energy very expensive and beyond reach of common man. To have more technology initiatives is the need of the hour to strengthen the harmony between Renewable Energy and environment and will open new initiatives for a better and safer future for coming generations.

CONCLUSIONS

The indian power sector has been continually governed by the technological developments in all spheres of generation, transmission and use of electricity. Any action plan for growth of the basic infrasructure sector has to be integrated with the technological changes that are taking place globally.

. this is more so necessitated by the greater emphasis on efficiency and environment, which are key drivers in the coming years.

Fo power generation, our dependence on fossil fuels especially coal is expected to continue for the time being. This calls for continuous efforts directed at generating maximum electricityfrom each…….. of coal in an environmentally friendly way at affordable cost. To achieve faster capacity auddition targets, large capacity plantsincluding 4,000 MW size Ultra Mega Power plants (UMPP) using 600/800 MW supercritical units have been ………… for intallation at different sites mainly at pithead and coasted locations, Ministry of Power, Govt of India in association with Central Electricity Authority and Power Finance Corporation lunched intiative for development of 4000MWcapacity coal based Ultra Mega Power Projects under tariff based international competitive bidding throgh shell companies initially 9 UMPPs- 4 at pithead and 5 at coasted sites have been envisaged. These Mega projects will be environmental friendly as supercritical technology proposed to reduce emmissions.

With the present trend of growth of emand for electricity and dominants depend upon coal as mainstay of power generation, it is expected that our coal reserves may be …….in next 50 to 60 years. Thereby it would be prudent to look in to future technologies to enhance the life of our coal reserves.

The future technologies trends arebeing driven by two main …………viz effifieny and environment. These main two issues are interrelated in that any improvements in efficiency would result in less fuel being burnt and in correspondency environmental benefits. However the approach to efficiency improvements would be effective only to a limited extent and there is a need to look beyond for ……..quantum of environmental benefit which is possible only by adopting new clean coal technologies. The new generations technologies, referred to as Clean Coal Technologies (CCT) are environmentally cleaner and in…

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EMERGING NEEDS OF SUSTAINABLE TECHNOLOGY- SOLAR PV DEVELOPMENT IN INDIA

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ABSTRACT

Solar Power generation in India ranks within top five countries of world in Green energy revolution. Photovoltaic (PV) cells, or solar cells, are active photoelectric system converting sunlight to electricity. Small panels are constructed with semiconducting material based on photoelectric effect. The material, usually used comprises silicon with potentially other polycrystalline thin films, generating direct current when sunlight hits the panel. PV cells are successful in all regions of the world. Commercially available PV panels are about 22.5% efficient for conversion of sunlight into electricity under standard test conditions, but even in partially cloudy weather, they can operate at about 80% of their maximum output. In India Solar radiation available is more than 300 days amounting to about 3,000 hours of sunshine with power equivalent to 5,000 trillion kWh. India's economic growth has been hindered by shortage of electricity since transmission and distribution losses have been extremely high over the years due to urban theft. This reached a worst proportion of about 24.7% during 2010-11. Thus, use of solar needs to be commercialized for economic development in India.

Towards planetary mission, solar use is being promoted in applications like street–home lighting systems, solar Lanterns, PV power plants, water heaters, solar cookers, agro-photovoltaic pumps, large solar arrays, and solar powered portable lighting devices, rooftop panels, pedal powered classrooms, green parks, green cities, standalone and grid structures etc. The capital investment in establishment of solar unit is not too large since costs of land & building is not included. The machineries of the units are fabricated by suppliers or local engineering workshops. The plants can be installed in villages of small scale industry production catchment. Though India is the second largest rural agro industry in World, the Research and Development support is negligible towards use of solar in agro-systems designing, fabrication/ manufacturing, lay-out, installation,

operationalization, maintenance of complete hard ware units as well as the product processes development, product manufacturing, product packaging, storage and marketing, etc.
Considerable research work has been done at ICAR Institutions by NISE, SEC, MHRD and NGOs in this direction. However, visible impacts are not seen on the real ground perhaps due to low risk capacity, limited internal resources and poor access to solar resources in areas of these entrepreneurs. In this presentation the present status and future needs for technovations and management skill in the areas of solar power extraction efficiency, improved fill factor, better MPP tracking, value added techniques with applications and overall modernization of solar PV processing, storage and marketing, etc have been mapped and discussed.

Keywords— *Photovoltaic's, Green energy revolution, agro-systems, solar power extraction efficiency, improved fill factor, MPP tracking.*

INTRODUCTION

Sustainability is the core for developing and delivering payload energy systems in world. Sustainability refers to productivity in spite of challenges in social, economic and environment areas. The foundation stone of present sustainable structure is determined by use of RET's (Renewable Energy Technology) that plays an important role in global development. Sustainable in broad terms means living within the limits, understanding the interconnections among economy, society, and environment and having equitable distribution of resources and opportunities using renewable energy sources. Although there are number of RET's like Solar, Wind, Ocean, Geothermal, Biomass and waste energy, Solar being most abundant has vast energy potential. Solar appears to be largest contributor among RET's and its use is consistently increased by 20-25% in investment sector. The upcoming solar sustainability is marked by (1) Increasing efficiency of solar cells (2) Manufacturing technical improvements and (3) Economics of scale. Solar finds three main applications in areas of (1) Solar Thermal (ST), (2) Solar Photovoltaic's (PV) and (3) Solar Hydro (SH). Solar Thermal uses large solar collectors or evacuated tubes in capturing sunlight. It is used in domestic cooking and heating. Solar PV uses solar cell modules to absorb sunlight and emit photons for electricity generation. Solar Hydro uses perennial streams or water for electricity generation and heating. Since PV flexibility makes simpler technology with easy fabrication it is preferred on commercial scale. PV is used in standalone domestic structures requiring no battery storage and grid applications operating on battery banks.

PV systems are providing secure investments being environment friendly and emission free. Application areas of PV are not limited to agriculture and industry alone but personal and planetary sustainability too. Case studies reveal that immense solar potential is being harnessed for profitable energy ventures in India. Subsidized institutional tie-ups with Tata BP, BHEL, and NGO's have played role of catalyst in facilitating growth of solar PV. Jawaharlal National Solar Mission (JNNSM) introduces ample opportunities for PV developers in India. Specific drivers for PV in India include the country's rapidly rising primary energy and electricity needs, the persistent energy deficit situation, the country's overdependence on coal for electricity generation and on oil and gas imports (amounting to 7% of its GDP).

Solar applications can be subdivided into many categories. As concerns electricity, power supply generation and distributions are most important. Small rooftop panels triggering power supply in homes to grid describing power utility over campuses all paralleled accommodated by solar. Water distillation used for domestic purification or pumps used in large farm lands spread over vast areas are watered using agricultural solo or Monedo solar pumps. Portability of panels makes domestic applications increased many times in consumer items. Electronic appliances in lighting systems and novel beautification handicrafts are another promoting feature. Solar panel integrated clothes, umbrellas, bags are interesting upcoming products in market. Be it east or west from hills to plains solar power is being harnessed in form of green houses to yield fresh vegetables throughout the year. Solar chargers, regulators, inverters, projectors and street lights form backbone in remote areas used in lighting fences or terrace lands. Solar cities and villages are bringing a direct link between energy and resources. Latest endeavors are being tested towards achieving set the ambitious target of deploying 20,000 MW of grid connected solar power by 2022. Together with this, efforts for reduction in power generation cost through solar tariffs are upcoming area in R&D.

PRESENT STATUS AND CHALLENGES

In India, GDP high growth rate has resulted in great demand of energy, but the supply is unable to match the demand. India being amongst sunny regions of the world receives 4 to 7 KWhr of solar radiation per square meter per day with 250-300 sunny days in a year. Even though, solar energy constitutes just a miniscule part in India's installed power generation capacity 905 MW as on 31 March 2012 as shown in Fig. 1.

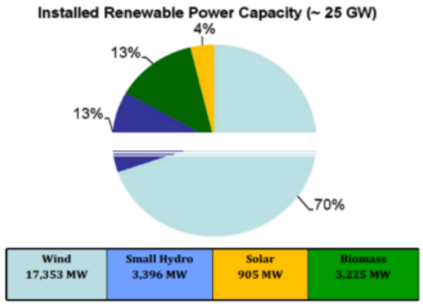

Fig. 1 Installed Renewable Energy Capacity

As indicated from above distribution that Solar although abundant in India is not being utilized effectively. The National Solar Mission as highlighted before is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth using solar addressing India's energy challenges. The major initiatives of JNNSM include promotion of solar energy technologies. The Mission aims to achieve grid tariff parity by 2022 through ¾ Large scale utilization, rapid diffusion and deployment at a scale which leads to cost reduction ¾ R&D, Pilot Projects and Technology Demonstration ¾ Local manufacturing and support infrastructure.

The roadmap planned by JNNSM to make photovoltaic's as most important components of country's energy mixture is given in Fig. 2.

Application Segment	Target for Phase I (2010-13)	Cumulative Target for Phase 2 (2013-17)	Cumulative Target for Phase 3 (2017-22)
Grid solar power (large plants, roof top & distribution grid plants)	1,100 MW	4,000 - 10,000 MW	20,000 MW
Off-grid solar applications	200 MW	1,000 MW	2,000 MW
Solar Thermal Collectors (SWHs, solar cooking/cooling, Industrial process heat applications etc.)	7 million sq meters	15 million sq meters	20 million sq meters
Solar Lighting System	5 million	10 million	20 million

Fig. 2 Road map for JNNSM

The execution of above plan has already been started using PV architectures suitable for India. Implementation results prior to 2013 statistics in India by about 1,114 MW installations, solar power installation rose to 2,319MW. Grid power PV area had provided 2,208.36 MW installations with OFF grid structures around 200MW by January 2014. Various application segments mentioned in above table are shown through implemented designs in Fig. 3-6.

Fig. 3 Grid Solar Plant System

Fig. 4   Rooftop Building Management System

Fig. 5   Solar Thermal Collectors

Fig. 6   Solar Lighting Systems

All systems visualized above using PV panels are dependent on type of solar cells used in manufacturing panel. As in India, emerging trends describe to use thin film solar cells in PV panels whose wafer thickness, cell efficiency and more absorbing characteristics provide adaptive features in manufacturing processes. However, concerns of different category solar cells are given in Table 1. It summarizes various types of solar cells used in PV panel manufacturing and the challenges faced from them.

S.NO	CATEGORY	TYPE	CHALLENGE
1	Silicon	Single crystalline	Manufacturing, Quality improvement
		Polly crystalline	
		Amorphous	Junction Multiplication
2	Compound Thin Film	III-V (GaAsInP)	Band Gap control, Junction Multiplication
		II-VI (CdTe/CdS Cu_2S/CdS)	
3	Organic	Pentacene Phthalocyanine Merocyanine	Structure, development of the device, multi-junction.
4	Photochemical	Dye sensitized	Development of the materials
5	Inorganic	Quantum dots	Synthesis and preparation

Table1: Solar cells types and challenges

The manufacturing of solar cell panel is not sufficient. Terminology describing high efficiency of solar cell also needs to be justified. Various terms that need to be managed associated with solar cells are given in Table 2.

s.no	PARAMETER	DESCRIPTION
1	Solar power extraction Efficiency	The ratio of maximum power to the product of the input light irradiance and the solar cell surface area.
2	Fill Factor	The ratio of maximum power delivered by panel to standard power conditions.
3	MPP (Maximum Power Point)	The operating point under which solar cell generates maximum power.

Table2: Solar cells high efficiency managed parameters

Thus upcoming demand for PV to be considered as most appropriate exhaustless long-term source could be only when above three factors are managed and properly incorporated in solar cell panels. Research efforts are developing in stimulating solar cells to produce increased outputs at a lower cost. By identifying SWOT for PV industry remarkable results can be traced out.

SWOT ANALYSIS FOR PV INDUSTRY IN INDIA

The major challenge in successful completion of sustainable standard after surveying various Applications based on PV panel can be determined by value concerns through following four main industry segments. A SWOT survey for Indian PV industry is given below:

STRENGTHS

1. Future of India poised to appear as major solar power. 2. Union Cabinet approves 25 solar projects for India's SunShot initiative. 3. JNNSM is accompanied with Ultra mega solar power plants in Budget 2014-15 in Rajasthan, Gujarat, Tamil Nadu and Ladhakh. 4. Sunlight availability is sufficient and adaptable to shade or no sun conditions. 5. Technology is proved, scalable with low operation and maintenance costs. 6. Availability of soft loans and government incentives for growth and expansion.

WEAKNESSES

1. Government incentives required to embark more facilities and subsidies for solar ventures. 2. High capital and space costs for establishment of grid utility plant. 3. Large business generally preferred due to capital intensive nature. 4. Distributed System designs cause base load difficulties. 5. Research and development projects simulation designs for shaded conditions are not up taken.

OPPORTUNITIES

1. Ambitious targets of Government for solar projects. 2. PV Developers to get easy statutory and clearances on projects. 3. Thrust on grid connected Defense establishments. 4. Priority sector implementation of rooftop houses in remote areas with Government financing. 5. Formation of Association of Renewable Energy Agencies of States (AREAS) to continuously monitor watch of solar programmers. 6. High innovative Green jobs in market by The Council on Energy, Environment and Water (CEEW) research institution through high-quality research by partnerships with public and private institutions.

THREATS

1. High risks of obsolescence as novel technology. 2. Cash flow reduction in off season. 3. Searching professionally skilled persons for PV industries.

SOLAR MARKETING AREAS

ELECTRICITY GENERATION

PV uses mini grid or mega grid power plant to trap solar energy for conversion to electricity. It is subdivided into Rooftop or Grid distribution. Rooftop systems act as micro power plant to serve basic electric needs of building. For improving performance they are connected to Grid. Here, number of panels is used to determine wattage outputs of PV structures. This mode of electricity generation spread over a macro power grid can compete to provide electrification of village rather than a single solar home

ELECTRIC APPLIANCES

Appliances like batteries, regulators, inverters and chargers for mobile phones, laptops, e-readers, tubes, mini emergency lights and electronic items run using solar panels. The most common use of solar street lights, solar lanterns and CFL's can be used in day to day life. Modern Lighting in buildings mainly focus on Sox Lamps and Solar powered projectors. Advertising sites, billboards can be easily operated by these.

WATER SYSTEMS

The uncertainty of timely water supply in urban and non direct supply in rural areas creates concerns regarding water heating, cooling and drying purposes. Solar water heaters, water pumps and sprinkler sets serve best alternate to such conditions.

INDUSTRIAL SYSTEMS

Distilled water industry uses solar panels on top for water distillation purposes. Catering in canteens uses solar parabolic cookers for fooding, baking applications. Small scale packing industries requiring small supply use generator sets with motor driven by solar panels. Pedaled bicycles, solar panel e-vehicles are increasingly being developed. Green Schools and clean classrooms are being prepared on solar generated pedaled devices. Refrigeration in crop processing and vegetable industries is also based on solar panel technology.

COMMUNICATION TOWERS

Communication through land by telecom towers, naval ships in running, satellites for programme relay all use solar panels aligned in such a frame that energy captured by them is easily transported for use. In India presently Bharti Infratel has largest number of solar towers as compared to other simulation tools.

CONCLUSION

Clean and Green applications of solar energy with challenges and opportunities have been discussed. To revolutionize solar energy reliance threats identified need to be tracked appropriately. Global Pollution check and conservation of environment can be done by use of solar devices for balancing our lives.

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Introduction to Internet of Things

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ABSTRACT

The term "Internet of Things" (IoT) describes how different physical items and gadgets are connected online. In 1999, Kevin Ashton initially suggested the phrase "Internet of Things. "The fundamentals of IoT are illustrated in the section below. It covers the different IoT levels and some of the fundamental concepts associated with it. In essence, it is an augmentation of Internet services. The IoT architecture is also presented in this section. For instance, in an IoT context, a system is referred to be a smart-home when everyday household appliances are connected to the internet. IoT is more than simply a bold vision for the future. It is currently being put into practice and affects more than simply technical advancement.

Keywords:*Internet of Things (IoT), Service Oriented Architecture (SoA).*

INTRODUCTION

The network of physical objects known as the Internet of Things (IoT) includes tools, equipment, cars, buildings, and other things that are equipped with electronics, circuitry, software, sensors, and network connectivity. This technology allows these objects to gather and share data. In order to more directly integrate the physical world into computer-based systems and to increase efficiency and accuracy, the Internet of Things enables items to be sensed and controlled remotely through the existing network infrastructure. The idea of a network of smart devices was initially suggested in 1982, and the first internet-connected appliance was a customized Coke machine at Carnegie Mellon University that could report its inventory and if freshly filled beverages were cold [3].Kevin Ashton, a British technology pioneer who was born in 1968, is credited with coining the phrase "the Internet of Things" to describe a setup in which the Internet is linked to the actual world by way of pervasive sensors.IoT can communicate without the need for a person. In the healthcare, transportation, and automotive industries, several early Internet of Things applications have already been created.

Although Internet of Things (IoT) technologies are still in their infancy, there have been several recent advances in the connection of physical things to online sensors. Many concerns, including infrastructure, communications, interfaces, protocols, and standards, are involved in the development of the Internet of Things.

This paper's goal is to provide a comprehensive understanding of the Internet of Things (IoT), as well as its architecture, levels, fundamental concepts, and services.

Foundation OF IOT

In his first 1999 proposal, Kevin Ashton defined the Internet of Things (IoT) as a network of individually identifiable linked items using radio-frequency identification (RFID) technology. However, the precise definition of IoT is still being developed and depends on the viewpoints used. "Dynamic global network infrastructure with self-configuring capabilities based on standards and communication protocols" was the broad definition of the Internet of Things.

We may divide the five periods of the Internet's development into five categories:

1. The Internet of Documentse-libraries and websites with document-based content.
2. The Internet of Commerce, which includes websites for e-commerce, e-banking, and stock trading.
3. Web 2.0 and the Internet of Applications
4. Social networks on the Internet of People.
5. The Internet of Things: Machines and connected gadgets.

In an IoT, both physical and virtual objects have unique identities and characteristics, are able to use sophisticated user interfaces, and may be connected to one another to form an information network. IoT may be thought of simply as a collection of linked, individually recognizable gadgets. The terms "Internet" and "Things" refer to a global network of interconnected devices that uses sensing, networking, communication, and information processing technologies. This network may represent the newest iteration of information and communications technology (ICT). Wireless sensor networks (WSNs), barcodes, intelligent sensing, RFID, NFC, low energy wireless communications, cloud computing, and other technologies are now used in IoT.The Internet of Things (IoT) refers to the next phase of the Internet, which will enable access to and identification of physical objects. The definition of the IoT changes depending on the different technologies used for implementation. IoT fundamentals, however, imply that IoT things may be individually identifiable in virtual representations. All objects in an IoT are capable of exchanging data and, if necessary, processing data in accordance with predetermined schemes.

Architectural Features of IoT

The network's objects must be linked to one another in order for an IoT to function. The IoT system design, which connects the real and virtual worlds, must ensure the IoT's functionality. IoT architectural design takes into account a variety of variables, including networking, communication, workflows, and more. The extensibility, scalability, and operability of devices should be taken into account while creating the IoT architecture. IoT design should be adaptable to enable devices to engage with one another dynamically and facilitate communication among them since items may move and need to communicate with others in real-time mode. IoT should also be decentralized and diverse in nature.

Service oriented architecture:

The interconnection of the objects in the network is a crucial necessity for an IoT. IoT activities, which connect the physical and digital worlds, must be guaranteed by IoT system design. Many variables, including networking, communication, business models and procedures, and security, go into the design of IoT architecture. The extensibility, scalability, and interoperability of heterogeneous devices and their models should be taken into account while creating the IoT architecture. IoT design should be adaptable to enable devices to engage with other things dynamically and facilitate clear exchange of events since objects may move physically and need to interact with each other in real-time mode.

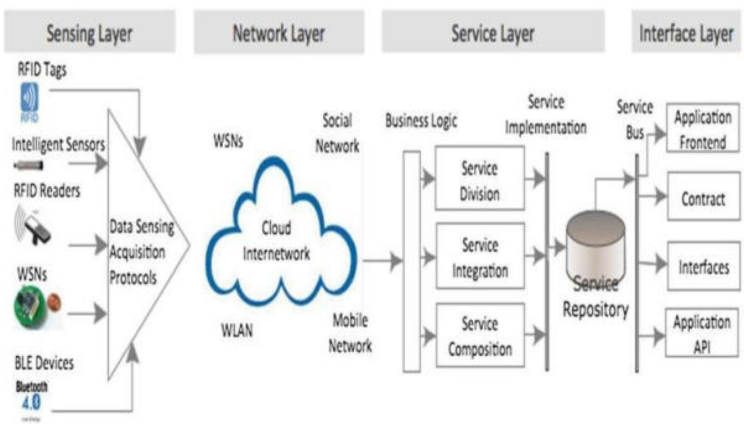

Fig1.Architectural Layers of IoT

A complex system is viewed by the SoA as a collection of well defined basic items or subsystems. The software and hardware parts of an IoT may be effectively upgraded and reused since those items or subsystems can be maintained and reused separately. These benefits have led to the widespread use of SoA as a standard design.SoA, which has four levels with distinct functionality, offers the devices' interoperability in a variety of methods. As follows:

All accessible objects (things) are integrated with the sensing layer to perceive their status.
The infrastructure for supporting wired or wireless communications is known as the network layer.
The purpose of the service layer is to develop and oversee services that users or applications need.
The user or application interaction techniques are contained in the interfaces layer.

Sensing layer

The Internet of items (IoT) is anticipated to be a widely dispersed, physically internal, linked network in which items are continually connected and can be managed from anywhere. Smart systems on tags or sensors may automatically perceive the surroundings and communicate data among devices in the sensing layer. It is possible to identify objects uniquely and to monitor the environment around them for a variety of uses. Every IoT device has a digital identification that makes it simple to trace it online. A universal unique identifier (UUID) is a method of giving a thing a distinct identification. Names and locations might be found in the IDs. A UUID is a 128-bit number that is used to identify anything specifically on the Internet.

The following factors should be taken into account when choosing an IoT's sensing layer:
Cost, size, resource use, and energy consumption: The items may include sensing components like RFID tags or sensor nodes. Intelligent devices should be made with as few resources and prices as possible because there are many sensors in applications.Deployment: Depending on the needs, the sensing objects (RFID tags, sensors, etc.) may be set up all at once, gradually, or arbitrarily.
Interaction. For objects to be retrievable and accessible, sensors must be able to communicate.
The network. The networks are set up as multi-hop, mesh, or ad hoc systems.

Network layer

In the Internet of Things, the network layer connects all objects and enables them to be aware of their environment. It is essential for intelligent event management and processing in the Internet of objects (IoT) that objects may communicate data with linked things via the network layer.
A robust network is necessary for data sharing and service delivery by a device.
Additionally, items should be automatically found and mapped by the network. To deploy, manage, and schedule the behavior of things, roles must be automatically allocated, and things must be able to move between any roles as necessary.
This makes it possible for gadgets to work together on tasks.

The following problems need to be solved at the networking layer:
Network management tools, such as those for controlling fixed, wireless, and mobile networks.
QoS requirements
Technologies for data processing and data searching.
Privacy and security

Service layer

IoT services and applications are enabled via the service layer. It is a platform with a low cost where hardware and software may be recycled. In order to efficiently find new services for an application and dynamically get data about services, the services in the service layer operate directly on the network. The majority of requirements are carried out by numerous standards created by various organizations. For the Internet of Things, a broadly approved service layer is crucial. A minimal set of apps, application programming interfaces (APIs), and protocols enabling necessary applications and services make up a viable service layer. The service layer is where all service-oriented tasks are carried out, including information exchange and storage, data management, search engines, and communication.

Interface layer

There are a lot of linked devices in the Internet of Things, but they don't necessarily adhere to the same standards since they belong to various individuals. The problem of compatibility between things must be resolved in order for objects to interact. Information exchange, communication, and event processing are all involved in compatibility. An efficient interface mechanism is desperately needed to make managing and connecting items easier. Basically, the application frontend or API (Application Program Interface) is where the interface layer is used.

Conclusion

IoT has advanced quickly over the past few years, and many supporting technologies have been presented.
The next Internet trend has been the Internet of Things. Everything in the world is becoming intelligent. There is a lot of room for IoT research. In the future years, there will be a huge influx of new technology, elevating our level of a smart world. The IoT has a very promising future. Everything would be connected, resulting in a better way of living, from our bills to our automobiles.

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- This systematic literature review provides insights into the Industrial Internet of Things (IIoT), discussing key concepts, challenges, and applications.

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Implementing energy-saving strategies and renewable energy sources in buildings using big data technologies

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ABSTRACT

The implementation of is currently one of the strategies for energy conservation in the industrial and social sectors of the Russian economy. energy-saving techniques and renewable energy sources (RES) that are both technically and financially feasible. However, it is frequently impossible to demonstrate how well introducing alternative energy sources has worked. This is because the comparison needs to be made under the same labour and resource constraints for raw materials, weather conditions, etc. In other words, it's important to compare energy-saving practices and the deployment of renewable energy technology under similar circumstances, which frequently necessitates finding solutions to a variety of challenging issues. A method for the integrated analysis and modeling of the processes involved in energy consumption in buildings has been created based on an analysis of existing methodological approaches to the gathering, compilation, and processing of large data sets, including statistical, neural network, and fuzzy methods. A approach for choosing a group of steps to maximize a building's energy efficiency was also put out at the same time. It is suggested to use the original model and approach for selecting energy-saving solutions, which takes into account a flexible multi-level structure, as well as the varying compatibility and importance of the indicators being examined. The suggested visualization technique enables the combination of economic project payback and energy-saving effect metrics on a single graph, which is a reflection of energy efficiency natural indicators. This model enables the process of improving a building's energy efficiency, and it can be helpful for energy managers who are in charge of optimizing energy flows.

Keywords- - *big data; energy efficiency of buildings; energy saving measures energy consumption; regression analysis; forecasting method, renewable energy sources*

INTRODUCTION

The inconsistency between, on the one hand, the volume of heterogeneous and varied information that is constantly growing (data on energy consumption volumes, including measurement data obtained from various sensors, expert estimates, data on the physical and geometric parameters of buildings, climatic and geo-information data, socioeconomic conditions, types of RES, their efficiency under the characterised by a variety of structures and semantics that originate from various sources, and on the other hand, by the absence of typical approaches to the evaluation, aggregation, and generalisation of such data into multidimensional data bases that characterise various aspects of energy consumption and optimise energy efficiency at various stages of the life cycle of buildings of various types.

In this context, the essential scientific issue of big data analysis, which will be applied in the future for the creation of predictive energy consumption functions and decision-making on enhancing the energy efficiency of various types of buildings, arises. The method of decomposing the issue into major issues with a consistent answer was chosen as a means of removing these contradictions and the problem mentioned above.

DESCRIPTION OF THE PROBLEM AND METHODS FOR SOLVING IT

The discrepancy has been addressed by consistently resolving four major issues. Considering that all of the studies' descriptions carried out significantly exceeds the allowed length of this article; therefore, just the theses of problem statements and the outcomes are provided.

The primary issue 1 is the justification of the project requirements, including the standards for determining sensor accuracy, installation sites, and data collection and processing techniques. The solution aims to analyze and identify scenarios for solving the problems of forming requirements for big data, at figuring out the requirements for the accuracy of measuring sensors, their installation locations for measuring the energy consumption of buildings, the methods for collecting and processing the received data, to the format and accuracy of the data to estimate the energy consumption of buildings.

The second major issue is the gathering, generalisation, and integration of vast volumes of data on a semantic level. The solution to this fundamental issue aims to advance the idea of gathering, generalising, and integrating data from diverse sources, such as information on the types and power of RES used, the geometrical and topological characteristics of buildings, measuring data (temperature, humidity, power, etc.), resident/visitor behaviour, and climatic and meteorological data. The software for semantic data integration, which is in charge of searching and directing data intended for analysis, modelling, and visualisation modules, is the answer to this issue. The proposed mathematical apparatus includes tools for comparing the veracity and precision of the data supplied by various modules to the predetermined standards.

The third major issue is the analysis of very big data sets and the knowledge extraction. In order to support prescriptive analysis and decision-making to increase the energy efficiency of particular buildings, a set of methods and analysis techniques have been developed to detect dependencies, typical situations, and useful information from extremely large amounts of data coming from various sources. Energy efficiency measures based on the information extracted will be the most accurate for each building because the information extracted is specific to each building. At this step, several mathematical models are applied, including self-configuring genetic algorithms based on artificial neural networks and mathematical multifactor regression.

The fourth and foremost issue is the modelling and verification of the energy-saving effects of RES and ESM in diverse types of buildings. The share of energy consumed in buildings, for instance, is about 40% of total energy consumption in Germany [2] and about 36% in Russia, including 23% of energy consumption in residential buildings [3]. This is when considering the full life cycle of a building, which includes its design, construction, operation, modernization, destruction, and disposal [1]. At the same time, the lower proportion of energy consumed by buildings in Russia compared to Germany is caused by a shortage of housing and major variations in the organization of the economic sectors. However, due to the greater specific energy consumption per square meter of buildings in

Russia, there is still a large possibility for energy savings (between 24 and 47 percent, depending on the kind of building) [4].

TASKS FOR CREATING MODELS

The following individual tasks have been completed within the framework of the final critical problem:

First Task: Analysis of the variables and approaches used in building energy consumption modeling. The goal of this assignment is to analyze the variables of different types of buildings, such as building envelopes, occupancy profiles, and environmental features in accordance with various energy consumption scenario alternatives. The factors affecting how much energy different types of buildings consume, including the use of RES, have been defined for this job. Building energy usage has been simulated in order to maximize their energy efficiency using a prescriptive approach.

Second task: Analysis of Russian legislation about increasing the energy efficiency of various structures and utilizing renewable energy sources is the second task. The assigned task entails analyzing systems for optimizing energy consumption of buildings in accordance with Russian legislation regarding energy conservation and efficiency improvement while taking into account the current status of building engineering systems and the most recent developments in the field of renewable energy.

Third task: Develop an energy flow model for typical buildings and specify the input and output of data from monitoring devices. Depending on certain criteria and factors, a methodology is suggested for developing and optimizing the proposed energy flow models in buildings. RES usage and building energy efficiency regulations in Russia were taken into consideration when developing the model. The primary technological requirements for input and output data of energy flow patterns in buildings generally and in connection to each of their particular constituents have been identified during the process of solving this challenge. Data from additional sources, such as meteorological and climatic data, are also considered.

Fourth task: is to develop an integrated model for calculating and simulating energy flows in buildings. Based on energy flow models and data measurement findings for various types of buildings, a complicated model for predictive analysis to optimize the energy efficiency of buildings has been built.

Fifth Task: Creating forecast data formats and strategies to improve buildings' energy efficiency with the optional usage of RES. It should be emphasised that the study was done during a time when methods and approaches for gathering, condensing, and integrating enormous and super-large data were actively being developed. Leading Russian and foreign experts including T.A. Gavrilova, V.V. Gribova, Yu. A. Zagorulko, N.V. Lukashevich, O.A. Nevzorova, Rybina G.V., Sosnin P.I., Khoroshevsky VF, and others have contributed to studies (both theoretical and practical) in this field. Nearly every major provider of information technologies and services (IBM, Oracle, Microsoft, Google, Yandex, Hewlett-Packard, EMC, etc.) is engaged in active research and development in this area. Effective models and technologies for gathering, condensing, and integrating vast amounts of data from formalised and unformalized sources have been developed and are now being used.

Additionally, several ontological models of data representation and generalisation are typically utilised for the generalisation and integration of data with the goal of subsequently extracting knowledge from them.

Statistical methods are mostly utilised to solve the issues of analysis, optimisation, and enhancement of a building's energy efficiency [5]. In-depth research is currently being done in the area of developing intelligent techniques and technologies, which, in addition to these methods and models, include, in particular, neural network and fuzzy methods and technologies [6]. They unquestionably have benefits and drawbacks [7].

The following are some benefits of fuzzy methods, models, and technologies: the ability to use a variety of data types, including expert data, presented through a variety of scales; the simplicity of knowledge representation; the ability to interpret the results in linguistic terms; the ability to present data inaccuracies and uncertainties; the ability to represent and model nonlinearity; the ability to parallelize fuzzy computing The complexity of building an expert knowledge base, the difficulty of ensuring that the knowledge base is complete and consistent, the difficulty of structural and parametric optimisation of the knowledge base, the lack of learning opportunities, and the inability to automatically acquire knowledge are the limitations of fuzzy methods, models, and technologies.The ability to recognise patterns in data and their generalisation; the potential to represent and model non-linearity; a typical method for solving various problems; adaptability and the capacity for learning; the potential to parallelize calculations; the potential to present inaccuracies and uncertainties in the data; and the potential for use in real time are all advantages of neural network methods. The complexity of describing how a system works, the number of cycles and length of learning, the difficulty of forming a topology and set of parameters for a neural network model that is appropriate for the task, and the difficulty of creating a representative and consistent teaching option are all drawbacks of neural network methods, models, and technologies. The development of hybrid neuro-fuzzy methods, models, and tools that can complement one another and make up for the drawbacks and limits of each approach separately is currently the subject of ongoing study [8].

DESCRIPTION OF THE MODEL

Combining the use of analytical, neural network, and fuzzy models is necessary to effectively analyse and optimise building energy efficiency while accounting for different sources of uncertainty. A thorough design model of the building's energy flows with the potential for employing RES was produced as part of the work's scope and served as a learning example. The fuzzy model itself is also built while simultaneously taking into account the constraints brought on by the thermal and electrical dependencies unique to the sorts of structures under consideration.

The capability of prescriptive analysis and modelling of the energy balance of buildings has been expanded and improved thanks to the method of combined analysis and modelling of energy consumption processes in buildings, which combines the capabilities of analytical, neural network, and fuzzy logic approaches. In order to achieve the requisite accuracy and reliability of the analysis results, the study establishes essential and sufficient conditions for the minimum number and composition of input data. Prognostic functions with daily, weekly, and seasonal periodicity of energy consumption exhibit differences. For the purpose of building forecast models with at least 90% accuracy, a minimal set of beginning factors is suggested. Thus, a workable analysis based on the five-factor regression model is demonstrated when analysing typical buildings for water sports typical of university campuses. the average monthly outside air temperature for the period in question, ° C; x2 is the relative humidity of the outside air,%; x3 - consumption of electrical energy in the building, kWh; x4 - number of visitors to the basin during the period under review, people; x5 - time of work of power-consuming equipment (furnaces of saunas), h; y - thermal energy consumption of the building, Gcal. Design coefficients for factors are multiplied by "Gcal" and have a dimension equal to the inverse dimension of the factors to which they are related. "Gcal" is the absolute term's dimension.

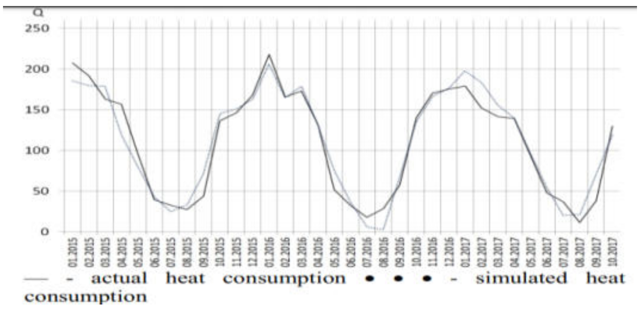

Fig.1. Actual function & forecast functions.[11]

BASED ON THE MODEL METHOD FOR SELECTION OF ENERGY SAVING MEASURES

In the process of fixing the issue, a system for choosing a group of actions to maximise buildings' energy efficiency was put out. The original model and method of selecting energy-saving methods are proposed, taking into account the varying compatibility and relevance of the indicators being examined as well as a flexible multi-level structure. You may obtain a visualized technologies comparison tool in relation to the object by placing all the technologies on the graph in Fig. 2, where the abscissa represents a simple payback period and the ordinate axis represents the amount of capital investment for the deployment of the measure. The area shown in green on the diagram represents the most suited and efficient technology for usage in this facility. Two previously mentioned elements—the amount of annual energy savings (proportional to the diameter of each ball in the diagram) and a straightforward payback period—were used to establish the practicality of implementation in this case. Using the research's findings as a foundation, formats and forms for presenting forecast data on energy consumption are suggested, taking into consideration changes to buildings' primary energy characteristics, the qualities of their engineering systems, and the use of renewable energy sources.

The Analytical Centre of the Government of the Russian Federation [9] and the Ministry of Construction, Housing, and Community Services of the Russian Federation [10] used the findings of this work to develop methodological recommendations for estimating the effects of implementing energy-saving measures and enhancing building energy efficiency.

CONCLUSION

Applying the method for resolving major issues outlined in the article will allow you to confirm and predict the energy-saving effect, which is a problem due to the contradictions mentioned above in the accumulation of heterogeneous and diverse information and the lack of typical approaches to its assessment. The only way to solve the scientific problem of massive data analysis that can be employed in the future to create intellectual functions of energy consumption is to apply integrated mathematical statistics and neural network algorithms. It is only possible to tackle the practical challenge of making decisions to increase the energy efficiency of different types of buildings by using the approach of expert assessments based on visualisation of the outcomes of solving important difficulties.

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Technological Assessment of Wireless Electricity Transmission: Research

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ABSTRACT

This research article discusses Wireless Power Transmission (WPT), a practical technique that may be used to gather solar energy and focus it on the earth's surface without the need for a wire connection (SPS) This study addresses the many techniques utilized for transmitting wireless electricity since wireless power transmission incorporates numerous ideas and is explicated by numerous techniques. The microwave source is shielded from reflected power by a waveguide ferrite circulator, which is linked to this adapter. The downsides of each, as well as any economic implications, will be discussed.

Keywords—*Wireless Electricity Transmissionhigh-voltage lines,electromagnetic field.*

INTRODUCTION

The primary idea behind a wireless transmission system is to deliver electricity wirelessly. Witricity was the first ever principle to be established. It denotes the abbreviation for electricity and the fact that magnetic resonance is crucial to its theory. In situations where running connecting lines would be difficult, hazardous, or impossible, wireless communication is helpful. Using high-quality materials can increase the effectiveness of the conventional power transmission system, but at a substantial cost premium.Direct induction is used as the most popular kind of wireless power transfer, followed by resonant magnetic induction. Other techniques use electromagnetic radiation in the form of microwaves or lasers, and occasionally electric wire mixed with organic materials. Power consumption is rising daily in accordance with demand, and while power generation is increasing, so is power loss.

The main source of loss is in the electricity transmission and distribution. Power loss occurs during transmission and distribution and is around 26%. Losses result from the use of cables and the grid; lowering this loss percentage Here, we're employing wireless transmission with the aid of various widely used techniques, such as wireless power transfer:

1. Electromagneticinduction
2. Electrostaticinduction
3. Electromagneticradiation
4. Lasermethod

5. Electricalconduction
6. Microwavemethod

ELECTROMAGNETICINDUCTION

Our design's primary goal is to enable wireless embedment network experimentation. In order to accommodate a variety of experimental works, it must be small, low power, and versatile. It contains a central microprocessor that handles all of the processing, communication, and sensing functions. At distances up to roughly one-sixth the wavelength, electrodynamic induction near-field wireless communication technology is employed. The simplest type of wireless energy transmission is this function of an electrical transformer. A transformer's primary and secondary circuits are not directly linked. Via a mechanism called as mutual inductance, energy is transferred. Electrical isolation and ramping the primary voltage up or down are the main purposes. Transformers for power distribution as well as chargers for mobile devices and electric toothbrushes are examples of devices that make use of this concept. The resonance's applicability range expands only a little.

The transmitter and receiver are tuned to the same resonant frequency inductors if resonant coupling is utilised. By changing the driving current of a sinusoidal waveform of a sinusoidal transient, the performance may be further enhanced. The simplest example of wireless energy transmission is the operation of an electrical transformer. A transformer's primary and secondary circuits are not electrically coupled to one another. Via a process known as mutual induction, electromagnetic coupling is used to transmit energy. In order to induce a current in a secondary coil, electromagnetic induction relies on the idea that a primary coil creates a field that is mostly magnetic and that secondary coil is located inside that field. A tight coupling is necessary for optimum efficiency. More and more of the magnetic field misses the secondary as the distance from the main grows. The basic induction approach is incredibly ineffective even over relatively short distances, losing a large portion of the communicated energy.

Resonance is used, and this slightly helps the condition. When resonant coupling is employed, the driving current is changed from a sinusoidal to a non-sinusoidal transient waveform, and the transmitter and reception inductors are adjusted to a common frequency. Systems exist to power and recharge computers and cell phones, and contactless smartcards are a typical use for the technology.

ELECTROSTATICINDUCTION

For wireless energy transmission using high frequency alternating current potential differences transmitted between two plates or nodes, the "electrostatic induction effect" or "capacitive coupling" is an electric field gradient or differential capacitance between two elevated electrodes over a conducting ground plane.Energy may be transferred to a receiving device (like Tesla's wireless lights) by electrostatic forces acting via natural media across a conductor located in a changing magnetic flux. It is the application of an electrical displacement, or the movement of electrical energy through space and matter, other than and in addition to the establishment of a potential across a conductor, and is also referred to as "the Tesla effect."

When only small amounts of energy are needed, it may not always be necessary to have the terminals at a high elevation, especially the receiving terminal. This is because, particularly when the frequency of the currents is very high, electrostatic induction from the upper air strata, which are made conducting by the transmitter's active terminal or through which the currents from the same are convectional, may be used to collect energy at the receiving terminal. –

the transmission of electric energy through a dielectric or electrostatic induction. In actuality, an electric field gradient or differential capacitance between two or more raised above a conductive ground plane insulated blocks, plates, electrodes, or nodes. By supplying the sheets with a high potential, high frequency AC power source, the electric field is produced. A voltage divider is created by the capacitance between two terminals and a more powerful device.

ELECTROMAGNETICRADIATION

Radio waves are utilised for communication, nautical and aviation navigation, as well as the wireless transfer of sound messages or information. Amplitude modulation (AM), frequency modulation (FM), or digital information is applied to the electromagnetic carrier wave (pulse modulation).Hence, transmission uses a frequency band instead of a single frequency electromagnetic wave, whose breadth is related to the information density. For telephone, high-fidelity sound, and high-definition television, the widths are around 10,000 Hz, 20,000 Hz, and five megahertz (MHz; one million hertz) respectively.The lower frequency limit for radio waves is established at a frequency of around 10,000 Hz due to this breadth and the decline in electromagnetic wave generation efficiency with decreasing frequency. The line of sight distance from the top of a 100-metre (330-foot) tower is only around 30 kilometres due to the curvature of the Earth (19 miles).The Kennelly-Heaviside layer, often known as the ionosphere, was discovered as a result of Marconi's surprising success in sending communications over 2,000 kilometres. This zone is a 300 km thick layer that begins about 100 km above the Earth's surface. In this layer, ultraviolet radiation from the Sun partially ionises the atmosphere, producing enough electrons and ions to effect radio waves.Due of the Sun, the stratified ionosphere's height, breadth, and level of ionisation change from day to night and from summer to winter.

The electromagnetic radiation may be in the distant field to be (with high directivity antennas or well-collimated laser beam) adapted the form of the receiving area, so it gives almost radiated power at long range. This is the major reason for higher distances with radio waves and optical devices. Physically, diffraction prevents antennas from having their greatest directivity.

LASERMETHODS

When electromagnetic radiation in the visible spectrum (10 um to 10 nm) in detail is capable of transmitting power by converting current into a laser beam, which is then received by a solar cell, Because the power at a receiver can be known and converted into useful electrical energy, this method is commonly referred to as "power beaming." Applications for commercial and consumer electronics are being developed using the laser "power beaming" technology, which has mostly been investigated for military weaponry and space uses. applications for low power Consumer space wireless energy transmission systems employing lasers must adhere to laser safety regulations. Higher energy densities, a tighter beam focus, and smaller emission and receiver diameters are all made possible by laser energy transfer. Mass of the laser generation system and the required laser generation temperature

ELECTRICALCONDUCTION

The movement of electrically charged particles through a gearbox medium is known as electrical conduction, and the movement can result in the formation of an electric current in response to an electric field. The substance will determine the underlying mechanism for this movement.

According to Ohm's Law, which states that the current is proportional to the applied electric field, conduction in metals and resistors is well defined. Charge of ground and air technique disturbed. Alternating current can be wirelessly transmitted through the ground with an equivalent electrical displacement acquired by the air above large regions that is higher than the resonant electrical induction techniques and low compared to the electromagnetic radiation methods. Because the net resistance between the earth's antipodes is less than 1 ohm, electrical adjustment occurs primarily through electrical conduction through the oceans, and metallic ore bodies and other similar subsurface structures, electrical energy can be transmitted through inhomogeneous earth with low loss. Electrostatic induction's ability to displace electricity through more dielectric areas, such quartz deposits and other nonconductive materials. Currents travelling through the ground draw recipients, while a corresponding electric displacement occurs in the atmosphere.

MICROWAVEMETHOD

It is possible to transmit power across vast distances using radio waves instead than the more common microwave spectrum, which uses shorter wavelengths of electromagnetic energy. an adapter The microwave energy is transformed into electrical energy using a rectenna. Almost 95% of its efficiency has been published. In order to transmit energy from solar-powered satellites circling the earth and leave the beaming of electricity to spacecraft orbit, power beaming utilising microwaves has been studied.

CONCLUSION

This presents the idea of wireless power transfer and microwave power transmission (MPT). As is well known, there are benefits and drawbacks to using microwaves for power transmission. Hence, the choice of technology depends on a variety of factors, including needed power, distance, medium, application, complexity, and cost. More than any invention or discovery, this idea opens up the possibility of power transfer with minimal losses and simplicity of transmission.

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The Creation of a Prognostic Health Monitoring System and a Safety and Failure Analysis of the Electrical Powertrain for Electric Vehicles

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ABSTRACT

Designing a prognostic health monitoring system for electrical powertrain components is one of the primary goals of the EU project HEMIS in order to improve the safety and maintainability of electric vehicles. Based on a generic design that tries to capture common properties of a wide range of electric cars, this paper summarises some of the preliminary work done in the areas of safety and failure analysis

Keywords- powertrain, electric vehicle, electric car, failure analysis, HEMIS.

INTRODUCTION

Due to the relative youth of the new technologies involved, moving towards mass manufacturing of hybrid and electric vehicles brings significant hurdles to the auto industry. The electrical powertrain, which consists of the electric traction machine and its related power electronics controller, is the most notable of these. Fully electric vehicles (FEVs) are characterised by the fact that their only source of traction is its electrical powertrain. Therefore, creating a Prognostic Health Monitoring System (PHMS) for the electric powertrain is one of the key goals of the EC project HEMIS in order to improve the safety and maintainability of FEVs. To do this, a generic electric vehicle architecture has been created and examined to look into pertinent safety and reliability issues. This has been accomplished by defining and analysing a generic electric vehicle architecture in order to look at pertinent safety and reliability issues and afterwards determine what is needed for the PHMS.

ELECTRIC VEHICLE GENERAL STRUCTURE

The RAMS (Reliability, Availability, Maintainability, and Safety) analysis tasks in the HEMIS project need an input from the underlying architecture. As the intended audience for The architecture that is defined must be generic, expressing the general qualities of electric vehicles that are pertinent to the HEMIS PHMS, as opposed to any individual vehicle, as the HEMIS PHMS is a large class of electric vehicles. The suggested generic electric vehicle architecture must therefore strike a balance between the need to make the analysis general (and hence high level) and the need to take into account enough specifics to make the RAMS analysis feasible. During the RAMS analysis processes, it is predicted that the architecture may need to be further enhanced.

This research concentrates on system components that are significant for the PHMS and the electrical powertrain components that this system seeks to monitor because it is not practical to address the full vehicle in the HEMIS project. To define the vehicle architecture at a level appropriate for study, some presumptions on the nature of the vehicle were necessary. First off, it is presumptive that a near-future, high-end passenger vehicle will be the HEMIS PHMS' intended use. Previous EU research initiatives, such as [1] through [3], suggest that the following features can be expected to be included in such vehicles, and in-vehicle data network divided into a number of "functional domains"; x connections between cars and infrastructure Systems for Advanced Driver Assistance (ADAS).

Although alternative powertrain vehicles have a wide range of physical and electrical architectures, the HEMIS project's primary focus is on fully electric cars (FEVs) as defined in the context of the European Green Cars Initiative [4], which includes: cars that are electrically propelled and offer a sizable driving range using only battery power; x includes cars with range extenders; x including compact, light-weight passenger and light-duty vehicles.

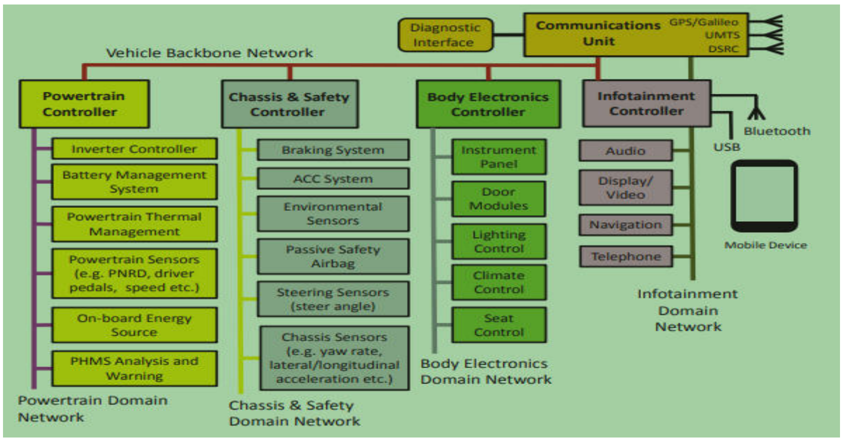

Fig. 1: HEMIS generic FEV architecture: network view.[27]

Thus, in addition to vehicles that are entirely powered by batteries, the FEV idea also include series hybrid architectures and vehicles that use alternative energy sources like fuel cells. As a result, the initial assumptions made about the electrical powertrain for HEMIS are that: x traction power is only provided by electrical machines, and not mechanically from any on-board source such as an internal combustion engine (ICE); x the electrical machine may be operated as a traction motor, or as a generator under braking conditions; and x the electrical machine may be operated as a generator under braking conditions. Being the most popular option, a high voltage traction battery provides electrical energy storage; Energy is assumed to come from the following sources: x the electricity grid (by conductive or inductive charging, the latter of which may be accomplished by wireless power transfer, during which the vehicle may be active but temporarily stationary above a source coil embedded in the road, or possibly even while in motion as in [5]); x energy recovery during regenerative braking; x possibly from an on-board energy source (which could be an ICE or turbine connected to a generator); A HEMIS PHMS that is focused on the electrical gearbox components (i.e., the electrical machine(s) and their related power electronics and control systems) is also presumptively installed in the vehicle. Based on [3], the presumptive network architecture is shown.

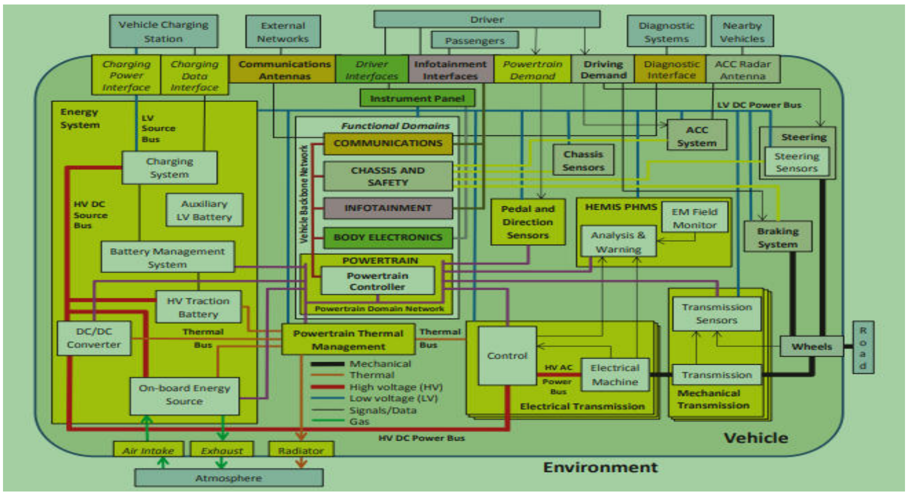

Fig. 2: Functional picture of the HEMIS generic FEV architecture.[27]

MAIN FUNCTIONS OF VEHICLE

The distribution of the vehicle systems throughout the five functional domains of the powertrain, chassis and safety, body electronics, infotainment, and communications is assumed in Figures 1-2. All domains are connected to a Vehicle Backbone Network, which allows for inter-domain communication, while each domain has its own network for intra-domain communication. Each domain has a domain controller, which serves as a back-up domain system in the event that the associated systems fail and serves as a gateway to the Vehicle Backbone Network. Although the Powertrain Domain is the one that HEMIS is most interested in, some Chassis and Safety Domain systems may also interact with Powertrain Domain systems in a meaningful way. Additionally, the Body Electronics Domain is interesting due to its function in informing and alerting drivers. However, the importance of the Infotainment and Communication domains for PHMS operation is smaller.

The architectural description was used to specify the high level functionality of the systems. The Energy System in the Powertrain Domain offers resources for getting, producing, and storing energy as well as for supplying energy to the Electrical Transmission. The HV Traction Battery, DC/DC Converter, On-Board Energy Source, Control, and Electrical Machine are just a few of the important powertrain sub-systems that the Powertrain Thermal Management system controls for maximum performance.

The Pedal and Direction Sensors, which keep an eye on the accelerator pedal and PNRD (Park, Neutral, Reverse, and Drive) selection lever, transmit driver demand to the powertrain. Torque delivery to the Wheels via the Mechanical Transmission is the primary purpose of the electrical powertrain (the Electrical Transmission of Figure 2). It is anticipated that the Electrical Transmission, under the direction of the Powertrain Controller, implements more complex tasks of the electrical powertrain, such as idle creep, hillhold, and torque vectoring. Regenerative braking, which essentially provides energy harvesting when the accelerator pedal is released if the machine's rotor is still turning, is also taken into consideration, however it is presumed to be Category A as specified in [6].

The Braking System of the Chassis and Safety Domain is the major source of braking. This system is also expected to include a variety of improved braking features, such as electric parking brakes, electronic stability control, and brake aid of Category A, which has been required since 2011 [9].

These features have all been required since 2007 and include anti-lock braking, brake assist of Category A, and electronic stability control. An Adaptive Cruise Control (ACC) system, as well as the Steering Sensors and Chassis Sensors, are additional systems from the Chassis and Safety domain that communicate with the electrical powertrain. The Chassis Sensors have parameters like longitudinal acceleration, which are needed as an input to the hill-hold function, which is carried out by the Powertrain Controller and Electrical Transmission. The ACC system also features a speed control function.

HAZARD ANALYSIS OF VEHICLES

A preliminary hazard analysis (PHA) is conducted by going over a system's high level functionality and operational environment. This makes it easy to recognise the dangers that could arise if the system's objective is not accomplished. The use of guidewords is suggested because the PHA is designed to be systematic and repeatable. The PHA makes a distinction between system failures and hazards, and the system under study must be taken into account without any safeguards or mitigations. Furthermore, for this kind of analysis, implementation specifics are irrelevant.

The HEMIS PHA was built on the foundation of the general architecture described in section 2. The goal of this investigation was to pinpoint risks related to vehicle handling and stopping distance, as well as risks related to acceleration and deceleration (i.e., unavailable, un-demanded, excessive, insufficient and reversed). The high level functions described in section 3 were evaluated to find functional flaws that might lead to dangers. The Powertrain Domain, Chassis and Safety Domain, and Electrical Transmission and Energy Systems were the main areas of analysis for these functional domains.

The process of identifying hazards was divided into two phases: the first phase focused on functional system failure-related risks, while the second phase focused on non-functional hazards that are inherent to the unique technologies used in the vehicle. The latter featured high voltage electrical power networks, traction batteries, and on-board energy production systems like fuel cells. Fire, explosion, exposure to dangerous compounds, and exposure to high voltages are a few of the potential risks associated with these. The PHA's goal is to convert system risks into design restrictions or functional safety requirements. After being found, each risk was evaluated in terms of Using qualitative classifications outlined , assess their possible effects ("severity"), likelihood of exposure to the danger ("exposure"), and chances for the driver to have some control over the result ("controllability"). The resulting hazards were then determined and categorised in accordance with the Automotive Integrity Levels (ASILs) of using a risk graph. The individual systems and functions that may result in the possible dangers were also identified using fault tree analysis (FTA) and failure mode and effects analysis (FMEA). The targeted, deductive nature of FTA may discover failures that the larger, inductive FMEA methodology could miss, making the FMEA and FTA methodologies complementary. On the other hand, the extensive coverage offered by FMEA may reveal pertinent problems that are outside the purview of the more constrained FTA analyses.

THE DESIGN OF ELECTRICAL TRANSMISSION

To enable more thorough study of the components that are supposed to be monitored by the PHMS, the Electrical Transmission's design was further improved, as shown in Figure 3.

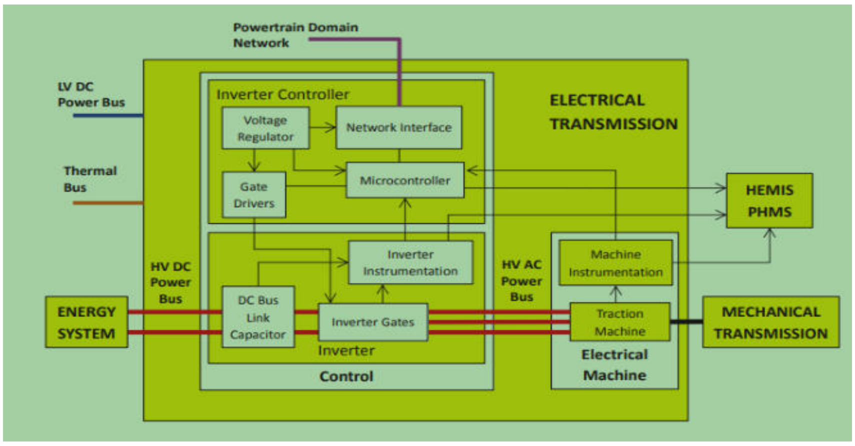

Fig.3: Information about the architecture of electrical transmission.27]

Three different types of traction machines were taken into consideration based on surveys of already available vehicles (like [11]) and conversations with vehicle and machine manufacturers. These featured switching reluctance machines, permanent magnet synchronous machines, and squirrel cage induction machines. The main parts of the three different types of machines—the rotor, stator, bearings, windings, etc.—are fundamentally the same. The implementation of the rotor magnetic field source is where they diverge most. A steel cage made up of rotor bars and rotor end rings forms the magnetic field of the rotor in the squirrel cage induction machine. Permanent magnets, primarily made of rare-earth elements, serve as the rotor magnetic field sources for the permanent magnetic machine. Salient rotor poles made of soft magnetic material that protrude from the rotor core in the switching reluctance machine provide the rotor magnetic field. As a result, while the failure types do differ slightly from one another, the failure behaviours as a whole are relatively similar.

The underlying design of the power electronics and controller utilised to power these devices is also similar. The failure behaviours are, thus, once more extremely similar for the Different circuit topologies are needed to drive the various machine kinds. FMEA and FTA were used to investigate potential functional failure mechanisms of the generic electrical powertrain utilising functions specified in accordance with the architecture shown in Fig. 3. Additionally, an overview of how electrical powertrain issues relate to the vehicle-level functional safety threats was developed using Ishikawa diagrams [12], offering a detailed breakdown of all potential reasons that could result in the bad outcome. This method offers a graphic picture of the connections between all of the possible reasons, making it easier to pinpoint the problem's underlying causes. In order to ensure that functional safety targets are met, the FMEA approach provides a mechanism for identifying and prioritising those failure modes that would call for remedial action.

FAULTS IN TRANSMISSION

Since these technologies are still in their relative infancy, specific information about problems in car traction machines and related power electronics converters is not generally available. There is, however, some information about comparable equipment used in other applications. At voltages below 1 kV RMS, electrical machine connection faults are reportedly relatively rare [13], but at higher voltages, they are more frequent due to increased dielectric stresses and strains on conductors. According to reports, hybrid and electric car traction battery voltages range from 120 V [14] to 650

V [15], which suggests that connection failures in traction machines now utilised in automotive applications may be improbable. However, it is generally acknowledged that bearing-related failures are the most frequent reason for electrical machine failure, with stator-related faults and other rotor-related faults making up the next two most important fault types. Table 10—which is based on the surveys mentioned in [16] and [17]—breaks down these categories into more detailed component flaws. Both surveys' findings are fairly similar, with 41% of defects being attributed to bearings, 35-36% to stators, and 9-10% to rotors. Stator ground insulation issues, which account for 22-23% of machine failures [16]–[17], are the main cause. These results, however, are heavily influenced by larger, higher voltage machines with higher degrees of vibration and dielectric stress, which could not accurately represent the properties of car traction motors. Additionally, it is said in [13] that larger machine bearings tend to be more dependable than those of smaller machines. According to a review of small (75 kW), low-voltage machines (often squirrel cage IM), bearing faults were to blame for 95% of the failures, whereas stator and rotor issues only accounted for 2% and 1% of the failures, respectively [18].

However, it is stated in [19] that because induction motors used for automotive traction applications experience more frequent, rapid temperature rises than comparable machines used for industrial applications, electrical issues may be far more common in the latter. In squirrel cage induction machines, these temperature variations could hasten the deterioration of insulation and result in mechanical strains that could lead to cracks forming at the intersections of the rotor bars and end rings. As a result, while the results of [18] would seem to indicate that bearing problems are the primary cause of machine failures in automotive traction applications, insulation and rotor-related faults may also play a substantial role in electrical machine failures. Failures in the converter were claimed to be caused by defects in capacitors (30%), PCBs (26%), semiconductors (21%) and solder (13%), according to a survey based on 200 items from 80 businesses [20]. Another industry-based survey's findings [21] indicate that 40% of semiconductors, 26% of capacitors, and 24% of gate drivers have problems. These findings imply that power semiconductors and DC link capacitors are likely to be responsible for a sizeable share (perhaps between 50 and 60 percent) of potential inverter failures.

POSSIBLE PHMS INPUTS

The Inverter and Electrical Machine sensors, as well as other vehicle metrics that may be relevant to their performance, will be monitored by the HEMIS PHMS in order to evaluate the health of these important electrical powertrain components. The remaining useful life may be predicted as well as flaws and degradation could be found using this information. This would improve dependability, availability, maintainability, and safety by warning the driver of potential issues and the need for repair.

Fault Indicators	Fault Types							
	Bearing and seals	Air-gap eccentricity	Rotor Bars	Winding short circuit	Insulation	Rotor Shaft	Rotor Core	Stator Core
Current	×	×	×	×	×			
Vibration	×	×	×	×		×	×	×
Temperature	×			×	×		×	×
Partial discharge				×	×			
Gaseous emission				×	×			
Air-gap torque				×				
Power				×				
Magnetic flux	×	×		×				
Acoustic emission	×							

Table 1: Possible signs of induction motor issues.[27]

Based on the reviews described in [22] and [23], Table 1 below provides an overview of the physical features used to track the signs of typical induction machine defects. Automotive traction machine failures are thought to most frequently be caused by issues with bearings, insulation, and rotor components (see section 6). As a result, the findings in Table 1 imply that temperature, vibration, and current may be helpful HEMIS PHMS indicators. Without the requirement for extra sensors (which might be more expensive and less reliable) or access to the machine, stator current signature monitoring may also be able to provide information on machine vibration characteristics. Additionally, the stator current is frequently already being watched for other purposes, such as safeguarding the machine against harmful fault currents and keeping an eye on the efficiency of inverters. Damaged bearings, fractured rotor bars, and air-gap eccentricity are a few vibration-related faults that might be identified by their effects on the stator current signature [22]–[23]. The large fluctuations in operating circumstances that arise during driving, however, may necessitate the use of more advanced signal processing techniques for automotive applications. It has been demonstrated that approaches based on short-time Fourier Transform and Wavelet Transform methods are appropriate for a range of load circumstances [23]. Based on tracking the stator current vector, methods for identifying IGBT failures in a PWM voltage source inverter drive for an induction machine are detailed in [24]. According to these methods, the damaged semiconductor may be located, and data clustering algorithms provide a reliable assessment that is not reliant on rotor speed. Due to the changeable speed and load conditions, the latter is especially interesting for FEV applications.

Drive capacitor failures brought on by ageing are often tracked in terms of the capacitor's ESR (equivalent series resistance) through Fourier studies of current or voltage data [25]. According to [26], when loads are reasonably constant, ripple voltage and ripple current are good indicators of capacitor ageing; if not, the ratio of ripple voltage to ripple current is used. An alternative method based on system modeling is proposed to estimate the ripple voltage from the converter input current in the absence of ripple monitoring. Alternative real-time condition monitoring is also suggested in [26], where the capacitance and ESR values are estimated.

CONCLUSION

According to ISO standards, a generic electric vehicle architecture has been proposed and utilised as the foundation for safety assessments 26262, FMEA, and FTA) to look into the specifications for a prognostic health monitoring system (PHMS) to watch over the electrical powertrain parts. The failure mechanisms related to the electrical machine and its related power electronics have also been examined in further detail utilizing Ishikawa diagrams, FMEA, and FTA techniques. Opportunities for electrical powertrain component condition monitoring have also been briefly addressed. The large fluctuations in operating circumstances that arise during driving, however, may necessitate the use of more advanced signal processing techniques for automotive applications. The breadth and accuracy of condition monitoring for electrical powertrain components are thus expected to be improved, as well as the accompanying forecasting capabilities, by merging information from a variety of sensors and analysing them using a variety of processing approaches.

Therefore, future work will focus on choosing the parameters that the HEMIS PHMS should monitor and developing appropriate analysis algorithms for eventual implementation and prototype presentation.

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Solar Tracking System: Effective Use of Solar Panels

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ABSTRACT

This paper shows the potential system benefits of simple tracking solar system using a servo motor and light sensor. This method is increasing power collection efficiency by developing a device that tracks the sun to keep the panel at a right angle to its rays. A solar tracking system is designed, implemented and experimentally tested. The design details and the experimental results are shown.

Keyword: *Solar Tracker, H-Bridge, LDR, Solar panel*

INTRODUCTION

Extracting useable electricity from the sun was made possible by the discovery of the photoelectric mechanism and subsequent development of the solar cell – a semi conductive material that converts visible light into a direct current. By using solar arrays, a series of solar cells electrically connected, a DC voltage is generated which can be physically used on a load. Solar arrays or panels[3] are being used increasingly as efficiencies reach higher levels, and are especially popular in remote areas where placement of electricity lines is not economically viable. This alternative power source is continuously achieving greater popularity especially since the realization of fossil fuels shortcomings. Renewable energy in the form of electricity has been in use to some degree as long as 75 or 100 years ago. Sources such as Solar[3], Wind, Hydro and Geothermal have all been utilised with varying levels of success. The most widely used are hydro and wind power, with solar power being moderately used worldwide. This can be attributed to the relatively high cost of solar cells and their low conversion efficiency. Solar power is being heavily researched, and solar energy costs have now reached within a few cents per kW/h of other forms of electricity generation, and will drop further with new technologies such as titaniumoxide cells. With a peak laboratory efficiency of 32% and average efficiency of 15-20%, it is necessary to recover as much energy as possible from a solar power system[1-5]. This includes reducing inverter losses, storage losses, and light gathering losses. Light gathering is dependent on the angle of incidence of the light source providing power (i.e. the sun) to the solar cell's surface, and the closer to perpendicular, the greater the power. If a flat solar panel is mounted on level ground, it is obvious that over the course of the day the sunlight will have an angle of incidence close to 90°in the morning and the evening. At such an angle, the light gathering ability of the cell is essentially zero, resulting in no output. As the day progresses to midday, the angle of incidence approaches 0°, causing a steady increase in power until at the point where the light incident on the panel is completely perpendicular, and maximum power is achieved. As the day continues toward dusk, the reverse happens, and the increasing angle causes the power to decrease again toward minimum again. From this background, we see the need to maintain the maximum power output from the panel by maintaining an angle of incidence as close to 0° as possible. By tilting the solar panel to continuously face the sun, this can be achieved. This process of sensing and following the position of the sun is known as Solar Tracking. It was resolved that real-time tracking would be necessary to follow the sun effectively, so that no external data would be required in operation.

TECHNIQUES USES IN SOLAR TRACKER:

Ball and Beam system-The purpose of the design is to the position of ball along the track by manipulating the angular position of servo. The beam consists of a steel rod in parallel with a nickel-chromium wire-wound forming a track upon which a metal ball is to free to roll. One end of the beams is coupled to the servomotor through a lever arm and gears and the other end is fixed. The wire-wound resistor is biased and when the rolls along the track it acts as wiper similar to a potentiometer. The position of the ball along the track is obtained by measuring the voltage at the steel rod.

An optional remote sensor is also available for operation in master/salve tracking mode. This sensor is used, as the input the Ball &Beam desired position, making the Ball on the beam follow the ball on the remote sensor.

H-bridge: An H-Bridge is an electronic power circuit that allows motor speed and direction to be controlled. Often motors are controlled from some kind of"brain" or micro controller to accomplish a mechanical goal. The micro controller provides the instructions to the motors, but it cannot provide the power required to drive the motors. An H-bridge circuit inputs the micro controller instructions and amplifies them to drive a mechanical motor. This process is similar to how the human body generates mechanical movement; the brain can provide electrical impulses that are instructions, but it requires the muscles to perform mechanical force. The muscle represents both the H-bridge and the motor combined. The H-bridge takes in the small electrical signal and translates it into high power output for the mechanical motor. This document will cover the electronic principles in creating the H-Bridge portion of the ”muscle”.

Implemented Technique: Many different methods have been proposed and used to track the position of the sun. The simplest of all uses an LDR [5] – a Light Dependent Resistor to detect light intensity changes on the surface of the resistor. Other methods, such as that use two phototransistors covered with a small plate to act as a shield to sunlight, as shown Fig1.

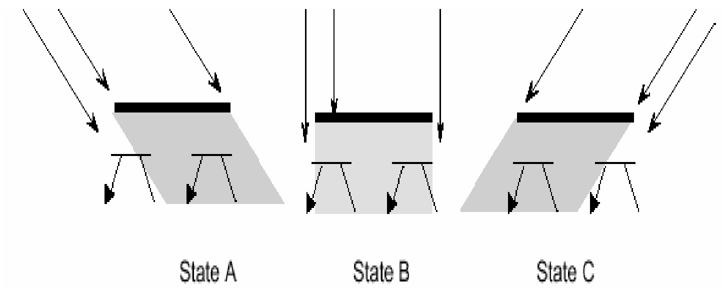


Fig. 1 Alternative solar tracking method

When morning arrives, the tracker is in state A from the previous day. The left phototransistor is turned on, causing a signal to turn the motor continuously until the shadow from the plate returns the tracker to state B. As the day slowly progresses, state C is reached shortly, turning on the right phototransistor. The motor turns until state B is reached again, and the cycle continues until the end of the day or until the minimum detectable light level is reached. The problem with a design like this is that phototransistors have a narrow range of sensitivity, once they have been set up in a circuit under set bias conditions. It was because of this fact that solar cells themselves were chosen to be the sensing devices. They provide an excellent mechanism in light intensity detection – because they are sensitive to varying light and provide a near-linear voltage range that can be used to an advantage in determining the present declination or angle to the sun. As a result, a simple triangular set-up was proposed, with the two solar cells facing opposite directions, as shown in Fig. 2.

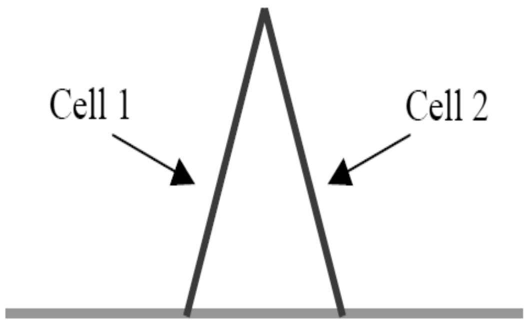


Fig. 2 Set-up of solar reference cells

In its rest position, the solar cells both receive an equal amount of sunlight, as the angle of incidence, although not 90° is equal in both cases.It can be seen in Fig. 3 that as the sun moves in the sky, assuming that the solar tracker has not yet moved, the angle of incidence of light to the reference panels will cause more light to fall on one cell than the other.

This will obviously cause a voltage difference, where the cell that is facing the sun will have higher potential than the other. This phenomenon will result in a detectable signal at each cell, which can be processed by a suitable circuit.

ADVANTAGE

An overall power collection efficiency increase from only 39% for a fixed panel to over 70% for the same panel on the tracking device.

By utilizing this simple design, it is possible for an individual to construct the device themselves.

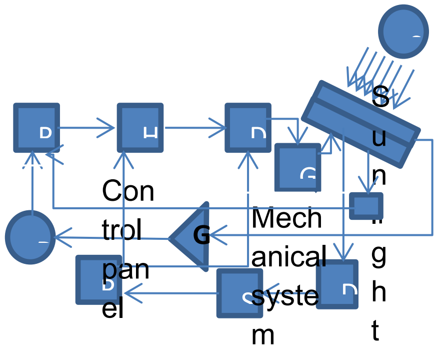
A solar tracker is designed employing to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output.

Solar tracking is by far the easiest method to increase overall efficiency of a solar power system for use by domestic or commercial users.

DISADVANTAGE

Problems arise during rainy season towards the cloudy nature of the day in which sun light not comes properly towards panel.

BLOCK DIAGRAM

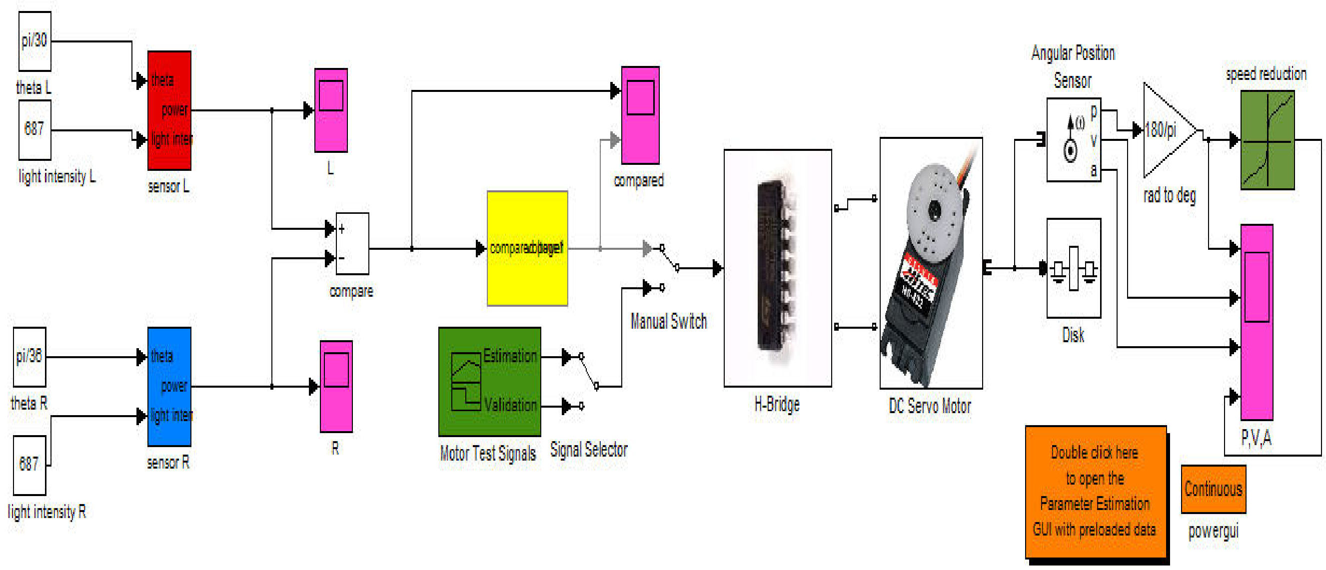


SIMULATION OF SOLAR TRACKER

Our Solar tracker system is design on Mat lab Simulation program in which we make different type of circuit which perform the task to tracks the sunlight. In the simulation part shown in simulation in which a light sensor which detected the light intensity of right and left sensor. Then after that both the data of light sensor goes to the comparator which compared the data and send a voltage signal to the H-bridge which command the servo motor/dc motor to rotate in forward or reverse direction if command is positive than motor rotate in forward direction and if negative than it rotate in reverse direction and if bother sensor are same intensity than motor get stop.

SENSOR L	SENSOR R	DIRECTION
0	0	STOP
1	0	COUNTERCLOCKWISE
0	1	CLOCKWISE
1	1	STOP

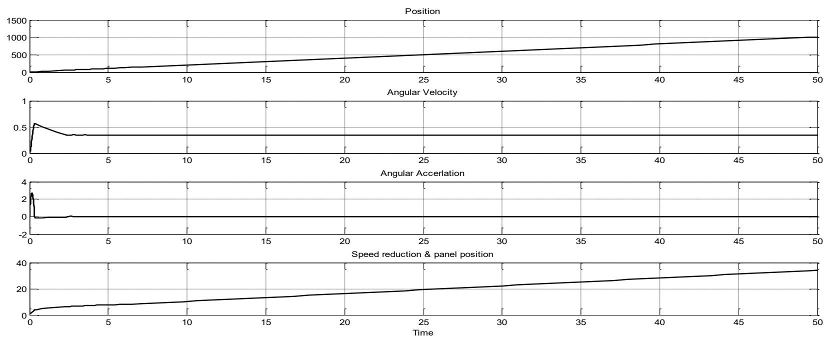
SIMULATION



RESULT

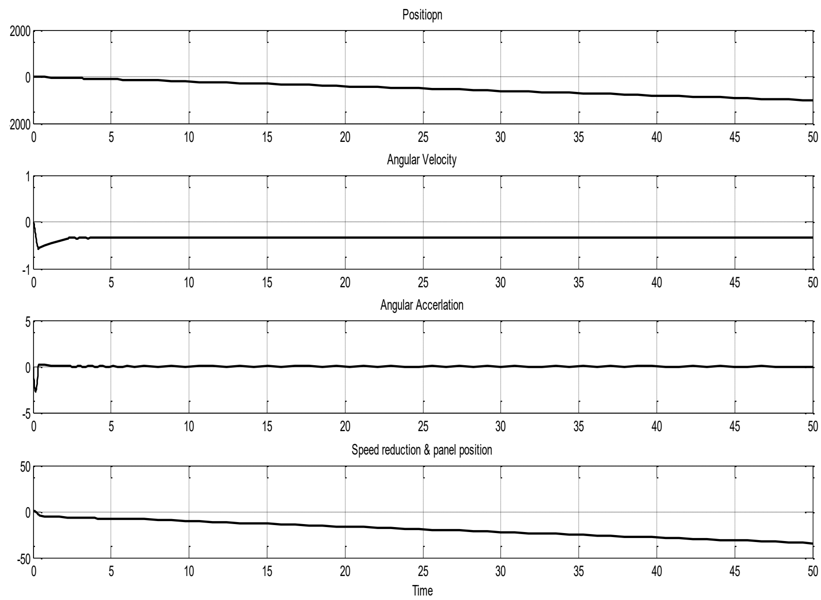
COUNTER CLOCKWISE ROTATION

Here in which the left sensor intensity is higher than right sensor the motor will rotate in left side i.e., counter clockwise.



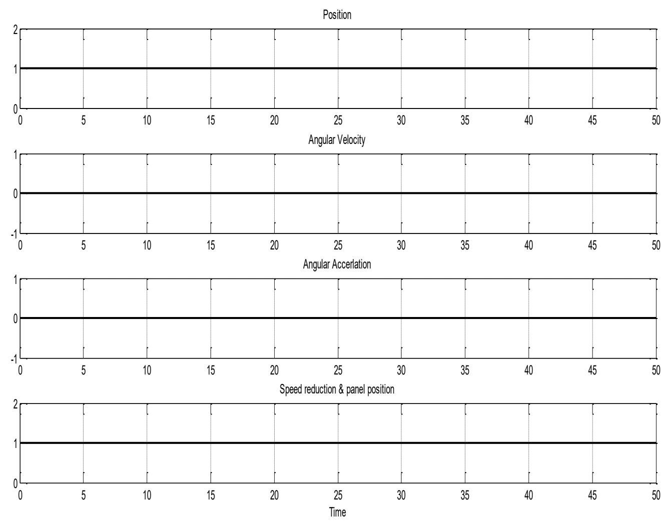
CLOCKWISE ROTATION

Here in which the right sensor intensity is higher than left sensor the motor will rotate in right side i.e., clockwise.



NO ROTATION

When either sensor will get the equal intensity or when there is no light in panel than motor will not rotate i.e., stop.



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CONCLUSION

A solar tracker is designed employing the new principle of using small solar cells to function as self-adjusting light sensors, providing a variable indication of their relative angle to the sun by detecting their voltage output. By using this method, the solar tracker was successful in maintaining a solar array at a sufficiently perpendicular angle to the sun. The power increase gained over a fixed horizontal array was in excess of 30%.

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Opportunities and Challenges for Near-Field Wireless Power Transfer : A Review

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ABSTRACT:

Traditional power supply cords have become less important because they prevent large-scale utilization and mobility. In addition, the use of batteries as a substitute for power cords is not an optimal solution because batteries have a short lifetime, thereby increasing the cost, weight, and ecological footprint of the hardware implementation. Their recharging or replacement is impractical and incurs operational costs. Recent progress has allowed electromagnetic wave energy to be transferred from power sources (i.e., transmitters) to destinations (i.e., receivers) wirelessly, the so-called wireless power transfer (WPT) technique. New developments in WPT technique motivate new avenues of research in different applications. Recently, WPT has been used in mobile phones, electric vehicles, medical implants, wireless sensor network, unmanned aerial vehicles, and so on. This review highlights up-to-date studies that are specific to near-field WPT, which include the classification, *comparison, and potential applications of these techniques in the real world. In addition, limitations and challenges of these techniques are highlighted at the end of the article.*

Keywords: *electromagnetic wave; capacitive coupling; inductive coupling; magnetic resonant coupling; near-field; wireless power transfer (WPT)*

1. Introduction

Wireless power transmission(WPT) is atermthatdenotesmanydifferenttechnologiesfortransmittingelectromagneticenergythroughaphysicalel ectromagneticfield.WPTisnotanewconcept. In fact, several efforts have been conducted in the past decades to transfer energy wirelessly.The beginning of WPT dates back to 1868, when James Clerk Maxwell merged “Ampère’s circuital law”and“Faraday’slaw”ofinduction.Inaddition,otherexperiments,observations,andmathematicalmode ls have been developed into the consistent theory that constitutes conventional electromagnetictheory. The Maxwell equations provide the keystone for current electromagnetics, including wirelessenergytransfer.In1884,John Henry Poynting presente danel ectromagnetic field mathematic calequation that can be used in contactless energy transfer. In 1888, Heinrich Rudolf Hertz discoveredradiowaves, confirming the forecast of electromagnetic propagation by Maxwell. Hertz’s experiments showed that electromagnetic waves could be produced intransmitter coils and wirelessly detected by a receiver coil. In 1894, Hutin and Leblanc’s patented WPT system was used to supply an electricrailway system]. Their system consists of a primary single wire that transmits power at 2 kHz alongtherailwaytrackandseveralresonantreceivercoilsusedatthesecondaryside.

WPT can be categorized into two types, namely, far-field and near-field WPT. Microwave energy transfer falls under the far-field category, in which a large amount of energy can be transmitted between two positions. A WPT system involves a transmitter unit that is connected to the main source of power or battery, which transforms the electrical power into an electromagnetic field. This field may be received by one or multiple receivers to convert it back into electrical power, to be used by the electrical load. On the transmitter side, the power signal and information are carried by the same radio frequency (RF) signal. The information can be recovered at the information receiver and the electromagnetic energy is recovered by the harvester section of the receiver to supply the power to the receiver. The oscillator circuit of the transmitter converts the input power to the electromagnetic field that can be transmitted via the transmitter antenna or coupling systems. At the receiver side, similar coupling systems or antennas are used to alter the received electromagnetic field into electrical current that can be harvested to run the receiver devices. This paper presents a concise evaluation of recent advancements in WPT, and near-field WPT is specifically reviewed. The contribution of this review paper can be outlined as follows:

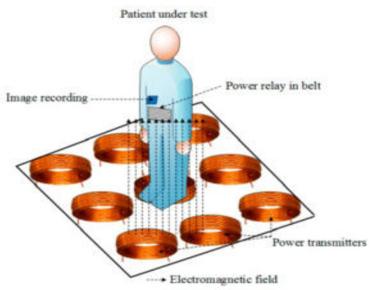
The near-field WPT techniques are critically reviewed for inductive coupling, magnetic resonant coupling, and capacitive coupling. Comparisons of our review paper with previous reviews are achieved based on types of near-field WPT, performance metrics, challenges, and applications. The performance metrics of near-field WPT are identified, which include transfer distance, transfer efficiency, output power, and operating frequency. In addition, the comparison between these metrics is presented.

A taxonomy of near-field WPT is introduced to select the more efficient technique in terms of transfer distance and transfer efficiency. Challenges and limitations are emphasized in terms of health and security, metallic element in the path of transferred power, and transfer distance and efficiency.

Wireless Power Transfer Applications WPT can be used over a short range in offices and homes to charge different devices. Battery charging can be performed on a table or a desk for different electronic devices, such as smartphones, PCs, tablets, and audio players. Special outdoor applications are also used, such as wireless charging for electric trams and vehicles; furthermore, power supply for running cars may be used. In addition, WPTs can be used in medical applications as a power supply for a capsule endoscope for diagnosis gastroenterologists, as well as other devices implanted under the human skin, such as cardiac implants. Tower and transmission lines can be inspected based on UAVs. The main task of the UAV is to inspect the transmission line via remote and rough terrain and forests, and at high altitudes. This is an important task because the transmission lines can supply power to hospitals, homes, industry, and others over long distances.

The main limitations of UAV are their endurance and range because of the limited battery capacity. UAV battery size cannot be increased because it would add extra weight, thereby becoming a limiting factor for flying. UAV batteries can be charged based on inductive coupling WPT to increase flight time or extend the UAV range that is used, for example, in surveillance or inspection. The energy of the UAV that inspects the high-voltage transmission line can be obtained from the electromagnetic field that is generated from the transmission line, in which the transmission lines operate as a long transmitting antenna. Thus, the limitation of the UAV can be overcome based on the presented method. By contrast, using UAVs overcomes the limitations of the current inspection methods, which rely on manned helicopters; this is considered a risky operation and an expensive task. UAVs can also be used to transfer power to the ground nodes based on inductive coupling as presented in the studies in which the transmitted coil is mounted on the UAV and the receiving coil is fixed on the sensor node. WPT technology is already used widely and looking forward to being used in new applications in the near future, as illustrated in Figure 1.

(a)



Pickup coil

Power rail underground

(b)

Figure1.Wireless powertransfer (WPT) applicationsfor (a) medical (b)transport.

WPT was used to recharge electric vehicle batteries rapidly to meet the extended workingrange.Batterychargingcanbeachievedduringatemporarystopinstationsbasedonreceivinga nd transmitting coils, through the transmitting coil embedded in the roadway and receiving coilequipped on the bus or rail transit. Yang et al.proposed an energy harvesting approach thatusedabicyclemotiontoacquirekineticenergy.Theirexperimentalresultsdisclosedthatmorethan mW of energy could be obtained under regular cycling situations. They concluded that the energyharvesting method could also produce electrical power uphill without increasing the mechanical workbythecyclist.

2. Classification of Near-Field Wireless Power Transfer Techniques

These technologies are classified based on the principal mechanism, power transfer, and transfer distance. Based on the power transfer air gap, WPT methods are divided into two categories: far field and near field. The technique can be considered far field if the wavelength of the electromagnetic signal is smaller than the transfer distance. By contrast, if the wavelength of the electromagnetic signal is longer than the transfer distance, the technique belongs to the near-field kind. For example, when the resonant frequency is relatively low (less than 5 MHz) and the transfer range is short (for example, 5 cm), the technique is near field.

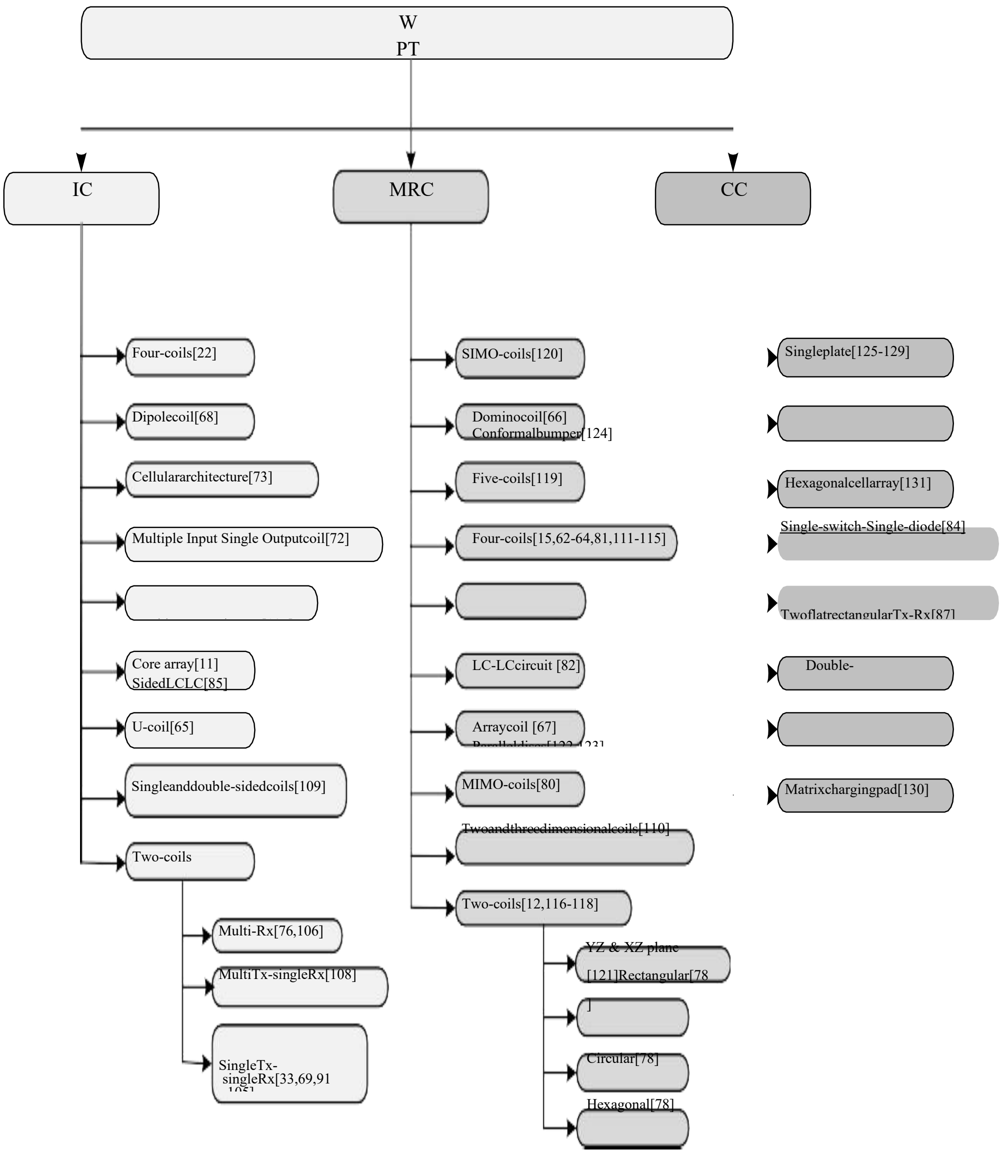
When the resonant frequency is 900 MHz, and the range of power transfer is more than 2 m, the technique is characterized as far-field power transfer. Microwaves, RF, photoelectric, laser, and acoustic can be classified as far-field energy transfer techniques, whereas inductive coupling and magnetic resonant coupling can be considered near-field techniques.

The transmission range of far-field techniques is up to several kilometers. Far-field techniques are subjected to trade-offs in the directionality of the antenna and transfer efficiency. Notably, transfer efficiency in the far-field technique remains low. The frequency band of the far-field method is extremely high, up to several GHz bands relative to near-field, thereby supporting the frequency range (kHz–MHz). Inductive coupling near-field techniques can be employed to transfer high power with significant efficiency in a very near distance up to several centimeters.

Figure 2 shows the subcategories of the near-field WPT techniques.

Figure2.ClassificationofnearfieldWPTtechniques

Performance Metrics Based on Wireless Power Transfer In WPT, certain metrics such as frequency, transmitted power, efficiency, and transfer distance canbe considered key parameters in determining the overall system performance. These key parameters are explained indetail in the following.



Frequency:
The design of near-field WPT operating frequency has been implemented with regulatory constraints and a number of technical limitations. For inductive coupling, the operating frequency varies in low-frequency (LF) bands. For example, in the authors' adopted a frequency range of 20–40 kHz when the planned distance from coil to coil is roughly 10 cm. Magnetic resonant coupling systems typically work in high-frequency (HF) bands; a frequency range of 1–50 MHz was considered. In the magnetic resonant coupling method, high efficiency with a larger distance between the receiving and transmitting antennas can be achieved when their resonance frequencies are the same.

Energy Transfer WPT can be categorized as radiative (i.e., far-field) and non-radiative (i.e., near-field). The radiative energy transfer technique can be classified into two types: directive and non-directive. For the non-directive application, omnidirectional radiation will be used to transfer energy to portable.

Efficiency of Power Transfer Transfer efficiency is defined as the receiver power at the receiver coil divided by the total input at the transmitter coils. The efficiency of the WPT system depends on the type of technique. Figure 3 shows the transfer efficiency of the different WPT techniques for near and far fields. The inductive coupling technique achieves an energy transfer efficiency of 70–90%; it decreases with the distance between primary and secondary coils. To perform such a high efficiency, accurate alignment between primary and secondary coils is required. Magnetic resonant coupling technique has a medium efficiency of 40–60% and also decays with distance. However, the transfer efficiency drops as it differs from the resonance frequency. The efficiency of the microwave and laser is less than the previous two techniques by roughly 30%; furthermore, it decreases extremely quickly as the separation between the receiving and transmitting coils increases.

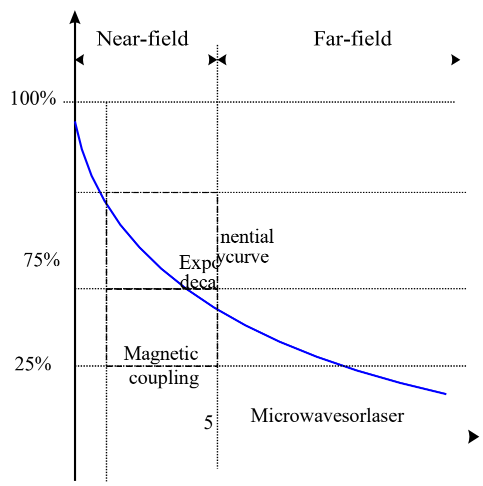


Figure3.ComparisonofefficiencyfordifferentWPTtechniques.

TransferDistanceThe transfer distances or air gaps are considered a critical issue in near-field WPT because itdetermines the DC output power. The transfer distance varies from one type to another near-fieldWPT,where it depends on the uses of the power transfer technique. The in ductivecouplingtechnique

has limited transfer distance with high transfer efficiency, whereas for magnetic resonant coupling, theenergy can be transferred at midrange from source to load relative to the inductive coupling method.However, in this method, the transfer efficiency will be reduced.By contrast, the transfer distancebecomes high with the electromagnetic wave method. However, the transfer efficiency is less than that of magnetic resonant coupling and in ductive coupling techniques.

3. Conclusions and Potential Opportunities in Near-Field Wireless Power Transfer

This study provided a review of near-field WPT techniques that are available academically. An evaluation of the previous studies for near-field WPT was introduced. The paper presented a concise review of recent WPT advancements that are specific to near-field techniques. Classification of near-field WPT techniques was presented, and the performance metrics for these techniques were compared. Applications of these techniques were also emphasized. Previous studies on magnetic resonant coupling are promising.

Magnetic resonant coupling WPT requires further studies to enhance the design of the resonators to perform high-transfer distance and maximum power transfer during angular or axial misalignment, to reduce system losses when high-oscillation frequency is used, and to increase the dynamic frequency and power control schemes to reduce the effect of EM waves on the human body to meet international standards.

Conventional transport vehicles are expected to be replaced by electrical vehicles in the near future, in spite of commercial and technical obstacles. The extended mileage is the main challenge for future electrical vehicles. At long distances, electrical vehicles require high-battery power that may be charged within a few minutes.

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New Lighting Landscape in India

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ABSTRACT

The lighting industry has kept up with these demands and aspirations by continuously introducing new and more efficient technologies, by changing and improving lighting design and creating a more effective total system approach. Lighting has progressed over the last century from Edison's light source to today's energy efficient, task oriented economic proposition. The Lighting Industry has further initiated to reduce energy consumption for lighting from present 18% of total power consumption to 13% by year 2020 by introducing more energy efficient products and working with government to execute various schemes and awareness programs to achieve this. The industry has been proactive and has always ensured production of all products in India. This tradition will continue for LED lighting products as well. The future promises even more involvement and contributions from lighting and 'Vision 2020' proposes to project what the Indian Industry visualizes for lighting by the end of this momentous decade.

Key Words: *LEDs, UJJALA, SLNP*

INTRODUCTION

The lighting industry in India accounts for around 20 per cent of the total energy consumption. Driven by the climate change targets as ratified by India at COP21, the government has introduced multiple policies and programmes to create a robust energy-efficient lighting environment the government initiative to replace all conventional lights including the highly inefficient incandescent bulbs with smart and energy efficient LEDS under the unnat jyoti by affordable LEDs for all (UJALA) programmed is an example of how the lighting market is witnessing a transformation.

UJALA

The UJALA programme was introduced in January 2015 to initiate the replacement of existing bulbs with LEDs it aimed at replacing nearly 770 million incandescent bulbs and has been catapulted into a countrywide energy efficiency movement the scheme has a dual objective :to produce LED bulb at lower prices as compared to market prices and to distribute them to domestic consumers to this end energy efficiency services limited(EESL), the super energy services company promoted by the government, has evovled a business model whereunder it carries out large-scale procurement of LED bulbs from private manufactures through competitive bidding and sells them through distribution centres at rates well below market prices consumers can pay for these bulbs either through on bill-financing model (partly upfront and then in instalments) or pay the entire amount at one go.

The cost of LEDs in various rounds of procurement by EESL has seen a significant reduction from Rs310 per bulb in January 2014 to Rs38 per bulb in the latest round of bidding in September 2016 Further the market growth has been phenomenal in 2014-2015 only 3 million LED bulbs were distributed while in 2015-2016 this figure crossed 150 million with almost 90 million of them distributed under UJALA alone as of December 2016 more then 180 million LEDs have been distributed across 22 states apart from the two primary objectives UJALA is aimed at reducing the pick demand of discoms the programme has helped shave off about 4703 MW from the load on the grid (as of December 9, 2016) these initiatives result in energy savings of 23 million kWh per year translating into savings of Rs 93 billion per year and a reduction of 19.2 million tonnes of $CO2$ per year

with the replacement of 770 million bulbs the total reduction in the country's connected load is estimated to be 20,000 MW translating into energy savings of 100 billion kWh every year the total saving in the electricity bills of consumers would be nearly Rs 400 billion per year considering an average tariff of Rs4 kWh various state-specific taxes and other administrative costs like distribution ae added to the pooled procurement price as a result there is a variation in the final costs like distribution are added to the pooled procurement price as a result there is a variation in the final costs of bulb across states which is typically in the range of Rs 75-95 per bulb.

SLNP

A key component of UJALA is the street light national programme (SLNP) the government has undertaken the task of replacing 35 million street lights with energy efficients LEDs buy 2019 under the SLNP with patchy implementation of street lighting systems in rural areas and the prevalence of inefficient systems in urban areas there is a need for a complete overhaul of street lights the SLNP aims at reducing the electricity demand of street lights by more than half from 3400 MW at present to 1400 MW translating into a cost benefit of Rs 55 billion per year.

under the SLNP the cost of replacing street light is borne upfront by EESL repayable by the urban local bodies(ULBs) over a period of five to seven years as a december 9, 2016 , nearly

1.5 million street light have been replaced with energy efficient LEDs in 20 states resulting in energy saving of upto 489.7 MWh or 44.52 MW in avoided demand per day this programme has so far been implemented in six ULBs and work is under way in another 88 out of the total 302 ULBs given the right impetus the SLNP will be able to further penetrate into rural areas which not only need energy efficient systems but also street lights.

CONCLUSION

The impact of UJALA on the lighting market has been significant according to the electrical lamp and component manufactures association the LED market has grown by 579 per cent from 2010 to 2014 and currently stands at Rs 33.95 billion it is expected to reach at least Rs 50 billion by 2016-2017further India share in the global LED market has increased from 0.1 per cent to 10 per cent in the market .

In sum, market aggregation efficient procurement methodologies and low procurement costs under UJALA have helped consumers overcome the price barrier and monetise energy savings and attract investments.

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