FORM 1

THE PATENTS ACT 1970

(39 of 1970)

&

The Patents rules, 2003

APPLICATION FOR GRANT OF PATENT

[See section 7, 54 & 135and rule 20 (1)]

(FOR OFFICE USE ONLY)

Application No:

Filing Date:

Amount of Fee Paid:

CBR No:

Signature:

1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)

2. TYPE OF APPLICATION [Please tick (√) at the appropriate category]

Ordinary (√)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )

3. (3A) APPLICANT

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3B. CATEGORY OF APPLICANT [Please tick (√) at the appropriate category]

Natural Person (√)	Other than Natural Person		
Educational Institute ( )	Small Entity ( )	Start up ( )	Others ( )

4. INVENTOR (S) [Please tick (√) at the appropriate category]

Are all the inventor(s) same as the applicant(s) named above?	Yes (√)	NO ( )
If "No", furnish the details of the inventor(s)		

Name	Nationality	Country of Residence	Address

5. TITLE OF THE INVENTION

A SYSTEM AND METHOD FOR E-WASTE AS COMPONENT IN CONCRETE MIXTURES

6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	**3637**
	Name	**Saurabh Kumar Jain**
	Mobile No.	**9806186045**

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Prof.(Dr).Sanjeev Gill Head of Department Civil Engineering JB Institute of Technology, Dehradun, (U.K) India, 248197, Hodcivil2017@gmail.com, phone:07895956363	

8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION

Country	Application Number	Filing date	Name of the applicant	Title of the invention	IPC (as classified in the convention country)
-NA-	-NA-	-NA-	-NA-	-NA-	-NA-

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)

International application number	International filing date
-NA-	-NA-

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION	
Original (first) application No	Date of filing of original (first) application
-NA-	-NA-

11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT	
Main application/patent No.	Date of filing of main application
-NA-	-NA-

12. DECLARATIONS:

(i) Declaration by inventor (s)

(In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

I/We, the above-named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

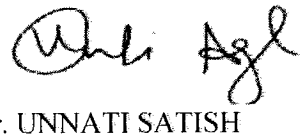
(a) Date: 07/11/2023

(b) Signature:

(c) Name:

Prof.(Dr).Sanjeev Gill

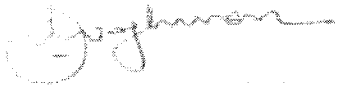
Manish Kumar



Dr. UNNATI SATISH AGRAWAL

Dr. Hira Lal Yadav

Bhaskar Singhal



Dr. Pravin Bhimrao Waghmare

(ii)Declaration by the applicant(s) in the convention country

(In case the applicant in India is different than the applicant in the convention country: the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date

(b) Signature(s) -------NA----------

(c) Name(s) of the signatory

(ii) Declaration by the applicant:

I/We, the applicant hereby declares that:-

☐ I am /we are in prosession of the above-mentioned invention

☐ The ~~provisional/~~complete specification relating to the invention is filed with this application.

☐ ~~The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.~~

☐ There is no lawful ground of objection to the grant of the patent to me/us.

☐ I am/we are the true & first inventor(s).

☐ I am/we are the assignee or legal representative of true & first inventor(s).

☐ ~~The application or each of the applications, particulars of which are given in Paragraph 8, was the first application in convention country/countries in respect of my/our invention(s).~~

☐ ~~I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.~~

☐ ~~My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph 9.~~

☐ ~~The application is divided out of my /our application particulars of which is given in Paragraph 10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.~~

☐ ~~The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph 11.~~

(d) Following are the attachments with the application:

(a) Form 2

Item	Detail	Fee	Remark
Complete specification	No. of pages: 15	1, 600	
No. of Claim(s)	No. of claims: 6 No. of pages: 1		
Abstract	No. of pages: 1		
Drawings	No. of drawings: 4 No. of Pages: 2		
Priority	No. of Priorities:		

~~In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to be mentioned here.~~

(a) ~~Provisioanl specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).~~

(b) ~~Sequence listing in electronic form~~

(c) ~~Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).~~

(d) ~~Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.~~

(e) ~~Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability.~~

(f) Statement and Undertaking on Form 3

(g) Declaration of Inventorship on Form 5

Total fee Rs. in Cash/ Banker's Cheque /Bank Draft bearing No.....
date.....on Bank

We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this 7th day of November, 2023

Saurabh Kumar Jain
(IN/PA-3637)
Agent for Applicant

To,

The Controller of Patents

The Patent Office, At Delhi/Mumbai/Chennai/Kolkata, India.

FORM 2

THE PATENT ACT 1970

(39 OF 1970)

AND

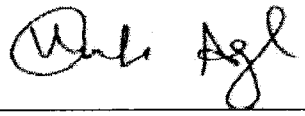
The patent rules, 2003

COMPLETE SPECIFICATION

(See section 10: rule 13)

TITLE OF INVENTION:
A SYSTEM AND METHOD FOR E-WASTE AS COMPONENT IN CONCRETE MIXTURES

APPLICANT (S)

Name	Nationality	Address
Prof.(Dr).Sanjeev Gill 	Indian	Head of Department Civil Engineering Hodcivil2017@gmail.com, phone:07895956363 JB Institute of Technology, Dehradun, (U.K) India, 248197
Manish Kumar 	Indian	Assistant Professor Department of Civil Engineering manish.bhati0911@gmail.com, 8218883744 JB Institute of Technology, Dehradun, (U.K) India, 248197
Dr. UNNATI SATISH AGRAWAL 	INDIAN	Assistant Professor, Dr. Vishwanath Karad's MIT World Peace University, Pune, H N0; 613, AGRAWAL NIWAS, MAIN ROAD SITABULDI NAGPUR-440012. unnatiagrawal2889@gmail.com
Dr. Hira Lal Yadav 		Assistant Professor Department of Civil Engineering ,hiralalyd@gmail.com, 9415818055 GB PANT INSTITUTE of Engineering and Technology 'Pauri Garhwal (UK) 246001
Bhaskar Singhal 	Indian	Assistant Professor Department of Civil Engineering bhaskarsinghal3045@gmail.com, 8273242075 JB Institute of Technology, Dehradun, (U.K) India, 248197
Dr. Pravin Bhimrao Waghmare 	Indian	Civil Engineering Department 'A Shiksha Mandal's - ACHARYA Shrimannarayan Polytechnic Pipri (M)- Wardha (Maharashtra)- (affiliated to M. S.B.T.E. Mumbai (0025)-&. DTE-Mumbai (4015)) Phone no: -9588473826 Email ID: pravin7717@gmail.com Pin code: -442001(MH)

PREAMBLE TO THE DESCRIPTION

COMPLETE

Following specification particularly describes the invention and the manner in which it is to be performed.

DESCRIPTION

TECHNICAL FIELD OF INVENTION

The present invention is related to the field of civil engineering. More specifically, it relates to a novel composition of concrete comprises an electronic waste. The technical field of "A System and Method for E-Waste as a Component in Concrete Mixtures" lies at the intersection of waste management, construction materials, and environmental sustainability. This innovative approach seeks to address the growing problem of electronic waste (e-waste) disposal and its environmental impact while improving the properties of concrete used in construction.

At its core, this system and method fall within the broader fields of materials science and civil engineering. It involves the extraction, processing, and incorporation of e-waste materials into concrete formulations. This requires expertise in material characterization, recycling technologies, and concrete engineering.

Key technical aspects encompass the identification and separation of e-waste components like printed circuit boards, glass, and plastics, as well as the development of processing techniques to render them suitable for inclusion in concrete. The system also necessitates an understanding of concrete mix design, which includes the selection of suitable e-waste components and the determination of their optimal proportions to achieve desired structural and mechanical properties.

Moreover, the research likely delves into the performance testing of e-waste-infused concrete, such as compressive strength, durability, and long-term behavior. The technical field also touches upon environmental impact assessments and life cycle analyses to evaluate the overall sustainability of using e-waste in construction materials.

In summary, the technical field of this system and method bridges the disciplines of materials science, recycling technology, civil engineering, and environmental science to develop a sustainable and environmentally responsible solution for reusing e-waste in concrete mixtures, contributing to both waste reduction and improved construction practices.

BACKGROUND OF THE INVENTION

The background information herein below relates to the present disclosure but is not necessarily prior art.

Disposal of E-waste is a matter of grave concern for every country in the world today. Despite the exponential rise in the use of electronic products, landfills are still the most common method for disposing of e-waste, and these days it is very difficult to obtain large areas of land. In addition, E-waste also includes a variety of dangerous substances including lead, cadmium, beryllium, and others. These substances, when mixed into ground water, cause significant levels of contamination, making it exceedingly dangerous for ingestion by humans or other animals. It is clear that e-waste recycling and reuse is a significant worldwide issue that has to be addressed as soon as possible.

On the other hand, despite the enormous inventive leaps, advances, and breakthroughs in the materials used in construction, the construction industry still heavily depends on Portland cement and aggregates. Since the natural resources utilized in concrete, such as aggregates, are steadily depleting, the construction industry is now concerned about excessive use and mass dependency on these raw materials. Additionally, this industry has been compelled to start exploring for replacements for the materials used in concrete due to environmental concerns around CO2 emissions from concrete. By experimenting with and using E-waste materials in the construction industry, both of these present environmental problems can be mitigated to some extent. E-waste is now being evaluated in the industry in addition to more conventional aggregate substitutes like fly ash and rice husk ash to see if it may be a useful material for enhancing concrete's durability and strength.

202141034529 related to the invention incorporates partial replacement of coarse aggregate by E-waste in M-30 grade concrete. Owing to scarcity of coarse aggregate for the preparation of concrete, Partial replacement of E-waste with coarse aggregate was attempted. The work was conducted on M30 grade mix. The replacement of coarse aggregate with E-waste is done in percentages of 0%, 5%, 10%,

15% and 20%. The mechanical properties of the concrete mix specimens are obtained and compared with control concrete mix. The test result showed that a significant improvement in compressive strength was achieved with 5% replacement in the E-waste concrete and tensile strength of concrete increases gradually upon partial replacement of coarse aggregates with E-waste up to 15% compared to conventional concrete and hence can be used effectively in concrete.

202241060271 related to enhancing the mechanical Properties of M40-Grade Concrete with PCB Fiber from recycled electronic waste. E-waste fiber concrete is an alternative to standard concrete since it enhances the qualities of conventional concrete while reducing the amount of electronic trash thrown in natural environments. Incorporating PCB fiber from electronic trash with aspect ratios of 10 and 20 and using a w/c ratio of 0.45 yielded M40-grade concrete. After seven, fourteen, and twenty-eight days of curing, the PCB fiber concrete's fresh and hardened characteristics were studied and compared to those of regular concrete. According to the tests conducted, the strength of concrete made from recycled electronic waste fibers was much higher than that of concrete used as a control.

202331003483 related to use of plastic aggregates as substitute of traditional aggregates either in road construction or building construction. Million- and million-years plastic remain same in our earth. So, the approach is taken to recycle the plastics waste into construction material. Waste plastic was collected from waste pickers and plastic dumping yards mostly. Then other materials like fly ash and sand were collected. After measuring specific gravity of plastic, sand and fly ash, the quantity required for each item was determined as the size of cube was known. Plastic aggregates are formed by crushing the plastic blocks in a manner so that plastic aggregates passing through 12.5mm sieve and retain on 10mm sieve. The aim of this research work is to use and promote plastic aggregates as substitute of traditional aggregates.

OBJECTIVE OF THE INVENTION

The primary objective of the present invention is to provide novel composition of concrete comprises an electronic waste.

Yet another objective of the invention is to provide a methodology for using non-biodegradable e-waste components as raw materials in the production of M-60-grade high-strength concrete.

Yet another objective of the invention is to assist in the efficient disposal of electronic waste in an environmentally safe manner.

Yet another objective of the invention is to provide an effective and sustainable solution for meeting the increasing demand for construction materials.

Yet another objective of the invention is to prove the potential of e-waste as a raw material to be used in concrete.

Yet another objective of the invention is to be helpful in addressing concerns related to pollution due to CO_2 emissions from concrete.

Yet another objective of the invention is to develop E-waste-incorporated high-strength concrete with desired properties such as adequate compressive strength, tensile strength, and flexural strength, along with being less environmentally toxic and more economically viable.

Yet another objective of the invention is to perform physical tests such as sieve analysis, specific gravity, water absorption, etc., and chemical characterization tests such as EDS, SEM, etc. to test the suitability of e-waste material as a raw material in concrete.

SUMMARY OF THE INVENTION

Accordingly the following invention provides a novel composition of concrete comprises an electronic waste. The purpose of this invention is to incorporate non-biodegradable E-waste components for partial replacement of the coarse aggregates in M-60 grade concrete with OPC 53 grade cement that complies with IS 8112. To determine the suitability of E-waste material for use in concrete, the collected sample was subjected to several physical tests such as sieve analysis, specific gravity, water

absorption, crushing value, abrasion value etc., and chemical characterization tests such as EDS, SEM, etc.

E-waste incorporated concrete mixes were prepared with varying compositions of E-waste in the range of 0-30%. Other materials to be used in the study namely cement and aggregates were sourced locally and subjected to physical tests such as consistency, fineness, soundness etc. and specific gravity, fineness modulus, water absorption etc., respectively.

Concrete mixes were prepared in which coarse aggregates were partially substituted with crushed E-waste material in quantities ranging from 0 to 30%. The prepared concrete mixes were subjected to slump cone test IS 1199 (1959) before casting to determine workability of the mixes. Concrete cubes, cylinders, and beams were cast and post curing were evaluated for compressive strength and flexural strength IS 516 (1959), along with tensile strength IS 5816 (1999), respectively.

Compression strength is determined and compared on days 7, 14, and 28 of curing, whilst tensile strength and flexural strength are compared on days 28, 56, and 90 of curing. At 28 days of curing, it was observed that the concrete mixes with up to 15% replacement achieved compressive strength which was nearly equal to that achieved by the control mix with 0% replacement.

Compressive strength of control mix (M-601) at 28 days was 68.25 N/mm2 while that of mix with 15% replacement (M-604) was 64.8 N/mm2. Concrete with up to 15% E-waste replacement was also found to have comparable values of tensile and flexural strength with those of control mix. At 90 days of curing, mix type with 0% replacement had 5.76 N/mm2 tensile strength and 5.83 N/mm2 flexural strength while mix type with 15% replacement had gained 5.60 N/mm2 tensile strength and 5.75 N/mm2 flexural strength.

The invention findings thus revealed that M60 grade concrete containing E-waste can achieve nearly equal compressive strength and other desired properties as that of the control mix, with up to 15% replacement of coarse aggregates.

The invention suggests the feasibility of incorporating non-degradable E-waste material into the development of sustainable concrete. Thus, it can be said that the utilization of E-waste for the production of concrete provides promising results of desired properties such as compressive strength, flexural and tensile strength. Crushed E-waste plastic waste could thus be utilized as a substitute material in the construction industry, bringing down the price of producing and building using concrete while simultaneously addressing environmental concerns.

BRIEF DESCRIPTION OF DRAWING

This invention is described by way of example with reference to the following drawing where,

Figure 1 of Sheet 1 illustrates an image of a crushed e-waste sample.

Figure 2 of Sheet 1 illustrates the casted cube moulds for the compressive strength test.

Figure 3 of Sheet 2 illustrates the SEM image of the collected e-waste sample.

Figure 4 of Sheet 2 illustrates the EDS image of the collected e-waste sample.

DETAILED DESCRIPTION OF THE INVENTION

As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

The present invention is related to a novel composition of concrete comprises an electronic waste. The principal raw material i.e. electronic waste sample was identified and collected from local industry. A pictorial view of the collected E-waste sample can be seen in Figure 1. Discarded electronics, household electronic goods, and other items have been used in the present study as E-plastic waste. The discarded E-waste obtained was in abstract shapes and sizes, thus it was ground and cut into 10

mm pieces before being utilized in different proportions as a substitute for coarse aggregates in concrete. Similarly, other raw materials such as cement, fine aggregate and coarse aggregate were collected. The cement used is the Ordinary Portland Cement (OPC) of Grade 53 confirming to BIS, IS:12269 (BIS,1987).

Thus, the included raw materials in the production of concrete are: -

- E-waste
- OPC of grade 53
- Fine aggregate
- Coarse aggregate

Raw material analysis: -

To determine the suitability of E-waste material for use in concrete, the collected sample was subjected to several physical tests such as sieve analysis, specific gravity, water absorption, crushing value, abrasion value etc., and chemical characterization tests such as EDS, SEM, etc. were carried out in the sophisticated laboratory. SEM and EDS test images of E-waste sample are visible in Figure 3 and Figure 4.

Table 1 shows a list of the characteristics of the E-waste material used in this investigation:

Sr. No.	Characteristics	Value
1	Specific gravity	1.77
2	Impact value	12.03%
3	Crushing value	17.74%
4	Abrasion value	2.258
5	Water absorption	Nil

Different physical tests were also conducted on Cement, Fine aggregate and Coarse aggregate to be used in the concrete mixes. Table 2 depicts tested characteristics of cement as per IS 2386 (PART-1) 1963, Table 3 and Table 4 depict the same for fine aggregate and coarse aggregate respectively, in accordance with IS-

2386 (PART-1)1963.

Table 2 shows the properties of cement:

Sr. No.	Characteristics	Value
1	Consistency of Cement	31 %
2	Initial Setting Time	87 min
3	Final Setting Time	350 min
4	Fineness	94 %
5	Soundness	2 mm
6	Specific gravity	3.15

Table 3 shows the properties of fine aggregate:

Sr. No.	Characteristics	Value
1	FM of Fine Aggregate	4.96
2	Bulking	3%
3	Water absorption	1.2%
4	Specific gravity	2.74

Table 4 shows the properties of coarse aggregate:

Sr. No.	Characteristics	Value
1	FM of Course Aggregate	8.69
2	Specific gravity of CA	2.74
3	Impact value of CA	10.52%
4	Crushing Value of CA	16.90%
5	Abrasion value of CA	16.76%
6	Water Absorption of CA	Nil

Mix Design:

The mix design for high strength concrete'M 60 was prepared using the following data given in Table 5, in accordance with IS 10262 (2019).

Table 5 shows the mix design of various mix types:

	Replacement Proportion						
Material	0 %	05%	10 %	15 %	20 %	25 %	30 %
Cement (Actual OPC)	413.6 kg/m3	413.66 kg/m3	413.66 kg/m3	413.64 kg/m3	413.6 kg/m3	413.66 kg/m3	413.66 kg/m3
Water	162 kg/m3	162 kg/m3	162 kg/m3	161 kg/m3	162 kg/m3	162 kg/m3	162 kg/m3
Fine aggregate	481 kg/m3	481 kg/m3	481 kg/m3	481 kg/m3	481 kg/m3	481 kg/m3	481 kg/m3
Coarse aggregate 20 mm	491.23 kg/m3	491.23 kg/m3	491.23 kg/m3	491.23 kg/m3	491.23 kg/m3	491.23 kg/m3	491.23 kg/m3
Coarse aggregate 10 mm	491.23 kg/m3	466.7 kg/m3	442.1 kg/m3	417.25 kg/m3	392.10 kg/m3	368.42 kg/m3	343.90 kg/m3
Silica fume	31.82 kg/m3	31.82 kg/m3	31.82 kg/m3	31.82 kg/m3	31.82 kg/m3	31.82 kg/m3	31.82 kg/m3
Fly ash	191 kg/m3	191 kg/m3	191 kg/m3	191 kg/m3	191 kg/m3	191 kg/m3	191 kg/m3
Super plasticizer	6.36 kg/m3	6.36 kg/m3	6.36 kg/m3	6.36 kg/m3	6.36 kg/m3	6.36 kg/m3	6.36 kg/m3
E waste	0 kg/m3	16 kg/m3	31.73 kg/m3	46.83 kg/m3	63.10 kg/m3	79.33 kg/m3	95.20 kg/m3
Revised Water-cement ratio	0.255	0.255	0.255	0.255	0.255	0.255	0.255

Casting and Curing:

After raw material characterization (Tables 1 to 4), E-waste integrated

concrete mixes with different proportions of partial replacement (0%,5%,10%,15%,20%,25% and 30%) were prepared. Table 6 lists the concrete mixes prepared with assigned names

Table 6 shows the Concrete mix types:

Sr. No.	% Replacement of Coarse aggregate by E-waste	Mix Type
1	0	M-601
2	5	M-602
3	10	M-603
4	15	M-604
5	20	M-605
6	25	M-606
7	30	M-607

15*15*15cm cubes were cast to test the compressive strength of different concrete mixes after 7, 14, and 28 days. Similar to this, 10*10*50 cm beams were cast to test the flexural strength of concrete, and 15*30 cm cylinders were cast to test its tensile strength. At 28, 56, and 90 days, tensile and flexural strength tests were conducted. The casting of the moulds that will be cured and assessed is shown in Figure 2. The cubes, cylinders, and beams cast for testing were properly cured in water tanks under appropriate conditions before being evaluated on specific curing days.

Tests conducted on concrete mixes:

Tests were conducted on the mix types of varying E-waste proportions. The prepared concrete mixes were subjected to slump cone test IS 1199 (1959) before casting to determine workability of the mixes. Concrete cubes, cylinders, and beams were cast and post curing were evaluated for compressive strength and flexural strength IS 516 (1959), along with tensile strength IS 5816 (1999), respectively.

For each composition, 3 samples were tested and the average was recorded. Compressive strength testing was done at 7, 14 and 28 days of curing While flexural strength and tensile strength were tested at 28, 56, and 90 days of curing.

Slump cone test:

The slump cone test was used to determine the workability of concrete at different replacement percentages. When coarse aggregate is replaced with E-waste in proportions of 0%, 5%, 10%, 15%, 20%, 25%, and 30%, the slump values for M-60 grade concrete were examined and the findings are listed in Table 7.

Table 7 shows the test result data for slump cone test:

Sr. No.	Grade of Concrete	% Replacement	Slump (mm)	Degree of workability
1	M-60	0%	76	High
2	M-60	5%	77	High
3	M-60	10%	75	High
4	M-60	15%	75	High
5	M-60	20%	72	Medium
6	M-60	25%	70	Medium
7	M-60	30%	70	Medium

With the increase in proportion of E-waste, there is gradual decline seen in the workability of concrete mix. However, up to 15% replacement, the change is marginal. The difference between slump of control mix v/s that of mix with 15% replacement is of 1 mm. Thus, it can be inferred that there will not be a significant change in the workability of concrete for up to 15% replacement of coarse aggregate by E-waste material.

Compressive strength test:

The compressive strength test is carried out on conventional cubes with dimensions of 150 mm * 150 mm * 150 mm at 7, 14, and 28 days after curing. The outcomes are presented in Table 8.

Table 8 shows the test result data for compressive strength test:

		Compressive strength at days of curing (N/mm2)		
% Replacement of CA by E-waste	Mix Type	7 days	14 days	28 days
0	M-601	47.75	54.56	68.25
5	M-602	46.73	54.4	67.63
10	M-603	45.93	52.47	66.3
15	M-604	43.07	50.15	64.8
20	M-605	39.67	45.85	59.41
25	M-606	38.04	43.93	55.48
30	M-607	35.81	40.96	52.52

Concrete is strongest in compression and is revered for its compressive strength in construction. Hence, it is important that any changes in material should not adversely affect the compressive strength of concrete. In the current study, with the increase in E-waste proportion a gradual decline in compressive strength is observed at 28 days of curing. However, the compressive strength of mix type with 15% replacement at 28 days of curing is 64.8 N/mm2, while that of the control mix is 68.25 N/mm2 which proves that up to 15% replacement the strength decline is limited to 5% decrease. With the concrete giving optimum results even with up to 15% incorporation of E-waste, it can be said that E-waste can surely be considered as a potential replacement of raw material to a significant extent in concrete.

Flexural strength test:

The investigation's standard specimen size for flexural strength was 500 mm in length, 100 mm in width, and 100 mm in depth. Flexural strength for mixtures including various percentages of e-waste material is demonstrated by the test results in Table 9.

Table 9 shows the test result data for flexural strength test:

		Flexural strength on days of curing (N/mm2)		
% Replacement of CA by E-waste	**Mix Type**	**28 days**	**56 days**	**90 days**
0	M-601	5.920	5.920	5.830
5	M-602	5.830	5.920	5.830
10	M-603	5.830	5.830	5.700
15	M-604	5.670	5.750	5.750
20	M-605	5.420	5.420	5.400
25	M-606	4.330	4.000	3.920
30	M-607	3.580	3.500	3.420

It can be observed that at 90 days of curing, the mix types exhibit comparable flexural strength up to 15% replacement. However, with further increase in E-waste content, the strength declines by considerable amount.

Split Tensile strength test:

For 300 mm long and 150 mm diameter cylinders placed in the machine with loads applied on the cylinder's opposite sides, the values obtained for various replacement proportions are provided in Table 10 for the cylinders.

Table 10 shows the test result data for tensile strength test:

		Tensile strength at days of curing (N/mm2)		
% Replacement of CA by E-waste	Mix Type	28 days	56 days	90 days
0	M-601	5.710	5.710	5.760
5	M-602	5.800	5.760	5.760
10	M-603	5.760	5.850	5.760
15	M-604	5.710	5.600	5.600
20	M-605	5.570	5.470	5.330
25	M-606	5.140	5.140	5.050
30	M-607	4.720	4.620	4.350

In keeping with the results of previous tests performed on the hardened concrete mixes, it is seen that tensile strength of mixes from 0% to 15% replacement are fairly comparable. But as the proportion of e-waste increases further, the strength values go on decreasing at a steeper rate.

From the results of all tests performed on the concrete mixes, it is evidently proved that E-waste can be safely used as a partial replacement of coarse aggregate in concrete up to 15% replacement proportion, without compromising on compressive strength or other desired properties of concrete. E-waste thus if properly used could have the potential to develop as a large-scale replacement of coarse aggregate, which are rapidly depleting due to huge demand, whereas E-waste is available in excess and rapidly increasing with the technology boom.

The invention suggests the feasibility of incorporating E-waste material into high strength concrete as a partial replacement of traditional coarse aggregate. Results achieved during the various tests conducted in this study reinforce that E-waste can be used for development of sustainable concrete which is also environmentally more useful.

Concrete mix with 15% E-waste replacement achieved compressive strength at 28 days of curing that was on par with concrete without any replacement, according to experiments on M-60 grade concrete utilizing E-waste as a partial replacement for coarse aggregate. The compressive strength of concrete started significantly declining

in comparison with the control mix after the replacement proportion exceeded 15%. Thus, it can be concluded that E- waste can be used as a partial replacement for coarse aggregate up to 15% replacement proportion.

At 28 days of curing, this mix with 15% E-waste replacement had flexural strength of 5.67 N/mm2 and tensile strength of 5.71 N/mm2 respectively, which were fairly comparable with respect to the values given by the control mix.

To dispose of or recycle E-waste more effectively, alternative ways are needed which can help incorporate and utilize the E-waste without creating additional environmental or other problems. The findings of the experiments show that employing E-waste as a raw material in concrete is a cost-effective and long-term solution for meeting rising construction material demand, reducing the burden on depleting natural resources and resolving waste disposal issues to a considerable extent.

While various embodiments of the present disclosure have been illustrated and described herein, it will be clear that the disclosure is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions, and equivalents will be apparent to those skilled in the art, without departing from the spirit and scope of the disclosure, as described in the claims.

I/We Claim:

Claim 1-Improved sustainability: The incorporation of e-waste into concrete mixtures reduces the environmental impact of e-waste disposal, contributing to a more sustainable construction industry.

Claim 2-Enhanced mechanical properties: Claims might involve improved concrete strength, durability, and other mechanical properties when e-waste components are added to the mixture.

Claim 3-Waste reduction: The method claims to reduce e-waste by repurposing electronic components and materials for use in construction.

Claim 4-Cost-effectiveness: It may claim cost savings in the production of concrete by utilizing e-waste materials.

Claim 5- Environmental benefits: Claims might include reduced energy consumption and greenhouse gas emissions in concrete production due to the incorporation of e-waste.

Claim 6-Safe integration: Claims may revolve around a safe and standardized method for extracting and processing e-waste materials to ensure their proper integration into concrete mixtures.

ABSTRACT

A SYSTEM AND METHOD FOR E-WASTE AS COMPONENT IN CONCRETE MIXTURES

The present invention describes an innovative approach to addressing electronic waste (e-waste) disposal and sustainable construction practices. This system and method propose the incorporation of e-waste materials into concrete mixtures, aiming to reduce environmental pollution and enhance the mechanical properties of concrete. By recycling e-waste components like printed circuit boards, glass, and plastics, the study contributes to waste reduction and resource conservation. The research outlines a systematic process for extracting and processing e-waste materials, ensuring their safe integration into concrete while maintaining structural integrity. The resulting e-waste-infused concrete demonstrates promising potential for use in various construction applications. This inventive solution highlights a sustainable avenue for reusing e-waste and advancing the construction industry's environmental and structural performance.

FORM 3

THE PATENTS ACT 1970

(39 of 1970)

&

The Patents rules, 2003

STATEMENT AND UNDERTAKING UNDER SECTION 8

(See section 8, Rule 12)

We,

APPLICANTS (S)		
NAME	**NATIONALITY**	**ADDRESS**
Prof.(Dr).Sanjeev Gill	Indian	Head of Department Civil Engineering Hodcivil2017@gmail.com, phone:07895956363 JB Institute of Technology, Dehradun, (U.K) India, 248197
Manish Kumar	Indian	Assistant Professor Department of Civil Engineering manish.bhati0911@gmail.com, 8218883744 JB Institute of Technology, Dehradun, (U.K) India, 248197
Dr. UNNATI SATISH AGRAWAL	INDIAN	Assistant Professor, Dr. Vishwanath Karad's MIT World Peace University, Pune, H N0: 613, AGRAWAL NIWAS, MAIN ROAD SITABULDI NAGPUR-440012, unnatiagrawal2889@gmail.com
Dr. Hira Lal Yadav	INDIAN	Assistant Professor Department of Civil Engineering ,hiralalyd@gmail.com, 9415818055 GB PANT INSTITUTE of Engineering and Technology 'Pauri Garhwal (UK) 246001
Bhaskar Singhal	Indian	Assistant Professor Department of Civil Engineering bhaskarsinghal3045@gmail.com, 8273242075 JB Institute of Technology, Dehradun, (U.K) India, 248197
Dr. Pravin Bhimrao Waghmare	Indian	Civil Engineering Department 'A Shiksha Mandal's -ACHARYA Shrimannarayan Polytechnic Pipri (M)-Wardha (Maharashtra)- (affiliated to M. S.B.T.E. Mumbai (0025)-&. DTE-Mumbai (4015)) Phone no: -9588473826 Email ID: pravin7717@gmail.com Pin code: -442001(MH)

hereby declare:

(i) That I/we have not made any application for the same/substantially the same invention outside the India.

Or

We who have made this application No. ---------- Dated____ alone/jointly with----------, made for the same/substantially same invention, application(s) for patent in the other countries, the particulars of which are given below :

Name of the country	Date of application	Application No.	Status of the application	Date of publication	Date of grant

NA	NA	NA	NA	NA	NA

(ii) That the rights and application has been assigned to none.

(iii) That I undertake that upto the date of grant of the patent, by the controller, I would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application.

Date 07/11/2023

Saurabh Kumar Jain
(IN/PA-3637)
Agent for Applicant

To,

The controller of Patents,
The Patent Office, At Delhi/Mumbai/Chennai/Kolkata, India.

FORM 5
THE PATENTS ACT 1970
(39 of 1970)
&
The Patents rules, 2003
DECLARATION AS TO INVENTORSHIP
[See section 10(6) and rule 13(6)]

1. NAME: OF APPICANT (S)	1. Prof.(Dr).Sanjeev Gill 2. Manish Kumar 3. Dr. UNNATI SATISH AGRAWAL 4. Dr. Hira Lal Yadav 5. Bhaskar Singhal 6. Dr. Pravin Bhimrao Waghmare

Hereby declare that the truth and first inventor (s) of the invention disclosed in the provisional specification filed in pursuance of my application numbered **2023**_____ dated _____ are.

7. INVENTOR (S)

NAME	NATION-ALITY	ADDRESS
Prof.(Dr).Sanjeev Gill	Indian	Head of Department Civil Engineering Hodcivil2017@gmail.com, phone:07895956363 JB Institute of Technology, Dehradun, (U.K) India, 248197
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		(Maharashtra)- (affiliated to M. S.B.T.E. Mumbai (0025)-&. DTE-Mumbai (4015)) Phone no: -9588473826 Email ID: pravin7717@gmail.com Pin code: -442001(MH)

Date 07/11/2023

Saurabh Kumar Jain
(IN/PA-3637)
Agent for Applicant

3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT (S) IN THE CONVENTION COUNTRY:-

-NA-

~~**We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way of assignment from the true and first inventor(s).**~~

Dated this____day of _____, 2022.

Signature:-NA

Name: of signatory:- NA

To,

The controller of patent

The patent office, at Delhi/Mumbai/Chennai/Kolkata.

FORM 9
THE PATENTS ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003
REQUEST FOR PUBLICATION
(See section 11A (2); rule 24A)

We (state name, address and nationality of Applicant)

APPLICANTS (S)		
NAME	**NATIONALITY**	**ADDRESS**
Prof.(Dr).Sanjeev Gill	Indian	Head of Department Civil Engineering Hodcivil2017@gmail.com, phone:07895956363 JB Institute of Technology, Dehradun, (U.K) India, 248197
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Dr. Hira Lal Yadav	INDIAN	Assistant Professor Department of Civil Engineering ,hiralalyd@gmail.com, 9415818055 GB PANT INSTITUTE of Engineering and Technology 'Pauri Garhwal (UK) 246001
Bhaskar Singhal	Indian	Assistant Professor Department of Civil Engineering bhaskarsinghal3045@gmail.com, 8273242075 JB Institute of Technology, Dehradun, (U.K) India, 248197
Dr. Pravin Bhimrao Waghmare	Indian	Civil Engineering Department 'A Shiksha Mandal's -ACHARYA Shrimannarayan Polytechnic Pipri (M)-Wardha (Maharashtra)- (affiliated to M. S.B.T.E. Mumbai (0025)-&. DTE-Mumbai (4015)) Phone no: -9588473826 Email ID: pravin7717@gmail.com Pin code: -442001(MH)

Hereby request for early publication of my application numbered 2023_____ dated _____, under section 11A (2) of the act.

Date 07/11/2023

Saurabh Kumar Jain
(IN/PA-3637)
Agent for Applicant

To
The Controller of patents,
The Patent office at Delhi/Mumbai/Chennai/Kolkata

Figure 1

Figure 2

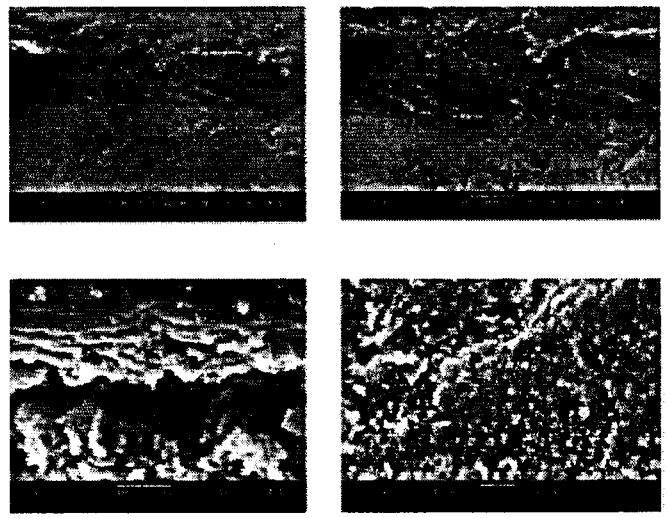

Figure 3

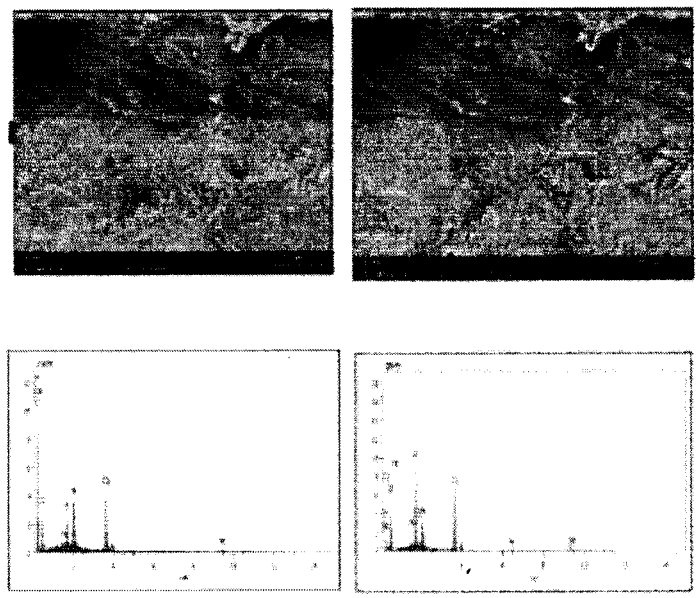

Figure 4