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Experimental Study on Concrete Using E-Waste

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Abstract: The waste material utilization by construction industry is a sustainable solution to ecological and environmental problems. Large-scale use of electronic goods in the recent times has contributed to generation of huge quantity of electric waste. E-waste consists of discarded refrigerators, TVs, radios, mobile phones, air conditioners, computers and several other electronic gadgets that have reached end of their useful life or become obsolete. The economic and safe disposal of these wastes has been a perennial problem confronted all over the world. Use of e-waste materials in cement-concrete, RCC and other construction materials is an accepted way of the disposal of the wastes. Efforts are being made in the construction industries to use non-biodegradable components of electronic waste as a partial replacement of the fine or coarse aggregates in concrete. A direct benefit of this is reduction in use as well as cost of precious concrete construction materials. Other indirect benefits include reduction in landfill cost, saving energy and reduction in solid waste. The main aim of this study is to investigate the change in mechanical properties of concrete with the addition of electronic waste in concrete. It is found that the use of electronic waste aggregates results in the formation of light weight concrete. In this present study, coarse aggregate is partially replaced by e-waste from 0% to 20%. It is hereby expected that utilization of this electronic waste in concrete will reduce the requirement for conventional coarse and fine aggregates thereby resulting in conservation of natural resources.

Keywords: Electronic Waste, Safe Disposal, Coarse Aggregate, partial replacement, Natural resources.

I. INTRODUCTION

Concrete is a material and widely used in construction field. The production of solid wastages is increasing day today and causes serious concerns to the environment. The recycled plastics are used in the concrete by partial replacement of coarse aggregate in concrete. Due to rapid increase of population in world, the amount of waste products such as waste plastic also increases rapidly .These waste plastic will remain in the environment for hundreds of years. The combined of these waste plastic in concrete may reduce the environmental problems up to certain extent. It is possibility of disposal of these wastages in mass concrete such as in heavy mass concreting in FCC in pavements consideration. The e-waste plastic is one component of Municipal Solid Waste (MSW). The disposal of the e-waste plastic which cause the big problems to the environment and the plastic is very low biodegradable material. As from many years the research concern that the use of by-products from industry may augment the properties of concrete. In the modern decades, the use of byproducts such as silica fume, glass culvert, fly ash, ground granulated blast furnace slag etc. Efforts have been made to use in civil construction. The application of the industrial by-products in concrete is as partial replacement of cement or partial replacement of aggregate. The use of these e-waste plastic in concrete can control the environmental problems or constraints if safe disposal of these products. In the present study the e-waste is used to prepare the coarse aggregate there by providing sustainable option to deal with plastic waste.

II. EXPERIMENTAL PROGRAM

For the purpose of testing specimens, various concrete specimens were prepared for different mixes using rotating drum mixer. Preparation of concrete specimens aggregates, cement and E-waste was added. After thorough mixing, water was added and the mixing was continued until a uniform mix was obtained. The concrete was then placed in to the moulds which were properly oiled. After placing of concrete in moulds, proper compaction was given using the table vibrator. For compressive strength test, cubes of size 150mmx150mmx150mm were cast. For splitting tensile strength test, cylinders of size 150mm diameter and 300mm height were cast and for flexural strength test, beams of size 100mmx100mmx500mm without reinforcement were cast. Specimens thus prepared were demoulded after 24 hours of casting and were kept in a curing tank for curing. Then the specimens were tested for a curing period of 7 and 28 days.

III. MATERIALS

A. Cement

Cement is a binder material, a substance which generally hardens independently and is used to bind the combination of cement and aggregate to form a strong building material. There are variable grades of cement available in our market, for this study ordinary Portland cement of grade 53 is used i.e. OPC 53.

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B. Fine aggregate

Fine aggregate is the inert or chemically inactive material, most of which passes through 4.75 mm IS sieve and contains not more than 5 percent coarse material. Fie aggregate used in concrete have the function of a filler material which fills the voids in concrete generated by coarse aggregate. The filler material used in Natural River sand which is passing in 2.36mm sieve.

C. COARSE aggregate

Coarse aggregate used in construction purpose involve a broad category of coarse particular like gravel. Aggregate are a component of composite material such as concrete asphalt concrete, the aggregate serves as reinforcement to add strength to the overall composite material. Crushed angular stone of size less than 20mm from a local source is used as coarse aggregate.

D. Electronic waste

The use of E-waste cement concrete termed as E-Concrete has been focused in this investigation as a viable solution to the problem of recycling and high disposal costs. E-wastes are grained into fine chips accordingly to replace coarse aggregate.

IV. RESULTS AND DISCUSSIONS

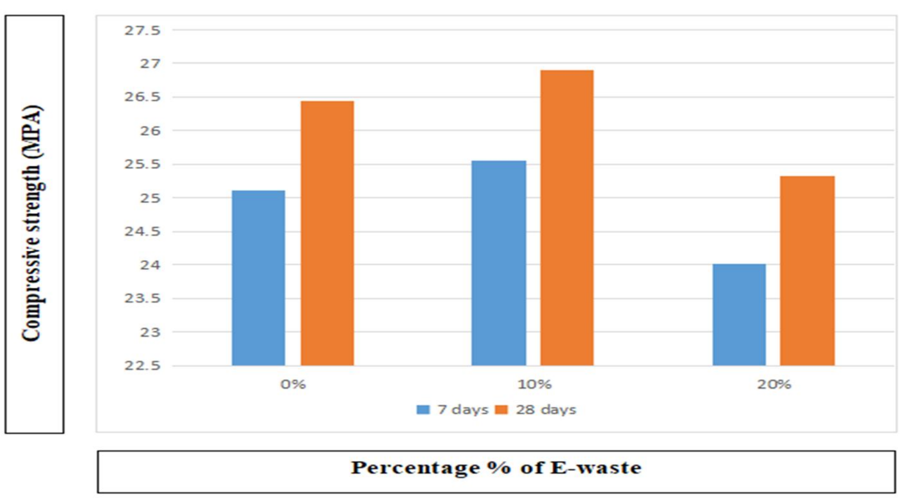
A concrete mix grade of M25 is aimed. The design mix proportion is obtained by Indian Standard method of mix design in accordance with IS 10262-2009. The mix proportion obtained is 1:1:2 with w/c ratio 0.5. E-plastic was added in amount of 0%, 10%, 20% and 30% by the weight of coarse aggregate in mix.

A. Compressive Strength Test Results:

Table 1 presents the Compressive strength of concrete mixes with and without E plastic aggregates, where M1 is Conventional Mix, M2 with 10% of E plastic, M3 with 20% of E plastic and Graph 1 shows the graphical representations of compressive strength of all mixes S1, S2 & S3 for 7 and 28 days.

Table 1: Compressive Strength test results at varying % of E plastic waste after curing of 7 and 28 Days

MIX SPECIFICATIONS	M1	M2	M3
PROPORTION OF E-WASTE	0%	10%	20%
7 DAYS	25.11	25.56	24.01
28 DAYS	26.44	26.89	25.33



Graph 1: Compressive strength gained in 7 & 28 days

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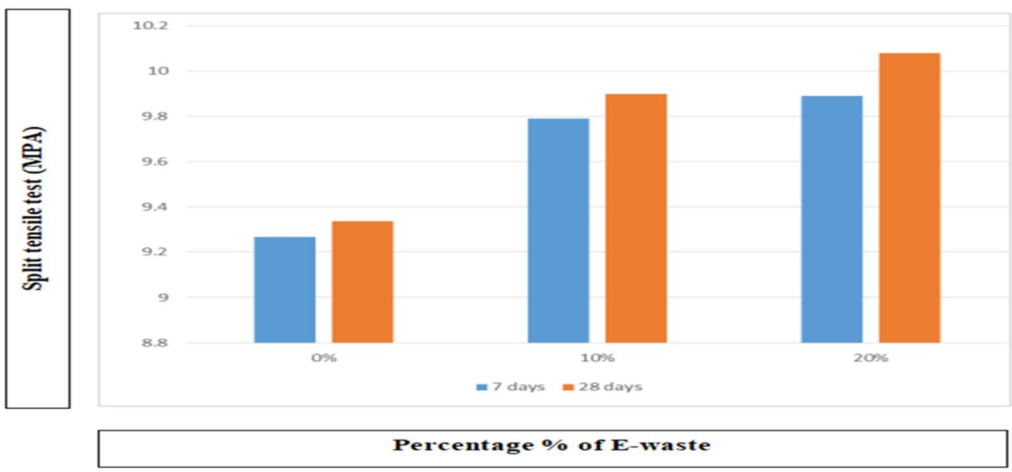
B. Split tensile Strength Test Results

Table 2 presents split tensile strength of all concrete mixes where the test for determining split tensile strength of concrete employs a cylinder specimen of size 300 mm length and 150mm diameter which is subjected to compression in compression testing machine and Graph 2 shows the graphical representations of split tensile strength of all mixes M1, M2 And M3 for 7 and 28 days as given below.

Table 2: Split tensile strength results at varying % of E plastic waste after curing of 7and 28 Days

MIX SPECIFICATIONS	M1	M2	M3
PROPORTION OF E-WASTE	0%	10%	20%
7 DAYS	9.27	9.79	9.85
28 DAYS	9.34	9.90	10.08



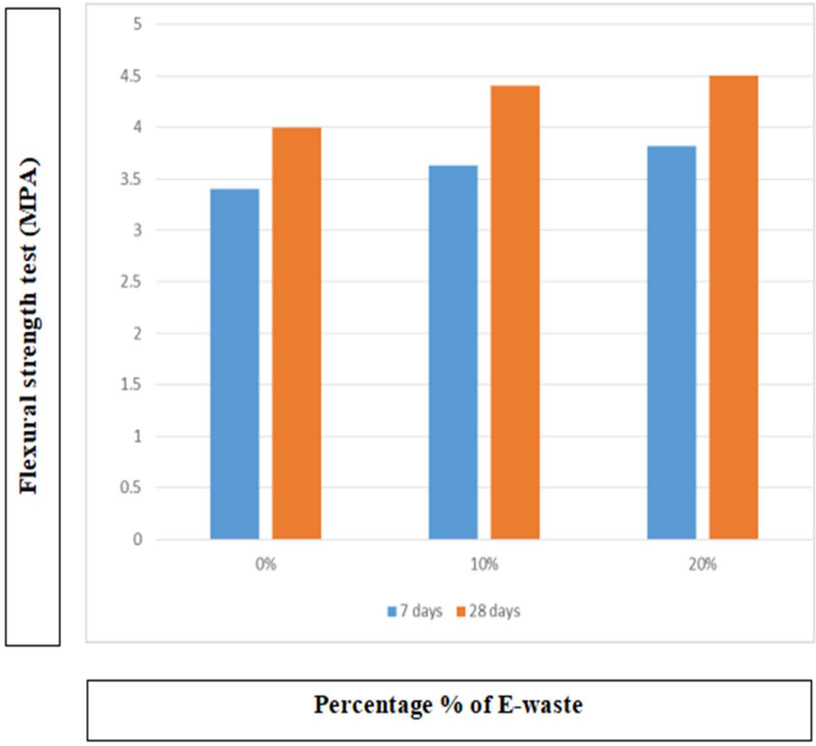
Graph 2: Split tensile strength gained in 7 & 28 days

C. Flexural Strength Test Results

Table.3 presents flexural strength of all concrete mixes where the flexural strength of the specimen is expressed as the modulus of rupture and for testing purpose beams of size 100 × 100 × 500 mm were casted in cured in clean water for 7 & 28 days and tested in Universal testing machine and Graph 3 shows the graphical representations of flexural strength of all mixes M1, M2 And M3 for 7 and 28 days as given below.

Table 3: Flexural strength results at varying % of E plastic waste after curing of 7 and 28 Days

MIX SPECIFICATIONS	M1	M2	M3
PROPORTION OF E-WASTE	0%	10%	20%
7 DAYS	3.4	3.63	3.82
28 DAYS	4	4.4	4.5



Graph 3: Flexural strength gained in 7 & 28 days

V. CONCLUSIONS

The addition of E-waste to the concrete has given a positive result in the improvement of the strength and tensile behaviour in it. The addition of E-waste gives high compressive strength, flexural strength and split tensile strength in concrete in a period of 7 days and 28 days of curing than the conventional concrete. The test values of compressive strength, flexural Strength and split tensile strength obtained for 10% of E-waste is greater when compared to value of 0% & 20%. Since the addition of the E-waste have improved the strength of the concrete in all three type of test such as compressive test, split tensile test and flexural test, the usage of E-waste can be used in the practice of construction of concrete structures. The use of E-waste in concrete is possible to improve its mechanical properties and can be one of the economical ways for their disposal in environment friendly manner.

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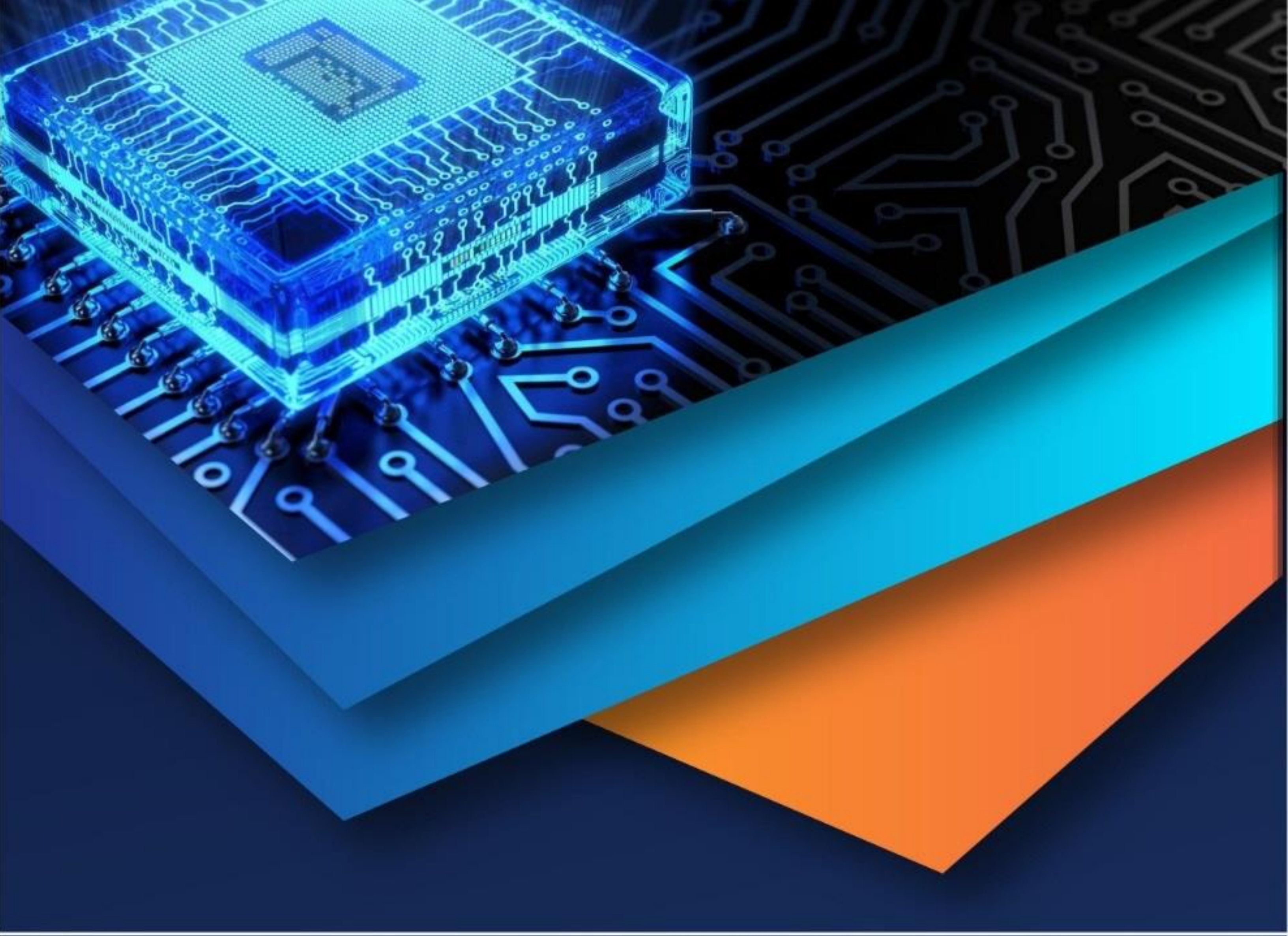

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