EFFECT OF E- FIBRE ADDITION ON E-PLASTIC INCORPORATED CONCRETE

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ABSTRACT

E-waste and plastic waste are the major problem in present scenario as these are non- biodegradable. Electronic Waste, abbreviated as E- Waste, consists of discarded old computers, TVs, radios can be defined as any electrical or electronic appliance which has reached its end of life. With the invention of LCD and LEDs, it displaces the old CRT based TVs and computers available in the market and hence these become obsolete and huge amount of these are dumped as E-wastes. The Utilization of e plastic waste materials in concrete can solve the environmental and ecological problems caused by e- wastes to an extent. In this paper a study of concrete was made with 15% coarse aggregate as e-plastics and the incorporation of e-plastic as fibre at 0.6%, 0.8% and 1%. The electronic plastics used as coarse aggregate was shredded into small pieces and sieved through 20 mm sieve. The insulation wires found on the casing of the electronic device were made into the form of fibre and its effect on the concrete on the strength characteristics was studied. The Specimens were casted to study the compressive strength and tensile strength. The optimum percentage of E- fibre and E- plastic incorporated concrete was found as 15% e-plastic and 0.8% E- fibre by testing compressive strength of concrete cubes. Use of E- plastic waste and E- fibre in cement, concrete and other construction materials will reduce the landfill cost, saves energy, reduce the cost of concrete and will protect the environment from possible pollution effects.

Keyword : *- Concrete , E- Plastic, E- Fibre, Obsolete*

1. INTRODUCTION

E-plastic describes loosely discarded, surplus, obsolete, broken, electrical or electronic devices. Rapid technology change, low initial costs etc have resulted in a fast growing surplus of electronic waste around the globe. Tones of E-plastic need to be disposed every year. Traditional landfill or stockpile methods, which are prevailing methods for the disposal of E-plastics now, is not an environmental friendly solution and the disposal process is also very difficult to meet EPA regulations [5]. The disposal of non disposable E-plastic becomes an important research topic. Technically electronic waste is only a subset of WEEE (Waste Electrical and Electronic Equipment). According to the Organization for Economic Co-operation and Development (OECD) appliances using an electronic power supply that has reached its end of life would come under WEEE.

E-plastic waste is one of the fastest growing waste streams in the world. New effective waste management options are need to be considered. In developed countries, previously, it was about 1% of total solid waste generation and currently it grows to 2% by 2015. In developing countries, it ranges 0.01% to 1% of the total municipal solid waste generation. The E-plastic inventory based on obsolescence rate and installed base in India for the year 2005 has been estimated to be 146180 tons. Ten states generate 70% of the total E-plastic generated in India. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of E-plastic generating states in India. In these cities a complex E-plastic handling infrastructure has developed mainly based on a long tradition of waste recycling. There are two small WEEE/E-plastic dismantling facilities functioning in Chennai and Bangalore. There is no large scale organized E-plastic recycling facility in India and the entire recycling exists in unorganized sector [4].

The integrated waste management approach is to be considered involving efficient use of plastic materials, recycling and disposal mechanisms. At the same time in India, the production of concrete has increased rapidly as a result of the growth in infrastructure development. Because of this development, there is an immense consumption of natural aggregate and will results in depletion of the natural resources. Hence the researchers have started to consider an alternative source for aggregate in concrete by using the waste material as building material.

2. OBJECTIVES

The aim of the research is to find the effect of e- fibre on e- plastic incorporated concrete. The specific objectives are:

- To evaluate the compressive strength and tensile strength with E-plastic as replacement of coarse aggregate 15% and 0.6, 0.8 and 1% E- plastic fibres in M25 grade concrete.
- To find the effect of E-plastic fibres on the strength characteristics of concrete with coarse aggregate replaced by E-plastics.

3. MATERIAL PROPERTIES

The aim of the experimental is to study the effectiveness of e- plastic to replace coarse aggregate and the effect of e- fibre addition in different percentage in the strength characteristics of concrete. The e- plastic waste was shredded into small pieces to the size of coarse aggregate and e- fibres were made confirming to the aspect ratio. Then the shredded e- plastic waste and e- fibre was mixed into fresh concrete and then the effect of shredded electronic plastic waste on the strength properties of concrete was studied. The experiments were carried out to explore the effect of using e- fibre on the e- plastic incorporated concrete The various types of tests were conducted on the cement, fine aggregate, coarse aggregate, e- plastic and e- fibre. The table 1 shows the results of the test conducted on cement.

Table- 1: Test on cement

Tests	Results
Specific gravity	3.15
Standard consistency	36%
Initial setting time	45 minutes

The table 2 shows the result of the tests conducted on fine aggregate. The specific gravity of fine aggregate was found by using pycnometer and is done according to IS: 2386 (Part 3) – 1963.

Table- 2: Test on Fine aggregate

Test	Results
Specific gravity	2.68
Gradation	Zone

The Fig. 1 shows the sieve analysis of fine aggregate and the test was conducted according to IS: 2386 (Part 1) – 1963.

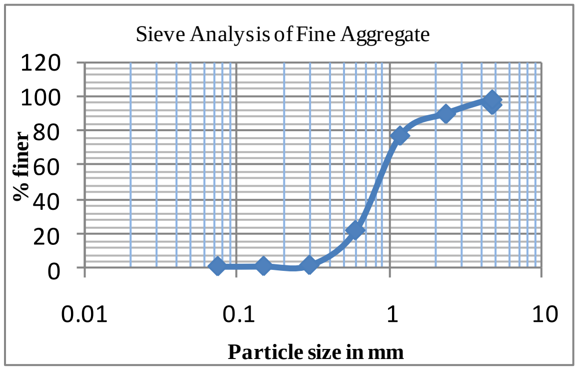

Chart- 1: Sieve analysis of fine aggregate

The table 3 shows the test results of tests conducted on coarse aggregate and e- plastic. This test is based on IS: 2386 (part III) – 1963 for testing specific gravity and water absorption of aggregates for concrete.

Table- 3: Test on coarse aggregate and e- plastic

	Coarse aggregate	e- plastic
Specific gravity	2.75	1.06
Water absorption	0.20%	0%

The Chart 2 shows the sieve analysis of coarse aggregate and e- plastic. The sieve analysis is done as per IS: 2386 (Part 1)-1963.

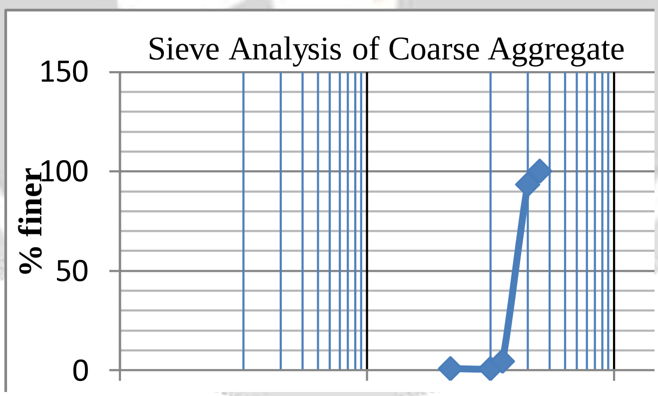

Chart- 2: Sieve analysis of coarse aggregate

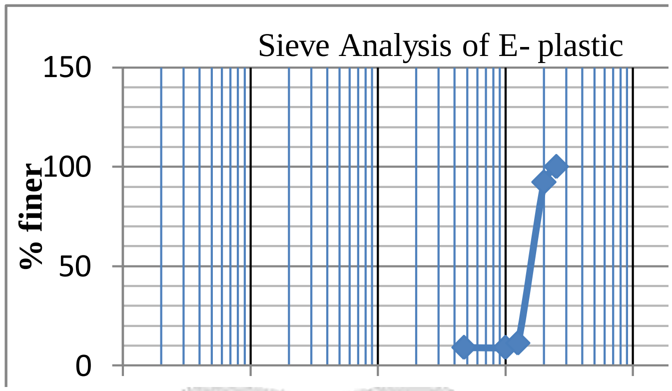

Chart- 3: Sieve analysis of e- plastic

The extracted outer casing of electrical wire (Polyvinyl chloride-PVC wire) was used for making e-waste fibers considering the plastic fiber aspect ratio and made into fibers. The table 4 shows the properties of e- fibre.

Table- 4: Test on e- fibre

Specific gravity	1.11
Aspect ratio	35
Diameter	4 mm
Width	1 mm
Length	35 mm

A total of 6 mixes of concrete with different proportion of e- plastic and e- fibre were prepared. The table 5 shows the mix proportion used for specimens.

Table- 5: Mix proportion of concrete

Specimen	Proportion
E0	Control Specimen
EP	15% e- plastic
EP1	15% e- plastic+ 0.6% e- fibre
EP2	15% e- plastic+ 0.8% e- fibre
EP3	15% e- plastic+ 1% e- fibre

4. RESULTS AND DISCUSSIONS

The strength characteristic of the e- plastic and e- fibre incorporated concrete was analysed. The specimens were made with 15% e- plastic as coarse aggregate replacement and addition of 0.6%, 0.8% and 1% e- fibre and the compressive strength was tested at the end of 7 and 28 days. The water cement ratio was taken as 0.39 for the M25 grade concrete.

Fig- 1: Compressive strength testing of cube

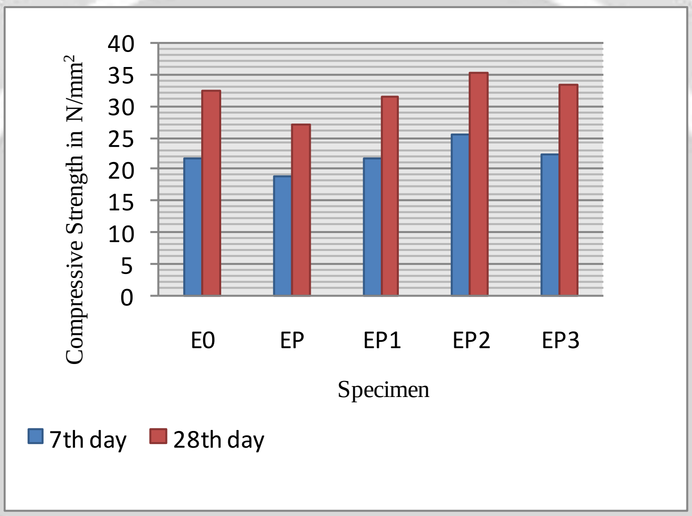

Chart- 4: Compressive strength of cubes

The results show that, the compressive strength of specimens with 15% coarse aggregate replacement and 0.8% E-fibre added has an increase of 8.8% in the strength compared to the control specimen. While replacing coarse aggregate with no fibre added has a reduction of 16.46% in the strength on 28 days of curing. The specimen with E-plastic content shows more deformation than the control specimen. As the E-plastic is flaky and light in weight compared to the coarse aggregate, it results in the reduction of concrete mass. The strength properties of the concrete depend on the volume of the coarse aggregate in concrete and hence it may be the cause of reduction in the strength of concrete. And when the E- fibre is added along with the E-plastic the specimens attained strength more than the control specimen and it is with the addition of 0.8% e-fibre addition the maximum strength is obtained. The increasing trend in the strength by the fibre addition is may be due to the texture of the fibre.

The split tensile strength characteristic of the e- plastic and e- fibre incorporated concrete was analysed and the results were shown in the Chart 5`.

Fig- 2: Split tensile strength testing of cylinder

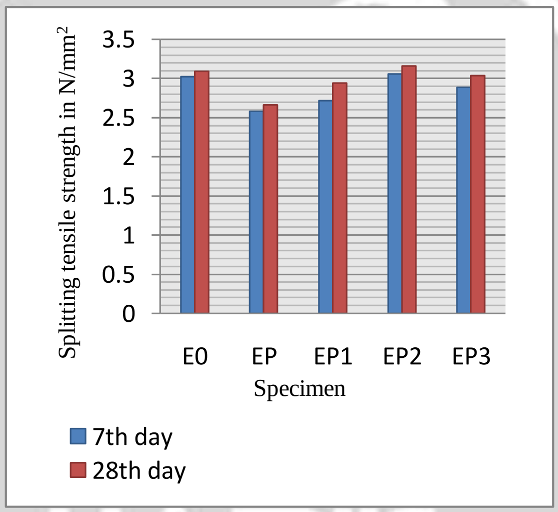

Chart- 5: Tensile strength of concrete cylinders

The results show that, the tensile strength of specimens with 15% coarse aggregate replacement and 0.8% E-fibre added has an increase of 2.26 % in the strength compared to the control specimen. The control specimen shows brittle failure while the specimens with e- plastic and e- fibre undergo large elastic deformation before failure. Hence it tends to shows ductile mode of failure.

5. CONCLUSION

It can be inferred that E-plastic can be used as a partial replacement for natural aggregate only in limited quantities and there is improvement in the strength characteristics with the addition of e- fibre. It is to be noted that since the compressive strength of concrete with E-plastic is comparable to conventional concrete, E-plastic can be utilised for manufacturing compressive members upto 15% replacement. The results show that, the compressive strength of specimens with 15% coarse aggregate replacement and 0.8% E-fibre added has an increase of 8.8% in the strength compared to the control specimen. And the tensile strength of specimens with 15% coarse aggregate replacement and 0.8% E-fibre added has an increase of 2.26 % in the strength compared to the control specimen. As the E-plastic is lighter compared to the natural aggregates, it results in the reduction of volume of concrete and this reduction of volume of concrete may cause reduction in strength with the increasing percentage of E-plastic waste. The E-plastic replaced concrete can be used in non-load bearing construction elements like lightweight roofs, curbs, road dividers, partition walls etc. From the replacements, two tasks can be accomplished, disposal of waste and alternate material for replacing natural aggregate.

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