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E WASTE MANAGEMENT BY UTILIZATION OF E-PLASTIC AS COARSE AGGREGATE IN CONCRETE

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Abstract - *Utilisation of waste material product in construction is one of efficient solution from environmental point of view. Incorporation of waste material in construction not only making their recycling but also deducts the manufacturing cost of concrete. Another advantage regarding utilization of waste material in concrete is deduction in landfill space, preservation of natural resources and decrement in solid waste. E-waste is discarded computers, washing machines; TVs, mobile phone and many more electric appliances that have reach to its end of life. Attempts have been made by civil engineers to use the non biodegradable (plastic) components of e-waste as a substitute for coarse aggregate. The chief motto of this research is to analyze the mechanical property of concrete like workability, compressive strength and flexural strength for M20 grade mix with 0.5 w/c ratio. Coarse aggregate is being replaced from 0 to 15% with regular interval of 5% with E-plastic aggregate*.

Key Words: **Coarse aggregate replacement, compressive strength, E-waste management, Environmental issue, flexural strength, workability.**

1. INTRODUCTION

E-waste is defined as the obsolete, loosely discarded electronic and electrical appliance that becomes waste after their life ends. Increasing innovation in science and technology has promoted the growth of e-waste. Annually we generate around 40 million tons of E-waste & according to US EPA e-waste is increasing 5 to 10% each year and only 5% is being retrieved, that indicate its growth is increasing every day. E-waste is composed of Iron, aluminum, copper, gold & other material which contribute around 60%, while plastic contribute 30% and other hazadarous material accounts 2.70% (such as lead, palladium, beryllium etc) [1].

The new waste materials incorporated in concrete industry is recycled e-plastic. In order to solve the disposal problem of e-plastic, incorporation of waste E-plastic in concrete is one of the efficient applications. Recycled plastic could be used as coarse aggregate in concrete. Nevertheless, it is critical to understand that incorporation of waste material in concrete is not an economically profitable, due to the transportation cost and it effect on overall cost [2].

Processing of E-waste component and its Environmental Impact.

E-waste component	Processing method	Environmental impact
CTB (cathode ray tube) used in monitors, computers, TVs, video camera	Breaking & removal of frame and then dumping	Lead, barium and other oxides get leached into ground water & releases toxic phosphor and thus pollute water.
PCB(printed circuit board), a plate, at which chip & other components are placed	Removal of chips and metals by de-soldering & open burning	Release of brominates dioxins, thus pollutes air
Chips & other gold plated components	Stripping using hydrochloric and nitric acid & then burning	Dumping of metals & brominates material in river contaminates aquatic life and emission of brominates dioxin pollutes air.
Plastics from keyboard, printers monitors and computer wires	Cutting into pieces and melt it for reuse and removes copper from wire.	Release of brominates dioxins and hydrocarbons ashes polluting air, water and soil.

The accumulation of waste plastic is increasing annually because of rapid growth in industrialization and the various properties of plastic that made plastic inseparable from our society like its long life or durability, low cost, strength, user friendly design, lightweight, low density and many more but unfortunately these majority of waste are not being able to recycled and posing serious problems such as contamination of natural resources like soil, air and water. This paper is dealing with the plastic waste and use as coarse aggregate in concrete. The major objective of the research paper is to analyze the property of concrete containing plastic in it, and to determine the extent at which we can utilize these waste product, this will not only help in disposal of waste plastic but also conservation of resources like soil, water, air, & reducing the price of concrete manufacturing. E-plastic is

substituted by coarse aggregate for 0%, 5%, 10% and 15% for M20 grade mix with 0.5 w/c ratio.

1.1 Plastic recycling & Methods of recycling

Plastic recycling is the process of collecting and sorting of waste material for new use. Recycling not only helps in getting waste used for new purpose but also conserves the natural resources, help in reducing the land fill areas.

(a) Mechanical Recycling: Mechanical recycling of plastic involves shredding, cutting, melting and granulation of waste plastic. Removal of dirt and other material from waste plastic should be sorted before mechanical processing.
(b) Chemical processing: Processing of waste plastic is done by depolymerisation which involves pyrolysis and hydrolysis method.
(c) Thermal processing: Thermal processing of plastic involves heating of plastic waste at very high temperature to make plastic flow in liquid form and used as new product when it cools down.
(d) Filler: In this process the waste plastic can directly used as filler in concrete as well as in road construction, the chemical composition has nothing to do with this application [3]

2. OBJECTIVE

(a) The main aim of this research paper is to find out the utilization of hard E-plastic waste material in concrete as a substitute to coarse aggregate and analyze the mechanical property such as compressive strength, flexural strength and workability.
(b) To examine the possibility of using recycled E-plastic waste in concrete.
(c) To find out the optimum plastic percentage replacement with coarse aggregate.
(d) To develop and improvise the technology for E-waste management.

3. METHODOLOGY

For this study, OPC of 43 grade is being used, natural sand below 4.75 mm is used as fine aggregate, natural crushed aggregate 10-20mm is used as coarse aggregate, crushed plastic which passed through 20mm sieve and got retained on 4.75 mm is used in study. As per 456-2000 IS Code mix is made. Mix is prepared with recycled plastic from 0% to 15% as replacement of coarse aggregate. 3 cubes for each percentage are prepared which is going to be tested at 7 and 28 days.

3.1. Experimental Program

In order to determine the property and behavior of coarse aggregate and plastic aggregate used in this research study under sudden impact, aggregate impact value has been carried out. On Fresh concrete workability test is carried out in order to find out the consistency of concrete and on harden concrete compression test and flexural test is being conducted.

Table -3.1 Tests on Aggregate.

S.no.	Test	Coarse aggregate	Plastic aggregate
1.	Impact value	7.90%	1.95%

Various concrete cube specimens are prepared for different mix using drum roller for testing purpose then, E-plastic waste is added accordingly their percentage replacement, then proper mixing of these material along with cement, sand and aggregate with w/c of 0.5 is done. After the mixing process, fresh concrete is placed into mould of 150*150*150 mm which is properly oiled. Then after the filling of moulds proper compaction is given using compactor or with tamping rod at the time of filling the moulds.

3.2 Test on fresh concrete

Slump cone test is used to determine the workability or consistency of concrete mix prepared. Slump cone is conducted on the fresh concrete with varying percentage of E-plastic. S1 is to 0% as conventional concrete, S2 with 5% of E-plastic in concrete, S3 with 10% of E-plastic, S4 with 15% of E-plastic with w/c ratio of 0.5. Results are given in table below.

S.NO.	PERCENTAGE OF REPLACMENT	W/C RATIO	SLUMP VALUE IN (MM)
1.	S1 00%	0.5	35
2.	S2 5%	0.5	43
3.	S3 10%	0.5	47
4.	S4 15%	0.5	54

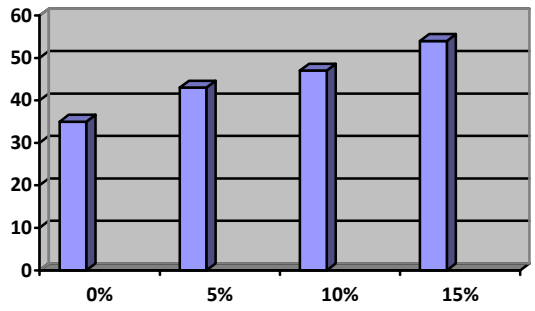

Table 3.2 Workability Graph.

3.3 Tests on harden concrete

(a) Compression test: The compressive strength is one of the most critical properties of concrete and used to check the stress, for compressive strength, 24 cubes of 150*150*150 are being casted. 3 cubes for conventional concrete 3 for 5% replacement, 3 for 10% replacement and 3 for 15% replacement of plastic aggregate with coarse aggregate is being prepared for 7 and 28 days and their average and strength reduction is shown in table 2.3. Compressive strength is calculated by applied load on specimen to specific area.

7-day test (N/mm²)

% replacement	0%	5%	10%	15%	Cube size
7 days	13.75	12.89	11.43	10.21	150*150*150
% reduction in strength	0%	6.25 %	16.87 %	25.75 %	

28-day test result (N/mm²)

% Replacement	0%	5%	10%	15%	Cube size
28 Days	20.11	19.76	17.58	15.72	150*150*150
% Reduction in strength	0%	1.74 %	12.58 %	21.82 %	

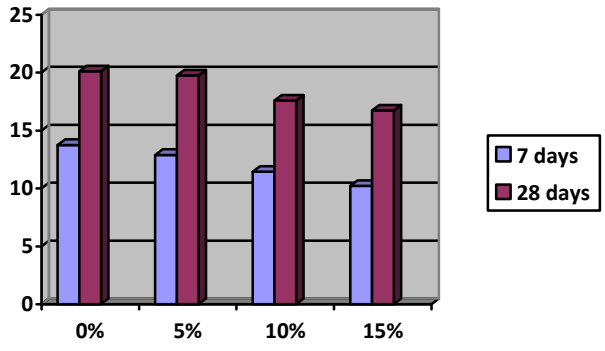

Table 3.3(a) Compressive Strength Graph.

(b) Flexural test: The flexural strength of concrete is determined by the beam testing, standard size of 15*15*70 cm. and we can calculate it according to IS CODE 456:2000 where flexural strength is 0.7√fck [5].

7-day flexural test result in N/mm²

% replacement	0%	5%	10%	15%
7 days	2.59	2.51	2.36	2.23
% reduction in strength	0%	3.08%	8.88%	13.89%

28-day flexural test result in N/mm²

% replacement	0%	5%	10%	15%
28 days	3.13	3.11	2.93	2.77
% reduction in strength	0%	0.63%	6.86%	11.50%

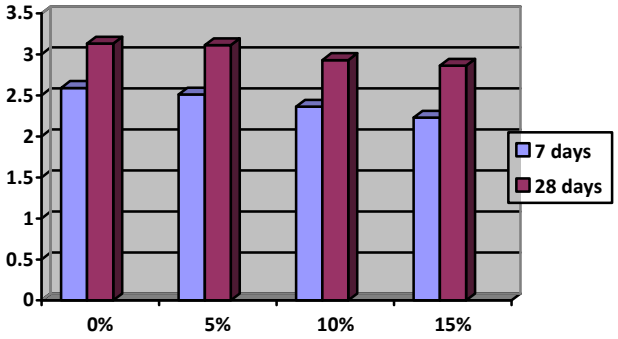

Table 3.3 (b) Flexural Strength Graph.

4. CONCLUSIONS

From the above experimental study, we can conclude that Recycled Plastic aggregate can be used in concrete to replace some of point of coarse aggregate. Following conclusion is being drawn from study.

*The electronic waste plastic has the potential to be utilizes as coarse aggregate in concrete at some replacement level.
*The degree of workability is low, so this type of aggregate could be used in floors, slab, canal lining, and hand placed pavements.
*From the above test done on aggregate, it shows that E-plastic has better crushing strength that natural aggregate.
*The reduction in compressive strength incorporated with electronic plastic aggregate is from 6.25% to 25.74% for 7 days and 1.74% to 21.82% for 28 days respectively.
*Flexural strength decreases as the electronic plastic aggregate content increases. By the replacement of 0%, 5%, 10% and 15% the reduction in flexural strength can be noticed by 3.08%, 8.88%and 13.89% for 7 days whereas for 28 days' reduction is noticed from 0.63%, 6.86% and 11.50% respectively.
*The value of slump cone is keep on increasing showing the inadaptability of plastic to absorb water.

*The E-plastic can be used in concrete mixture as aggregate up to 5% replacement without large reduction in compressive and flexural strength.
* Chemical & corrosion resistance, ease of placement, long durability, low permeability and thermal stability are some of advantages of plastic suitable for pre cast component, bridge deck overlays, artificial marble, repair material for concrete structure and machine tools basement etc.

4.1 Recommendation

***** For better results, silica which is present in printed circuit board (PCB) can be mixed along with E-plastic waste for replacement of fine aggregate.
*** For** further investigation admixtures can also be added to gain the missing strength.

REFERENCES

[1] Amiya Akram, C. Sasi Dhar,and K. Mehraj Pasha, E-Waste Management by Utilization of E-Plastics in Concrete Mixture as Coarse Aggregate Replacement, International Journal of Innovative Research in Science, Engineering and Technology, 4(7), 2015, 5087-5095.

[2] Ashwini Manjunath B.t, Partial Replacement of E-plastic Waste as Coarse-Aggregate in Concrete, Procedia Environmental Sciences, 35, 2016, 731-739

[3] Rafat Siddique, Jamal Khatib, and Inderpreet Kaur "Use of recycled plastic in concrete: A review", Waste Management 28 (2008) 1835–1852

[4] Sunil Ahirwar, An Experimental Study on Concrete by using E-plastic waste as Partial Replacement for Coarse Aggregate, International Journal of Science Technology & Engineering, 3(4), 2016, 7-13.

[5] Standard specification of Indian code IS code: 456:2000.