An Overview on Concrete by using Powder form of E-Waste as Partial Replacement for Cement Material

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Abstract— The management and recycling of E waste is rapidly growing as it is a valuable resource of IT industries and it is very hazardous substances and with low recycling rate. The Utilization of e waste materials is a partial solution to environmental and ecological problems. As the use of E waste will reduces the cement cost and provides a good strength for the structures and roads. It will reduces the landfill cost and it is energy saving. The E- waste consists of discarded plastic waste from the old computers, TVs, refrigerators, radios; these plastics are non-biodegradable components of E- waste as a partial replacement of the cement. An experimental study is made on the utilization of E-waste crush fine powder as cement in concrete with a percentage replacement ranging from 0 %, 10% to 50% .on the strength criteria of M30 Concrete. Compressive strength and Flexural strength Concrete with and without E- waste plastic as partial replacement cement was observed which exhibits a good strength. The feasibility of utilizing E-waste powder as partial replacement of cement has been presented. In this paper we collect all relevant data for our project such as literature review, required material their properties and test methods from lots of author's research papers.

Key words: E Plastic Waste, Concrete, Compressive Strength; Flexural Strength, Printed Circuit Board

I. INTRODUCTION

Now-a-days, the world facing a real challenge is disposal of solid waste in particular E- waste without inducing any environmental issues. Electronic waste accounts that obsolete, broken, surplus, and loosely discarded electrical or electronic devices (Krishna and Kanta, 2014; Suchithra, et al., 2015). In India, the primary source of E–waste is public and private sector, institutions which leads 70% of the total waste (Balasubramanian, et al., 2016). The estimated annual generation of electronic waste is 4, 00,000 tons that is (10-15%) approximately. The wastes are generated from the top cities such as Mumbai, New Delhi, Bangalore and Chennai were calculated to be 10,000 tons, 9,000 tons, 8,000 tons and 6,000 tons respectively. But from these sources only 4% recycling of it (Vivek, et al., 2015). The need for disposal of E–waste several tons per year due to its increasing manner.

The efforts have been made to use the components of E–waste as a partial replacement of cement in the field of construction. Utilization of crushed E–waste materials as a conventional concreting material and other materials in the building construction helps in reducing the cost of concrete manufacturing. It is the most important method to reduce the quantity of E–waste as well as to achieve an eco–friendly concrete and protecting environment from the effect of pollution.

A. Literature Review

1) Chen et al (2006) Waste E-glass particles used in Cementous mixtures, Cement and Concrete Research,

In this papers demonstrated that use of E-glass waste in concrete as fine aggregate replacement. It is evident that the total charge passed decrease with an increasing E-glass content. The total charge passed as reported is less than 2000 which indicates very low chloride permeability. That use of E-glass waste in concrete as fine aggregate. The increase in E-glass content significantly decreases weight and strength loss, mostly for the specimens with lower water/cement ratio. The surface defects of tested specimens also show a qualitative evidence of sulfate attack. The positive effect of E-glass on sulfate resistance of concrete is very prominent. That use of E-glass waste in concrete as fine aggregate replacement. The compressive strength of specimen with 40% E-waste glass is 17%, 27% and 43% higher than control concrete at the ages of 28, 91 and 365 days. The E-waste particles act as crack resistors in concrete.

2) Zheng et al. (2008) Influence of non-metals recycled from waste printed circuit boards on flexural properties and fracture behavior of polypropylene composites. Materials and Design.

He studied the properties of flexure and fracture behavior of polypropylene composites. It is observed that the flexural strength and flexural modulus of the composites can be successfully enhanced by filling non-metals recycled from waste PCB into polypropylene (PP). By using scanning electron microscopy (SEM), the influence of nonmetals on fracture behavior of PP composites is evaluated by in-situ flexural test.

3) Lakshmi and Nagan (2011) Utilization of waste E plastic particles in cementitious mixtures, Journal of Structural Engineering,

This Journal utilized E-waste in concrete as coarse aggregate replacement from 0% to 24%. The average loss of weight and loss of compressive strength of E-plastic concrete is considerably lesser than the corresponding loss of weight and loss of compressive strength of conventional concrete. It shows that E-waste particles in the concrete are not influenced by Sulphate.

Utilized E-waste in concrete as coarse aggregate replacement from 0% to 24%. The decrease in strength was observed at all substitution levels. At 20% replacement the highest strength reduction was observed. They also utilized 10% fly ash as mineral admixture which resulted in better compressive strength. Till 12% replacement of natural aggregates the compressive strength was better than reference concrete.

4) Arora and Dave (2013) Utilization of e- waste and plastic bottle waste in concrete, International Journal of Students Research in Technology & Management,
This paper present studied the low amount replacement of E-waste as fine aggregates in mortars. They concluded that 4% replacement of E-waste as fine aggregates resulted in acceptable strength gain. So it is good for mortar to replace fine aggregate.
5) Prasanna and Rao (2014) Strength variations in concrete by using e-waste as coarse aggregate, International Journal of Education and applied research,
This research is investigated the use of E-waste in concrete as partial replacement of concrete. The strength loss was 33.7% when 20% of E-waste is used to replace coarse aggregate; it is reduced by 16.86% when coarse aggregate is replaced by 20 % of E- waste plus 10% Fly ash.
6) Vivek et al. (2015) Utilization of Electronic Waste Plastic in Concrete" Int. Journal of Engineering Research and Applications ISSN,
Stated that 7.5% of fine aggregate replaced by E-Waste gives optimum results of compressive strength. The compressive strength of concrete is gradually decreased when fine aggregate are replaced beyond 15% with E-Waste.
7) Suchithra et al. (2015) Study on Replacement of Coarse Aggregate by E-Waste in concrete".
International Journal of Technical Research and Applications stated that the addition of E-Waste shows better compressive strength up to 15% replacement. E-waste has more pronounced effect on the flexural strength than the split tensile strength. Also, the results of the durability study show that sulphate attack and chloride attack do not affect the strength of concrete and the optimum mix was found to be more durable than the control mix
8) Alagusankareswari et al. (2016) An Experimental Study on E-Waste Concrete",
Indian Journal of Science and Technology, experimented with E-Waste as a replacement material for fine aggregate. The rate of strength attainment of control mix, E10, E20, E30 was observed. The compressive strength and split tensile strength of concrete pertaining to E-Waste aggregate is slightly less in comparison with the control mix concrete sample. It can be consumed as light weight aggregate because the self-weight of the concrete decreases with the increase in percentage of E-Waste.
9) Sunil Ahirwar et al. (2016) An Experimental Study on Concrete by using E- Waste as Partial Replacement for Course Aggregate" IJSTE – International Journal of Science Technology & Engineering,
In this papers stated that the workability of concrete increases when the percentage of E-Waste increases. The workability of fly ash with E-Waste concrete gives better results than conventional concrete. The compressive strength of concrete decreased with increase in percentage of E-Waste. It has been observed, when cement is replaced by fly ash in concrete with E-Waste as a coarse aggregate, its compressive strength is increased. Cement with 30% of fly ash replacement shows a better result.

B. Objectives of work

To identify that e-waste can be disposed by using them as construction material.

- To find the optimum percentage of e-waste gives how much desirable strength to concrete mix M30.
- To develop and improve the technology for e-waste management.
- To reduce the pollution due to recycling of e-waste in the un-organized section like dumping ground, land filing, burning open ground.
- To determine the compressive and flexural strength of concrete containing e-waste powder as partial replacement of cement.

C. Advantages of using the E- waste in concrete:

The growth in the use of plastic is due to its beneficial properties, which include:

1) Extreme versatility and ability to be tailored to meet specific technical needs.
2) Lighter weight than competing materials reducing fuel consumption during transportation.
3) It improve Durability
4) Resistance to chemicals, water and impact.
5) Excellent thermal and electrical insulation properties.
6) Comparatively lesser production cost.
7) At melting point the bonding capacity increases as the temperature increases.

II. MATERIALS USED

In this study E – waste materials were utilized to produce Structural concrete. The following materials were used in this investigation

A. Cement

Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Table 2.1 gives the properties of cement used

Description of test	Requirements of IS: 8112 1989
Initial setting time	Min. 30minutes
Final setting time	Max. 600minutes
(specific surface by Blaine's air permeability Fineness test)	Min. 225 m2/kg

Table 1: Properties of cement

B. E-waste

Plastics collected from the disposal area were sorted to get the superior one. These were crushed into small fraction and washed to remove the foreign particles. Then it was heated at a particular temperature so that the necessary brittleness was obtained. After extrusion the molten plastic was cooled down and collected in boulders of 100 mm size approximately. These plastic boulders were crushed down to the size of cement powder.

Fig. 1: E-waste Plastic

The analysis showed that printed circuit boards [PCBs] consist of approximately 26% metal, made up mainly of copper, lead, aluminum, iron and tin, as well as other heavy metals such as cadmium and nickel

Metal	PCBs (%) b
Copper	12.0–29.0
Zinc	0.1–2.7
Tin	1.1–4.8
Lead	1.3–3.9
Iron	0.1–11.4
Nickel	0.3–1.6
Gold	0.0029–0.112
Silver	0.01–0.52

Table 2. Metal content in PCBs.
Source: a Veit et al. (2002) [14], Ayres (1997) [2];

C. Fine Aggregate

Locally available river sand conforming to Grading zone I of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.

D. Coarse Aggregate

Locally available coarse aggregate from crusher plant. Its size 20 mm use clean and dry, dust free coarse sand.

E. Water

In this study used Water cement ratio 0.45 Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. It should be free from organic matter and the pH value should be between 6 to 7.

III. Conclusions

According to the overview of the study, we can conclude that:

1) Utilization of partial replacement of E–waste as a coarse aggregate is the best alternative for the conventional concrete.
2) The disposal of E–waste can be used as a coarse aggregate provides the reduction in burden on landfill disposing and environmental pollution.
3) The E–waste concrete density is less as compared with the conventional concrete which reduces the cost of the concrete and produces the light weight concrete structure.
4) The results show that the good strength, greater durability and addition of E–waste exhibits increase in compressive strength up to 15% replacement.
5) The use of EWC is potential to improve the mechanical and chemical properties which tends to eco–friendly concrete.

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