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Utilization of e-waste in concrete by partial replacement of coarse aggregate

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ABSTRACT

E-waste is the problem with which every country is dealing right now. Because there is no method for the disposal of e-waste and with the growth in the consumption of electronic goods this problem is getting bigger and bigger. Like plastic and PCB's which are part of e-waste, is a big threat to the environment when left without treating them. The most effective way of the disposal of e-waste is through landfill and this method require large land mass which is very difficult to find in these days. So, this is a very good concept of using e-waste as an ingredient in concrete by partial replacement of aggregate. We cannot replace it completely as aggregate provides some key properties to concrete like strength, durability and workability. Using e-waste as building material seems right when we look at the amount of aggregate required for making concrete and if we are able to reduce that amount it will be very beneficiary as it reduces the load from the natural resources. In our research work we have partially replaced the aggregate with e-waste.

In the present study the influence of E-waste as a partial replacement of coarse aggregate in concrete mixture is investigated. The mix design of M25 grade of concrete for normal mix (without E-waste) and with a partial replacement of coarse aggregates with E-waste material with 5%, 10% and 15% is carried out. The effect of E-waste particle size using less than 16mm, between 10 to 16 mm and up to 20 mm on compressive strength of concrete cubes, tensile strength and flexural strength of beam is also studied. The compressive strength of concrete cubes and flexural strength of beam tests at 7, 14 and 28 days is determined with and without E-waste material.

Key words: E-waste, PCB's, workability, compressive strength, tensile strength and flexural strength, etc.

INTRODUCTION

Concrete is used in more than any other man-made material in the world. Concrete is a very heterogeneous composition material. It is a binding and composite material, where coarse and fine materials are filler material and cement paste are binding materials. The maximum properties of concrete and workability of concrete is depending on aggregate. The mechanical properties of concrete depend on the properties of aggregate like shape of aggregate, size of aggregate, source of aggregate, crushing type of aggregate, normal or light or heavy weight aggregate, angularity index, modulus of elasticity, surface texture, specific gravity, bulk density, adsorption and moisture content, cleanliness, soundness of aggregate, bulking of aggregate, thermal properties and grading of aggregate etc. Waste materials from other industries are being utilized in concrete productions such as fly ash, silica fume etc. The waste materials from electronics and electrical industries are divided in two categories hazardous and inert waste materials. The inert waste is also known as

E-waste describes obsolete, discarded and malfunctioned electrical or electronics devices. It is very difficult to dispose-off the E-waste materials (16).

E-waste is the waste generated form the discarded electronic devices it is an emerging issue causing serious environmental problems as it is very difficult to efficiently dispose the e-waste without causing any harm to the environment. The conventional method for the disposal of e- waste is dumping the waste into land fill but this method has so many serious problems as it needs a lot of landmasses which is in scarcity in our country and it also contains so many different (17).

Harmful materials like lead, cadmium, beryllium etc. These materials when mixes with soil they contaminate the soil and when mixes with ground water they contaminated it also makes it very harmful to consume by any anyone and if someone consume this water it with cause serious health issues and in some cases, it even cause cancer. In india we generate about 15 million metric tons of e-waste and this number is going to 30 million metric tons by the year 2018 and still 3% of the e-waste generated in is decomposed properly and the rest of it is decomposed by the small peddlers who will not concern the harmful effects of the e-waste.

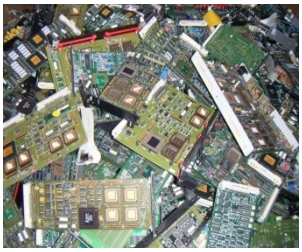


Fig. 1 E-waste

The E-waste that generated is usually disposed in the form of land fill, incineration, reuse, recycling. However, the cost of these disposal measures is high and has hazardous effect on our environment. It is necessary to arrive at a cost effective and environmental friendly recycling process, which may be considered as the real need hour.

Problem Statement

When electronics end up in landfills, toxic like lead, mercury, and cadmium leach into the soil and water and harming ecosystem around over. The objective of this project is to determine how e-waste can be used in construction industry.

Project Objectives

To overcome the above said problem and to come up with a solution we are intending to develop eco friendly concrete.

1. To Improve its Strength by Using E-Waste.
2. To Minimize the Overall Environmental Effects of Concrete Production Using E-Waste as Partial Replacement.
3. To Perform and Compare the Compressive Strength and Flexural Strength of Concrete with and Without Replacement of E-Waste as Coarse Aggregate.

LITERATURE SURVEY

Lakshmi and Nagan (2011) studied the utilization of E-waste particles as coarse aggregates in concrete with a percentage replacement ranging from 0 % to 30% on the strength criteria of M20 concrete. The compressive strength, tensile strength and flexural strength of concrete with and without E-waste as aggregates was observed which exhibits a good strength gain.

Arora and Dave (2013) used E-waste and plastic waste in concrete. The grinded E-waste and plastic waste were replaced by 0%, 2%, and 4% of the fine aggregates. The compressive strength and flexural strength were tested and compared with control concrete. They found that compressive strength of concrete has increased by 5% and reduce the cost of concrete production by 7% at optimum percentage of grinded waste.

Prasanna et al. (2014) studied the non-recycling waste materials. They used E-waste materials as coarse aggregates replacement in concrete with a percentage from 0%, 5%, 10%, 15%, and 20% for M-30 grade concrete without using E-waste aggregates. They found that use of E-waste aggregates produces the lighter concrete as compared to conventional concrete.

Manjunath (2015) studied the utilization of E-waste particle as a fine and coarse aggregate in concrete. An experimental study was made on the use of E-waste particles as fine and coarse aggregates in concrete with a percentage replacement

ranging from 0% to 30% (in an interval of 10%) for M20 grade of concrete. The compressive strength, tensile strength and flexural strength of concrete with E- waste gives better strength as compared to concrete without E-waste.

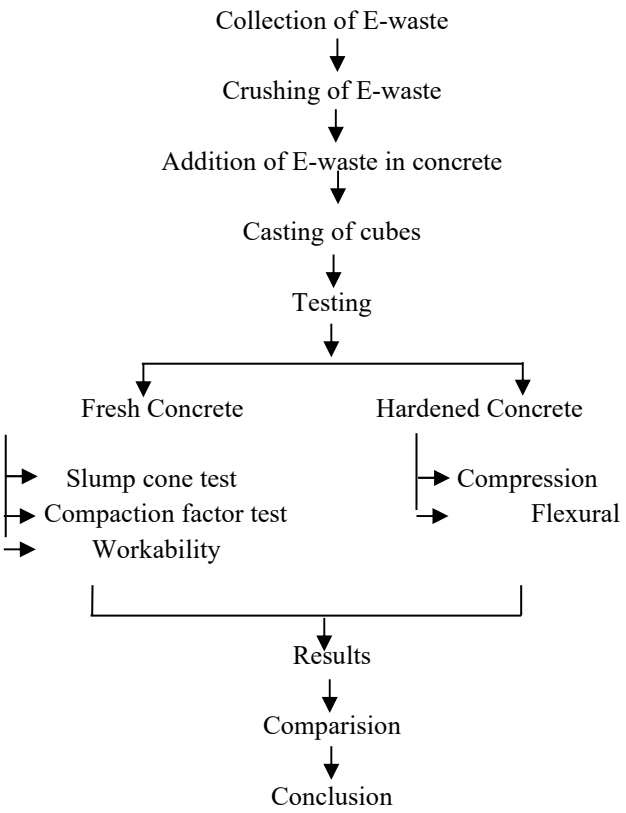
Dawande et al. (2016) studied the use of recycled E-waste material as a replacement of coarse aggregates in concrete. It was found that the use of E-waste aggregates results in the formation of light weight concrete. In this study coarse aggregate was partially replaced by E-waste material up-to 25% along with fly ash partially replacing cement in M40 grade of concrete and properties like workability, compressive strength and flexural strength were evaluated.

Devi et al. (2017) carried out the utilization of E-waste materials from discarded old computers, TVs, refrigerators, radios. The E-waste were used a partial replacement of the coarse aggregates, ranging from 0 % to 20%, for M20 concrete. They found that E-waste used as coarse aggregates exhibits strength gain.

PROPERTIES OF E-WASTE CONCRETE

E-waste concrete can be defined as a composite material consisting of mixtures cement morter or concrete and uniformly dispersed suitable e-waste material. In this research, we have used only printed circuit boards (PCBs). We replace coarse aggregates partially with PCBs in concrete to study its effects on the compressive strength, flexural strength, workability and tensile strength, and to reduce environmental problems created by the improper disposal of e-waste.

METHODOLOGY



MATERIALS USED IN THIS STUDY

1. Cement
2. Fine Aggregates
3. Coarse Aggregates
4. E-waste
5. Water

CONCLUSION

As per the comparison test of the results, it can be observed that there are variations in properties of concrete according the changes in percentages of e-waste.

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