RECYCLING OF E–WASTE AND ITS SIGNIFICANCE IN INDUSTRY AND ENVIRONMENT

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ABSTRACT

Electronic waste is one of the most popular growing issues of the world. Improper disposal of E – waste can cause serious threats to human health and environment. This paper attempts the possibility of using the E - waste in concrete to replace the coarse aggregates. Efforts have been made in the concrete industry to use non-biodegradable components of E–waste as a partial replacements of the aggregates.

Key words: E – waste, Mechanical properties, Concrete, Aggregates, Compressive Strength.

I INTRODUCTION:-

According to the report of Confederation of Indian Industries, the total waste generated by obsolete or brocken down electronic or electrical equipment in India has been estimated to be 1,46,000 tones per year. Apart from domestic e – waste, the country also has to content with tones of e - waste from developed countries landing on its shores either through charity or delivered to scrap yards for recycling. Generate early electronics scrap is a way of luxury life and we would think of the ways to extend the useful life of electronic items. The construction industry is not slowing down, and neither is the use of electronics. We can combine the two. An experimental study is made on the utilization of e- waste particles as coarse aggregates in concrete with a percentage replacement. Compressive strength of Concrete with and without e – waste as aggregate was analysed.

The process involves obtaining the e- waste, separation of e- waste, crushing the e- waste into aggregates using crusher, mixing them with construction materials and testing for compressive strength. Strength characteristics are analysed by conducting the tests on e – waste concrete and found out how much percentage e – waste percentage replacement gives maximum Compressive Strength. Partial aggregate replacement in construction is a relief to the e – waste problem.

II.INDUSTRIAL AND ENVIRONMENTAL IMPACT :-

Precious and special metals concentration is low which are mined. For this considerable amounts of lands are used. Waste water, sulphurdioxide and carbondioxide emission are high. Benefits of recycling are reduction of need for land fills, asset recovery, resale , reuse and creation of jobs. But there are difficulties in extraction of metals from e – waste. E – waste recycling is complex and expensive owing to the diversity of metallic and non metallic components as well as their difficulty in separation. Various technologies like pyrometallurgy (Bernards et al, 1997 : Hall and Williams 2007) and hydrometallurgy (Jha,2012, Pozzo et.al,1991, Xiu et.al.,2013 Yazici and Deveci, 2013)have been employed for the extraction of metals from e – waste PCB. Poisonous gases like dioxins and furans generated as a result of the pyrometallurgical process and high volume of acidic effluents generated owing to the hydrometallurgical process lead to the environmental pollution.

III E – WASTE REDUCING METHODS:-

a) Use of renewable materials and energy:- Bio based toners, glues and inks, solar computers.
b) Adopt centralized networks similar to telephone system.
c) Use of non renewable materials

d) Designers should ensure the product is built for re-use, repair or upgradability.
e) Reduce the use of fibre glass as it is not recyclable.
f) Choose durable products and avoid disposable products.
g) Replacement of CRT with LCD screens eliminate use of Pb.
h) Impliment advance recycling fee for electronics goods.

IV E-WASTE AS CONSTRUCTION MATERIAL:-

The construction industry is not slowing down and neither is the use of electronics goods and hence the accumulation of e – waste. We can pair the construction industry and e – waste accumulation. To convert e – waste as construction material , separate e – waste on the basis of their constituents, reaction nature with heat and its degradable feature. Meltable plastics are separated from PCB's to avoid voids in bricks. Separated e – waste is crushed into aggregate size using machines. Crushed material is mixed for the following products such as bricks, concretes, tar roads and as a basement material. Temperature sensitive e – waste should not be added with brick because there is possibility of voids at high temperature. These e – waste can be used in concrete, slabs and basement construction. Lead and Tin can be removed from copper by electrodissolution in a dilute caustic soda solution. The power consumption was estimated at 27 Kwh /tone. The dissolved lead was precipitated. The scrap boards may be delaminated from glass fibre sheets by roasting at 325 – 350^{0}C .

V PROCEDURE:-

Determination of target strength of Mix. :- Himsworth constant for 5% risk factor is 1.65. In this case standard deviation is taken from IS 456 : 2000 against M30 Mix is 5 (Clause 9.2.4.2).

$F_{target} = F_{ck} + 1.65 \text{ x } S= 30 + 1.65 \text{ x } 5 = 38.25$ N/mm^2.,

Where F_{ck} = Characteristic compressive strength in N/mm^2.

S = Standard deviation in N/mm^2 = 5 as per table – 1 of IS 10262 – 2009

Test results:- Characteristic compressive strength = 30 N/mm^2., Target mean strength = 38.25 N/mm^2.

Specific gravity of fine aggregate = 2.73, Specific gravity of 20 mm Coarse aggregate = 2.74

Specific gravity of DECAN OPC 53 grade cement = 3.12,

Slump obtained for design Mix. = 55 mm.

Table I : Compressive Strength of Concrete on 150 mm size Cube prepared from M30 Mix.

Mix.	Sl. No.	Age on Testing	Ultimate Load(KN)	C.Strength (N/mm^2)	AverageStrength (N/mm^2)
	1	7 Days	684.3	30.41	
	2	7 Days	681.3	30.27	30.45
0% e – waste in	3	7 Days	690.1	30.67	
C.A. %	4	28 Days	870.6	38.69	
	5	28 Days	878.0	39.02	38.87
	6	28 Days	875.0	38.89	

Similarlly proceeding for 15% and 20% replacement of C.A. by e- waste. Strengthvalue is found to be within target mean strength value. Then conducted strength test for 20.1%, 20.2%,20.3%, and 20.4% replacement of C.A. by e – waste. Strength values of 20.1% and 20.2% replacement of C.A. by e- waste is same but it is decreasing from 20.3% onwards replacement of C.A. So the optimum percentage of replacement of C.A. by e – waste without affecting strength is concluded as 20.2% in this Mix. The compressive strength of the 150mm x 150mm x 150mm cube specimen of M30 grade concrete Mix design [C: MS : CA : W] = [1: 1.825 : 3.25 : 0.41] is tested for 7 days and 28 days of curing according to the provisions of the Indian Standard Specification IS : 516 – 1959. Mix design is done as per IS : 456. The optimum percentage of aggregate replacement is found to be 20.2% of e-waste by conducting compressive strength test of concrete cube.

VI CONCLUSION:-

E-waste can be utilized in the construction field without compromising strength. This is one of the economical ways for the disposal of e-waste without creating any environmental issues. It is found that up to 20.2% aggregate can be replaced by e-waste without affecting compressive strength. It is estimated that one cubic meter concrete contain 1283 kg of aggregate. By replacing 20.2% of aggregate we can save 260 kg of aggregate per one cubic meter of concrete.

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