Study on Properties of Concrete with Electronic Waste

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***Abstract*— E-Waste that is increasing day by day turning into a major threat to public health and successively pollutes the setting. India ranks fifth in the world for e-waste generation, about a pair of million a lot of e-waste is generated associate rally and an unrevealed quantity of e-waste is foreign from alternative countries around the world. We replace course aggregate with E-waste by 15% to manufacture eco friendly tiles with proportion of 1:1.3:1. The aggregate used in this process is 6mm aggregate, Tests carried out for the aggregates is impact test compressive test, specific gravity test. The harden concrete test carried out is compressive strength for 28 days, water absorbtion test. The compressive strength obtained for 28 days is 25n/sq.mm. The final compressive strength of the concrete of E-waste tile is 31.34 which is more than the conventional concrete tile by 1.19.**

INTRODUCTION

E-waste can be defined as the disposal created by discarded electronic devices and components as well as substances involved in their manufacture and production. E-waste is a term used to cover almost all types of electrical and electronic equipment (EEE) that has or could enter the waste stream. Although e-waste is a general term, it can be considered to cover TVs, computers, mobile phones, white goods (e.g. fridges, washing machines, dryers etc), home entertainment and stereo systems, toys, toasters, kettles – almost any household or business item with circuitry or electrical components with power or battery supply. The European Waste Electrical and Electronic Equipment Directive Directive classifies waste in ten categories: Large household appliances (including cooling and freezing appliances), Small household appliances, IT equipment (including monitors), Consumer electronics (including TVs), Lamps and Luminaires, Toys, Tools, Medical devices, Monitoring and control instruments and Automatic dispensers. These include used electronics which are destined for reuse, resale, salvage, recycling, or disposal as well as re-usables (working and repairable electronics) and secondary raw materials (copper, steel, plastic, etc.). The term "waste" is reserved for residue or material which is dumped by the buyer rather than recycled, including residue from reuse and recycling operations, because loads of surplus electronics are frequently commingled (good, recyclable, and non- recyclable). Several public policy advocates apply the term "e-waste" and "e-scrap" broadly to all surplus electronics. Cathode ray tubes (CRTs) are considered one of the hardest types to recycle.

E-waste is used as a generic term embracing all types of waste containing electrically powered components. e- Waste for short - or Waste Electrical and Electronic Equipment (WEEE) - is the term used to describe old, end- of-life or discarded appliances using electricity. It includes computers, consumer electronics, fridges etc which have been disposed of by their original users. e- Waste contains both valuable materials as well as hazardous materials which require special handling and recycling methods.

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Electronic waste, e-waste, e-scrap, or waste electrical and electronic equipment (WEEE) describes discarded electrical or electronic devices. There is a lack of consensus as to whether the term should apply to resale, reuse, and refurbishing industries, or only to product that cannot be used for its intended purpose. Informal processing of electronic waste in developing countries may cause serious health and pollution problems, though these countries are also most likely to reuse and repair electronics.

All electronic scrap items, such as CRTs, may contain contaminants such as lead, cadmium, beryllium, or brominated flame retardants. Even in advanced countries recycling and disposal of e-waste may involve significant risk to workers and communities and great care must be taken to avoid unsafe exposure in recycling operations and leaching of material such as heavy metals from landfills and incinerator ashes.

E- Waste - Electronic waste or e-waste describes discarded electrical or electronic devices. Used electronics which are destined for reuse, resale, salvage, recycling or disposal are also considered e-waste. Informal processing of electronic waste in developing countries may cause serious health and pollution problems, as these countries have limited regulatory oversight of e-waste processing.

E-waste encompasses ever growing range of obsolete electronic devices, such as computers, servers, main frames, monitors, TVs and display devices, cellular phones, calculators, audio and video devices, printers, scanners,copiers, refrigerators, air conditioners, washing machines, microwave ovens, electronic chips, processors, mother boards, printed circuit boards (PCBs), industrial electronics such as sensors, alarms etc. Electronic and electrical equipments are made up of several components, many of which contains toxic substance, like lead, chromium, mercury, beryllium, cadmium, acids and plastics etc. Monitors and televisions made with tubes (not flat panels) have between 4 and 8 pounds of lead in them. Most of the flat panel monitors and TV's being recycled now contain less lead, but more mercury, from their mercury lamps. About 40% of the heavy metals, including lead, mercury and cadmium, in landfills come from electronic equipment discards.

These toxic substances can have highly adverse impacts on human health and environment, if not handled properly. Often these hazards arise due to improper recycling and rudimentary processes used for disposal of E-waste. For example, improper breaking or burning of printed circuit boards (PCBs) and switches may lead to the release of mercury, cadmium and beryllium which are highly toxic to human health. Another dangerous process is the recycling of components containing hazardous compounds such as halogenated chlorides and bromides used as flame retardants in plastic, which form persistent dioxins and furans on combustion at low temperatures.

COMPOSITION ON E-WASTE- Electrical and Electronic equipment contains metallic and nonmetallic elements, alloys and compounds such as Copper, Aluminium, Gold, Silver, Palladium, Platinum, Nickel, Tin, Lead, Iron, Sulphur, Phosphorous, Arsenic etc. If discarded in the open, these metals can cause a severe environmental and health hazard.

Materials Used

E-Waste: E-Waste is a popular , informal name for electronic products nearing the end of their useful life, because technology advances at such a high rate, many electronic devices become "trash" after a few short years of use computers, television, VCRs, stereos and fax machines are common electronic products. Many of the products can be resused and recycled. E-Waste is taken from the E-Waste Recycling Plant present at Coimbatore. The used E-Waste is of Printed Circuit Board that contain Plastics, Fiber, Epoxy Resin, etc. That E-Waste is in form of small pieces & colour of powder is grey. Cost of E-Waste pieces is Rs.30 per kg.

Fig 1: Electronic waste

Cement: Cement is used right from ancient periods in construction industry .The most commonly available Portland Pozzolana cement was selected for the investigation. The cement used was dry, powdery and free from lumps. All possible contact with moisture was avoided while storing cement. The Portland Pozzolana Cement is a kind of Blended Cement which is produced by either intergrinding of OPC clinker along with gypsum and pozzolanic materials in certain proportions or grinding the OPC clinker, gypsum and Pozzolanic materials separately and thoroughly blending them in certain proportions. Portland pozzolana cement has spherical cement particles and they have higher fineness value. Due to the spherical shape concrete move more freely and more fineness of particles allows better filling of the pores. This type of cement also gives better cohesiveness to concrete. PPC cement also reduces the rate of slump loss of concrete as compared to concrete made with ordinary cement, particularly in hot weather condition. PPC cement reduces bleeding by providing greater fines volume and lower water content for a given workability. This also helps to block bleed water channels. PC cement slightly prolongs the setting time of concrete which helps the mason for good finishing of concrete or cement mortar. The cohesiveness of concrete mix helps for better finishing of concrete. The silicate formation of PPC continues even after the rate of hydration of ordinary cement slows down. This results in increased strength gain at later ages. This higher rate of strength gain will continue with time and result in higher later age strength. PPC in concrete helps to reduce drying shrinkage and plastic shrinkage.

Coarse Aggregate: Ordinary crushed stone with size 6mm was used as coarse aggregate in concrete mixes. They generally possess all the essential qualities of a good stone showing very high crushing strength, low absorption value and least porosity. The high crushing strength of the coarse aggregates defines the capacity of the coarse aggregates in concrete which can bear a large amount of load to withstand the crushing effect caused by the different types of load. The low absorption value and porosity are determined to find the permeability of fluids through the coarse aggregates which may cause the cracks and other deformation which may lead to the collapse of the structure.

WATER :Water fit for drinking is suitable for mixing concrete. Impurities inthe water may affect concrete setting time, strength, shrinkage or promote corrosion of reinforcement. Hence locally available purified drinking water was used for the work.

M SAND:Manufactured sand (M-Sand) is a substitute of river sand for concrete construction . Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm. It is well graded in the required proportion. It does not contain organic and soluble compound that affects the setting time and properties of cement, thus the required strength of concrete can be maintained. It does not have the presence of impurities such as clay, dust and silt coatings, increase water requirement as in the case of river sand which impair bond between cement paste and aggregate.

CHEMICAL: We used Chemical for manufacturing of parking tile is Polycarboxilic Acid Superplastisizer. To ensure good workability of concrete at low water cement ratio plasticizer and super plasticizerare used.

Mix design

MIX DESIGN FOR CONCRETE TILES AS PER IS 10262:

(Using E waste to replace 15% Coarse Aggregates)

DESIGN STIPULATIONS

Characteristic compressive strength required in the field at 28 days -25 N/Sq.mm

Maximum size of aggregate - 6mm

Degree of workability - 0.9 Compacting factor

Degree of quality control -Good

Type of exposure - Mild

TEST DATA FOR MATERIALS

Cement used -Ordinary Portland cement.

Specific gravity of cement – 3.15

Specific gravity

Coarse aggregate -2.6

Fine aggregate -2.6

Water absorption

Coarse aggregate -0.45%

Fine aggregate-1.10 %

Target Mean strength : $f_{ck} = f_{cr} + t \times s$

$= 25 + 1.65 \times 5.30$

$= 33.75$ N/Sq.mm

Selection of water cement ratio:

From Fig.1 Free water cement ratio required for the target mean strength of 33.75 N/Sq.mm is 0.42.
Selection of water and sand content:
As per table 4 of IS 10262 the water content for Nominal maximum size of aggregate is:
Water Content /cum of concrete: 208 Kgs
Sand as percent of Total volume of aggregate: 40%
Determination of cement content:
Water cement Ratio: 0.42
Weight of water: 208 Kgs
Therefore weight of cement will be: 208/ 0.42 = 495.3 Kgs
Determination of Fine & Coarse aggregates:
1Cum = (208 + 495.3/3.15 + fa /(0.4X2.6)) * 1/1000
fa = 661.20 Kg/Cum
1Cum = (208 + 495.3/3.15 + Ca /(0.6X2.6)) * 1/1000
Ca = 991.788 Kg/Cum
Replace 15 % of Coarse aggregate by using E waste – then Coarse Aggregate
Ca = 843.020 Kg/Cum
Weight of E waste per cum
EW = 148.760 Kg/Cum
The Mix Proportion then Becomes: 1:1.3:1

Test Result And Discussion:
COMPRESSIVE STRENGTH OF TILES

Trial no	Specimen details	Test results		
		Weight(KG)	Ultimate load (KN)	Compressive strength (N/MM²)
1	Conventional concrete tile	3.85	2010	29.39
	E waste concrete tile	3.53	2144	31.34

FLEXURAL STRENGTH TEST

Trial no	Specimen details	Test results		
		Weight (KG)	Proving Ring division	flexural strength (N/MM²)
1	Conventional concrete tile	3.79	31	5.49
	E waste concrete tile	3.58	26	4.61

WATER ABSORPTION TEST

Trial no	Specimen details	Test results		
		Dry Weight (kg)	wet Weight (kg)	Water absorption
1	Conventional concrete tile	3.85	4.04	4.94
	E waste concrete tile	3.53	3.75	5.67

Water absorption value is within permissible limit which is less than 10%.

CONCLUSION

- From this project, there is a Better and perfect alternating solution for reusing of e-waste in easiest way is to be found and new creative parking tile to be introduced.
- Tests are carried out successfully and results are to be obtained in perfect manner as per standard specifications. we get more compressive strength than conventional concrete tiles.
- The characteristics and properties of e-waste tiles are similar to the normal tiles and cost of the E-waste tile is greater than when compared to normal parking tile.
- In future it will reduce by increasing in large level of production. And it will be a good solution for reducing the E-waste.

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