



Experimental Investigation on Replacement of Bottom Ash as Cement and Electronical Waste as Coarse Aggregate

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Abstract: Recycling of the waste materials is the art of creating new materials. The availability of natural raw materials is at huge demand in the current scenario. The use of waste materials as a replacer of the concrete raw materials can reduce the use of raw materials. Bottom ash which is a residue from the Power plant is used as a replacer of cement. Electronical waste which is a waste from electronic devices which attains its life time is used as a replacer of Coarse aggregate. The problem that arrives due to the lack of availability of construction materials can be controlled by using these waste materials. Coarse aggregate is replaced by the Electronical waste in the ratio of 10% of coarse aggregate weight. Cement is replaced by the Bottom ash in the ratio of 15%, 20% and 25% of cement weight. The Conventional Concrete and the replacement concrete was designed in the mix proportion of M30 grade as per IS code. The Strength tests such as Compressive Strength test and Split Tensile Strength test were conducted for 7 days, 14 days and 28 days. These tests were compared with Conventional concrete with the Replaced concrete. The results of these concrete will be compared. The use of Electronical waste and Bottom ash in concrete are studied in this project.

Keywords: Cement, Aggregates, Bottom Ash, Electronical Waste, Compressive Strength Test, Split Tensile Strength Test.

I. INTRODUCTION

Electronical wastes are those which are hazardous to the human being. These wastes are used once they attained their life time. Electronical waste are also called as E-Waste, many researchers have been undergoing in using of these waste in Concrete as Coarse aggregate in specified proportions. Use of E-waste is one of the major solutions to control the environmental pollution. Its nearly 50,000 tones of E-wastes are produced every year around the world. This waste has many indirect privileges like reduction in landfill cost, saving in energy and protects the environment from all possible pollution effects. The Environmental Protection Agency estimates that only 15-20% of e-waste is recycled, the rest of these electronics which are not suitable for recycle go into landfills and incinerators. Bottom ash is the residue which is obtained from the Power plants. These residues are treated for the further purpose for making Fly ash. This bottom ash contains the property as much as cement. Bottom ash is coarse, granular, incombustible materials that are collected from the bottom of furnace that burnt coal. The bottom ash mainly contains stone, bricks, glass, ferrous and non-ferrous matter as well as unburned

materials. Research studies had been made on the idea to use bottom ash in building materials, such as raw material for cement or aggregate in concrete. In Tamil Nadu nearly a number of tons of bottom ash are produced because of the Power plant. These ash are not disposed in the correct way, they are disposed in sea which becomes harmful for aquatic lives and also make unhealthy water with more impurities. So to reduce the effect from these waste materials these can be added in concrete. These waste materials are good substitute for Cement and Coarse aggregates.

II. MATERIALS AND PROPERTIES

- a. **Cement:** As per IS code Ordinary Portland Cement of grade 53 was used. This is the most widely used Cement used in Construction field.
- b. **Bottom Ash:** Bottom ash is a residue of Power Plant which is available in Kudankulam Power plant.



Physical Properties of Bottom Ash

Properties	Values
Specific Gravity	2.72
Fineness Modulus	4%
Consistency	25%

Chemical Properties of Bottom Ash

Chemical Composition	% of Chemical Content
SiO ₂	38
CaO	21.1
MgO	2.4
Fe ₂ O ₃	8
Al ₂ O ₃	17.5

Fineness modulus	2.298%	1.942%
Crushing value	12.42%	<2%
Abrasion value	14.5%	10.4%
Impact value	11.2%	<2%

f. **Water:** Portable water was used for concrete.

MIX DESIGN

Cement	Fine Aggregate	Coarse Aggregate	Water
394	659	1283	158
1	1.67	3.2	0.4

Proportion of replacing materials:

Mix Proportions	E-waste	Bottom ash
CC	0%	0%
Mix 1	10%	15%
Mix 2	10%	20%
Mix 3	15%	15%
Mix 4	15%	20%

c. **Fine Aggregate:** Locally available River sand is used.

d. **Coarse Aggregate:** Locally available Coarse aggregate of size 20mm is used.

e. **E-Waste:** Electronic wastes are called as E-waste which is available in local shops. They are the components of TV, Laptops and Mobile phones etc. These wastes are broken into the sieve size of 20mm.

Physical Properties of Coarse Aggregate and E-Waste

Property	Coarse aggregate	E-waste
Specific gravity	2.64	1.79
Water absorption	0.5%	0.1%

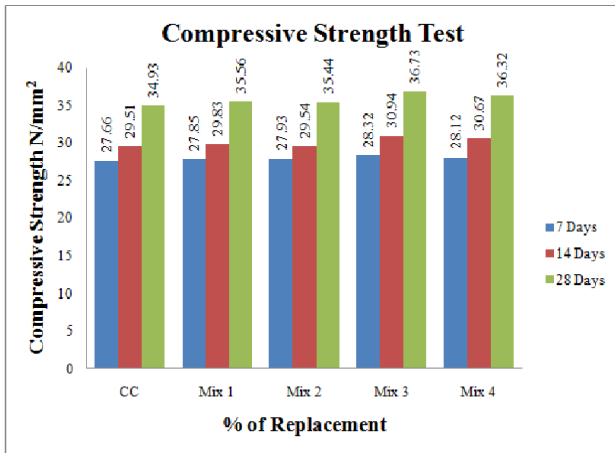
III. RESULT & DISCUSSION

a. COMPRESSIVE STRENGTH TEST:

The Compressive Strength test for the Conventional concrete and the Trial mixes was conducted to evaluate the strength development at the age of 7, 14, 28 days.

COMPRESSIVE STRENGTH TEST N/mm²

Mix Proportions	7 Days	14 Days	28 Days
CC	27.66	29.51	34.93
Mix 1	27.85	29.83	35.56
Mix 2	27.93	29.59	35.44
Mix 3	28.32	30.94	36.73
Mix 4	27.74	29.67	36.32

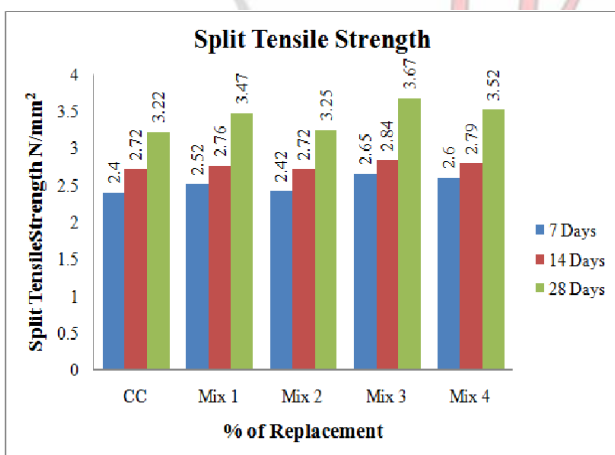


b. SPLIT TENSILE STRENGTH TEST:

The Split Tensile Strength test for the Conventional concrete and the Trial mixes was conducted to evaluate the strength development at the age of 7, 14, 28 days.

SPLIT TENSILE STRENGTH TEST N/mm²

Mix Proportions	7 Days	14 Days	28 Days
CC	2.40	2.72	3.22
Mix 1	2.52	2.76	3.47
Mix 2	2.42	2.72	3.25
Mix 3	2.65	2.84	3.67
Mix 4	2.60	2.79	3.52



IV. CONCLUSION

This study intended to find the effective ways to reutilize the E-waste materials as a Coarse aggregate and Bottom ash as Cement. Analysis of the strength characteristics of concrete containing E-waste and Bottom ash gave the following results:

- The strength of M30 grade is achieved by replacing E-waste and bottom ash in concrete.
- The Maximum Strength of replacing E-waste as Coarse aggregate and Bottom ash as Cement was achieved at 15% of E-waste and 15% of bottom ash in concrete.
- The strength characteristics of conventional concrete are slightly lower than the trial mixes.
- The maximum compressive strength is attained at the Mix 3 (15% of E-waste + 15% of Bottom ash) is 36.73N/mm² whereas the Conventional concrete strength attained is 34.93N/mm².
- The maximum Split tensile strength is attained as 3.67N/mm² whereas conventional concrete strength is 3.22N/mm².
- It is concluded that 15% of E-waste and 20% of bottom ash can be used in concrete respectively.

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