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Augmentation of mechanical properties by utilization of E-wastein concrete as partial replacement of coarse aggregate

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Abstract

Concrete is a combination of cement, aggregates and water. At present difficulty in availability of raw material and high cost is big concern. Therefore other alternative materials need to find out. Also E-waste is the big problem and consumption of electronic itemsis increasing day by day. To solve this problem of disposal a decent idea is to utilize E-waste in concrete industry. The work was conducted on M20 grade of mix concrete with a range of 0%, 5%, 10%, 15% and 20% replacement of coarse aggregate with E-wasteThisresearch is carried out to understand workability, slump, compressive strength and flexural strength characteristics of concrete with replacement of coarse aggregate with E-waste.

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).Electronic waste is one of the fastest growing waste streams in the world.In India, the primary source of E–waste is public and private sector institutions which lead 70% of the total waste (Balasubramanian, et al., 2016).For solving the disposal of large amount of E waste, utilization of E-waste material in concrete is used which may reduce the environment problem as well as cost of concrete manufacturing.

Key words: E-waste, coarse aggregates, fine aggregate, compressive strength

3. MATERIALS USED

Cement

A cement is a binding material which is used for construction that sets, adheres and hardens to aggregate and other materials, In construction industry cement in used from ancient times, The most commonly ordinary Portland cement are used. The cement used was dry, free from lumps and in powdered foam and all possible contact with moisture was avoided while storing

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cement. The 43 grade cement complying to IS 8112 (2013) was used in this project.

Physical properties	Observation
Specific Gravity	3.14
Standard Consistency	33%
Initial setting time	30 min
Final setting time	8 hrs 35 min
Fineness (m2/kg)	30

Aggregates are natural materials, which are hard and imparts strength to concrete. They are important constituent in concrete. They cover the major portion and give the shape and rigid skeleton structure for concrete, reduce the shrinkage, improve the strength and effect economy. The aggregates constitute major volume and occupy 75 to 80% in concrete and influence the properties of concrete.

Properties	Fine aggregate
Specific gravity	2.80
Fineness modulus	3.10
Water Absorption(%)	0.50
Surface texture	Smooth

Sieve analysis of fine aggregates

Sl.No	IS sieve	Weight retained in g	Cumulative Weight retained in g	Cumulative percentage weight retained	Percentage of finer passing
1	4.75mm	11.00	11.00	1.10	98.90
2	2.36mm	114.00	125.00	12.50	87.50
3	1.18mm	146.0	271.00	27.10	72.90
4	600micron	459.00	730.00	73.00	27.00
5	300micron	233.0	963.00	96.30	3.70
6	150micron	37.00	1000.0	100.0	0.00
7	<150micron	0.00	0.00	0.00	0.00

Coarse Aggregate

Locally available stone which are broken into small sizes and irregular in shape and it is crushed and angular coarse aggregate.The aggregates are generally acquired by blasting in stone pits or breaking them by hand or by crusher machines. The physical properties of coarse aggregate were tested as per IS 387-1970. The results of experimental study on coarse aggregate are tabulated
in Table

Properties	value
Specific gravity	2.8
Absorption (%)	0.5
Colour	Dark
Crushing value	27.4%
Shape	Angular
Impact value	24.62%

E Waste

E-waste was collected from the sources in the form of scrap material which resulted from the electrical or electronic devices. In this study, crushed E wastes were used as for partial replacement in concrete. The E wastes are collected from scraps industry at Ujjain in Madhya Pradesh state.

Physical Properties of E waste

Properties	E-waste
Specific gravity	1.07
Absorption (%)	<0.2
Colour	Dark
Crushing value	<2%
Shape	Crushed and Angular
Impact value	<2%
Size	10-12.5mm

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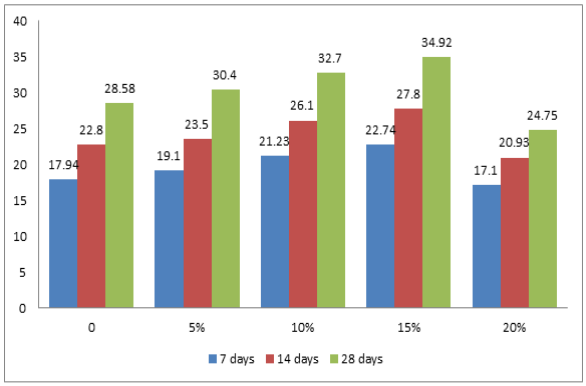
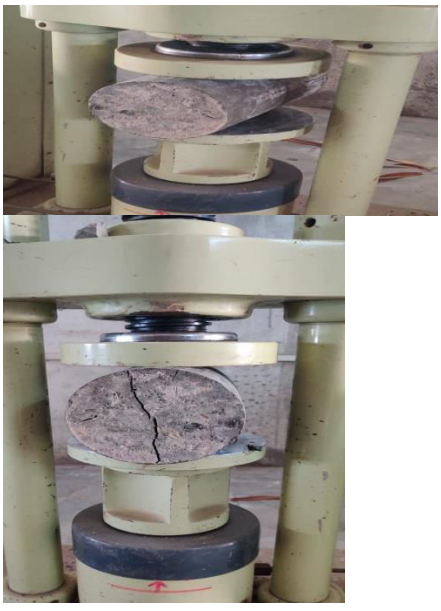
Compressive strength of specimen is determined by using 2000 kN capacity compression testing machine. For entirely tests, each one value was taken as the average of three samples. Test results for controlled concrete at 3, 7 and 28 days curing were tabulated in Table .The testing arrangements are shown in Figure

% of E-`waste	Compressive Strength(N/mm2)		
	7 days	14 days	28 days
CC/0	17.94	22.80	28.58
5	19.10	23.50	30.40
10	21.23	26.1	32.70
15	22.74	27.8	34.92
20	17.10	20.93	24.75



Split Tensile Strength

Tensile strength of concrete was measured by using split tensile strength in compression testing machine. Test results for controlled concrete for 7th, 14th and 28th days curing were tabulated. Dimension for the concrete cylinder specimen was 150mm dia. and 300mm length. The cylindrical specimens were cast with various amounts of E wastes like 0%, 5%, 10%, 15% and 20%.



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Tensile strength result for concrete cylinders

% of E waste	Split tensile strength (N/mm2)		
	7 days	14 days	28 days
CC/0	2.10	2.65	3.68
5	2.64	3.05	3.55
10	3.15	3.42	3.84
15	2.74	3.27	3.78
20	2.32	2.65	2.92

Conclusion

The use of 15% partial replacement of E waste in coarse aggregate in found to be satisfactory. This study projected to find effective techniques to reutilize the electronic & electrical waste particles as the partially replacement of coarse aggregate. From the compressive strength tests, it has been confirmed that within the range of E-waste (5% -20%) as filler material used in this study, increase in strength was observed upto 15% and reduction in 20% mixes was noted as compared to conventional concrete. Split tensile strength observations also reveal that the effective percentage utilization of E-waste as filler material in concrete was 12.5% by weight percent of coarse aggregate. Thus present study demonstrates the effect of E- waste on the various mechanical properties and durability parameters of concrete and it was reported that utilization of E-waste in concrete provides definite advantages to minimize the E-waste disposal problem and effective recycling methodology.

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