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An Experimental Study on Concrete Containing E-Waste and Fly Ash

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Abstract

Electronic waste is an emerging issue posing serious pollution problems to the human and the environment. The Disposal of electronic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. To rectify this environmental problem of disposing the E-waste, reuse of E-waste in concrete industry is considered as the most feasible application. This study focuses on the possibility of re-using E-waste that is now produced in large quantities in the formulation of concrete as a partial replacement of coarse aggregate along with the substitution of cement by fly ash. The work was conducted on M25 grade mix. Various cube specimens were casted with 5% replacement of coarse aggregate by e waste with fly ash ranging from 0-30% by weight of cement. Compressive strength test was conducted on the specimens after 7, 14 and 28 days of curing and the strength was recorded and compared with the strength of standard mix. The- E- waste is suitable to replace the coarse aggregate but not suitable as fine aggregate.

Keywords: Coarse aggregate, Compressive strength, E-waste, Fly ash, Partial replacement

I. INTRODUCTION

In this modern era the use of electronic and electrical equipments is increasing day by day .after the use, the discarded part produced by these equipment is called e waste .E waste is harming our environment every day by causing air pollution, water pollution and by many other ways. It also affects human body by serious health disease. The life style of common man has been changed by the invention in field of science and technology. The common man is able to purchase and use these E- products because they are available at low cost. Thus, in recent year markets for e product are growing speedily and that's why E waste is growing exponentially. In these cases it is necessary that the disposal of e waste is treated in same manner. Use of E waste in concrete and other construction material, helps in reducing the cost of concrete manufacturing and also provide several indirect benefits. In the concrete industry, efforts have been made to use non-biodegradable component of E-waste as partial substituted of the coarse aggregate.

A. Objective

To study on concrete containing E- waste along fly ash compressive strength of concrete mixtures M25 at standard ages (7, 14 and 28 days)

B. Scope of the Work

An experimental study on the effect of e-waste along with fly ash on the compressive strength of concrete at early and later ages, assume greater importance to use the e-waste and fly-ash as a replacement of coarse aggregate and cement to achieve durable and environmental friendly concrete mixes.

II. EXPERIMENTAL PROGRAMME

The properties of materials used in preparation of concrete is determined as per the codal provisions and described as follows:

A. Materials

Ordinary Portland cement grade 53 conforming to IS 12269-1987 was used. It was tested as per Indian standard specification, whose physical properties are given in Table 1. Locally available natural sand conforms to grading zone III as per IS: 383-1970 was used as fine aggregate. Its physical properties are given in Table 2. Crushed stone with maximum 20 mm graded aggregates (nominal size) conforming to Table 2 of IS: 383- 1970 was used.

Table - 1
Physical Properties of Cement

Cement	*Specify gravity*	*Setting time*		*28 days compressive strength(N/mm²)*
		Initial	*Final*	
OPC 53	*3.15*	*52*	*260*	*53.78*

Table - 2
Physical Properties of Fine and Coarse Aggregates

Aggregate	*Specific Gravity*	*Bulk Density(loose) kg/m³*	*Bulk Density(compacted) kg/m³*
Fine	*2.64*	*1568*	*1680*
Coarse	*2.81*	*1537*	*1666*

B. Concrete Mix Proportioning

Proportioning Concrete mixtures of grade M 25 are designed as per new guidelines of IS 10262:2009. Table 3 shows the ingredient per cubic meter of concrete.

Table - 3
Concrete Mix Proportioning

Grade	*Water*	*Cement (kg)*	*Fine Aggregate (kg)*	*Coarse Aggregate (Kg)*
M25	*165*	*366*	*724*	*1185.84*

C. Details of Test Specimens Control Specimens:

Total Sixty three (63) specimens, cubes have been prepared for M 25 grade of concrete. Out of sixty three specimens, seven cubes of nominal mix and 54 cubes with E-waste along with fly ash specimens have been tested for compressive strength.

D. Test Procedure

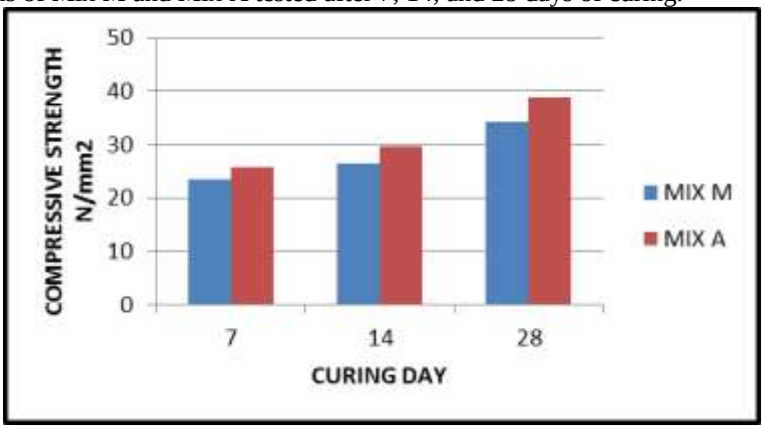
Cube moulds of size 150 mm x 150 mm x 150 mm were prepared. After 24 hours these moulds are removed and test specimens are put in water for curing. These specimens are tested using compression testing machine after 7, 14 and 28 days of curing. Table 4 shows the mix composition.

Table – 4
Concrete Mix Composition

MIX	*PROPORTION*
MIX M	*OPC +FA+CA*
MIX A	*OPC +FA+CA+5% E-WASTE+5 % FLY ASH*
MIX B	*OPC +FA+CA+ 5% E-WASTE+10% FLY ASH*
MIX C	*OPC +FA+CA+ 5% E-WASTE+15 %FLY ASH*
MIX D	*OPC +FA+CA+ 5% E-WASTE+20 %FLY ASH*
MIX E	*OPC +FA+CA+ 5% E-WASTE+25 %FLY ASH*
MIX F	*OPC +FA+CA+ 5% E-WASTE+30 %FLY ASH*

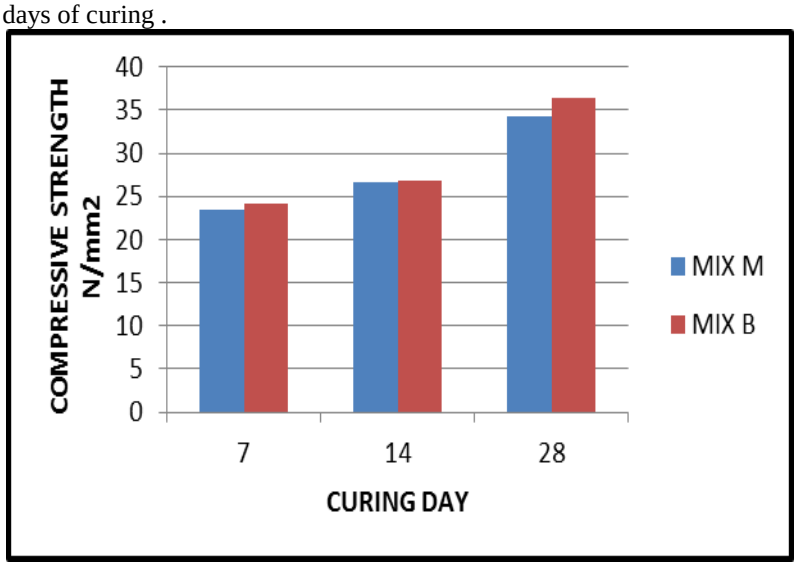
III. RESULTS AND DISCUSSION

The Compressive strength of the concrete mixes as mentioned in Table-2 is calculated by casting cubes and testing them on compression testing machine at 7, 14 and 28 days of curing. The compressive strength test result of Mix-A is found to be more than the Nominal Mix-M at each testing day. The result show compressive strength of concrete is increased when E-waste is used as 5% replacement of coarse aggregate along with 5% replacement of cement by fly ash. The rate of gain of early strength of Mix-A is 15 % more than that of Mix-M in twenty eight days. Graph-1 below shows the comparison of the compressive strength obtained by the test specimens of Mix M and Mix A tested after 7, 14, and 28 days of curing.



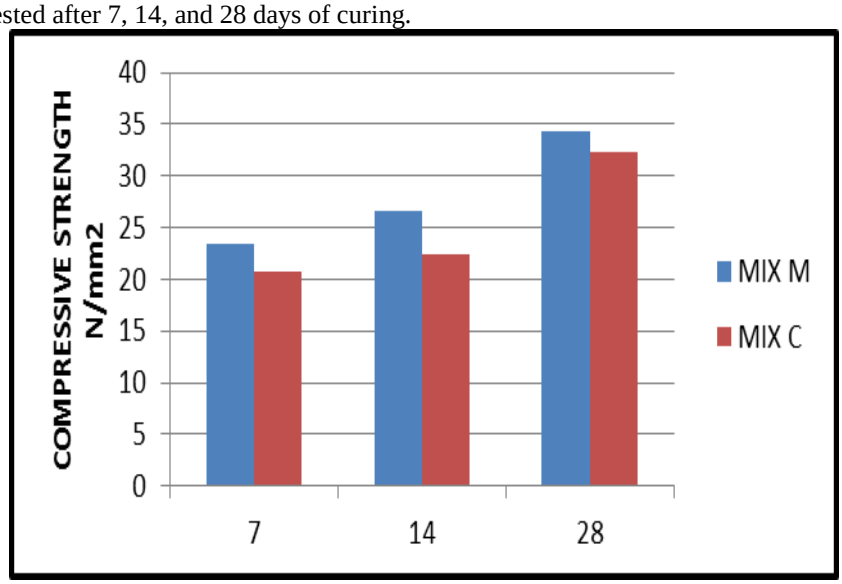
Graph 1: Strength Comparison of Mix M and Mix A

The compressive strength obtained for Mix-M (Nominal Mix) at 7,14 and 28 day is less than the compressive strength obtained by the Mix-A. E-waste used 5% replacement of coarse aggregate with fly ash used 10% replacement of cement compressive strength of concrete is increased. The rate of gain of early strength of Mix-A is more than that of Nominal Mix-M i.e. 7 % in twenty eight days. Graph 2 shows the comparison of the compressive strength obtained by the test specimens of Nominal Mix M and Mix B tested after 7, 14, and 28 days of curing .



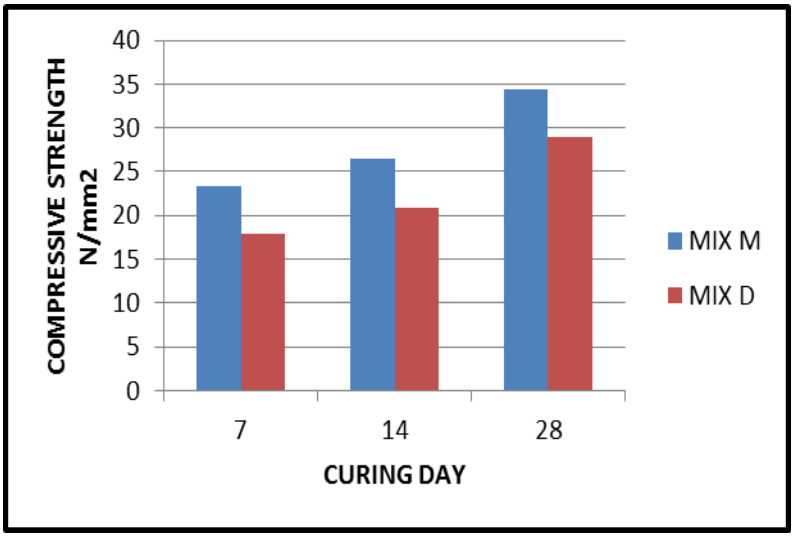
Graph 2: Strength Comparison of Mix M and Mix B

The compressive strength obtained for Nominal Mix-M at Seven day is more than the strength obtained by the Mix-C at fourteen day. The result show compressive strength of concrete is reduced when coarse aggregate is replaced by 5% E-waste along with 15% replacement of cement by fly ash. the rate of gain of early strength of Nominal Mix-M is more than that of Mix-C in seven to twenty eight days .In Graph 3 below shows the comparison of the compressive strength obtained by the test specimens of Mix Nominal M and Mix C tested after 7, 14, and 28 days of curing.

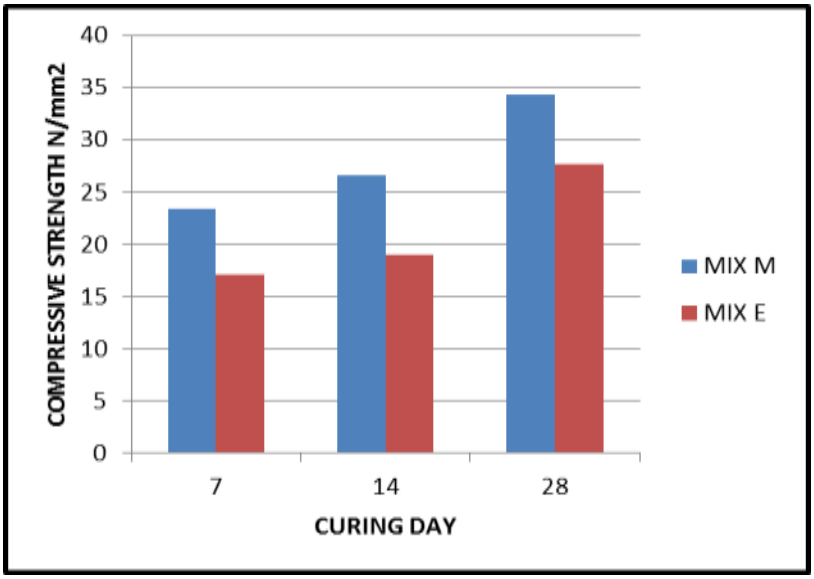


Graph 3: Strength Comparison of Mix M and Mix C

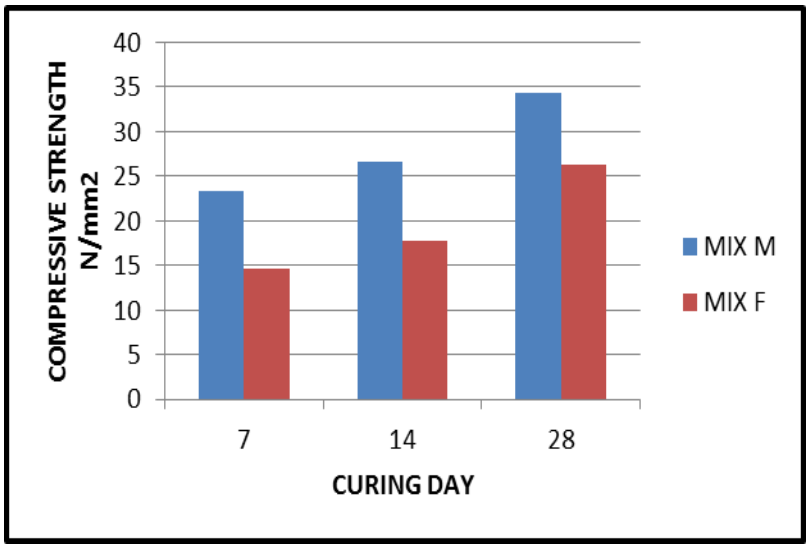
Graph 4, 5 and 6 shown below the comparison of the compressive strength obtained by the test specimens of Nominal Mix M, Mix D, Mix E and Mix F tested after 7, 14, and 28 days of curing. The compressive Strength obtained for Mix-M is found to be more than the compressive strength obtained by the Mix D, Mix E and Mix-F at each stage of testing The result show compressive strength of concrete is reduced with replacement of cement by fly ash in range (20%25,%and 30 %) along with the replacement of coarse aggregate by 5% E-waste. With increases percentage of fly ash compressive strength of concrete is decreased.



Graph 4: Strength Comparison of Mix M and Mix D

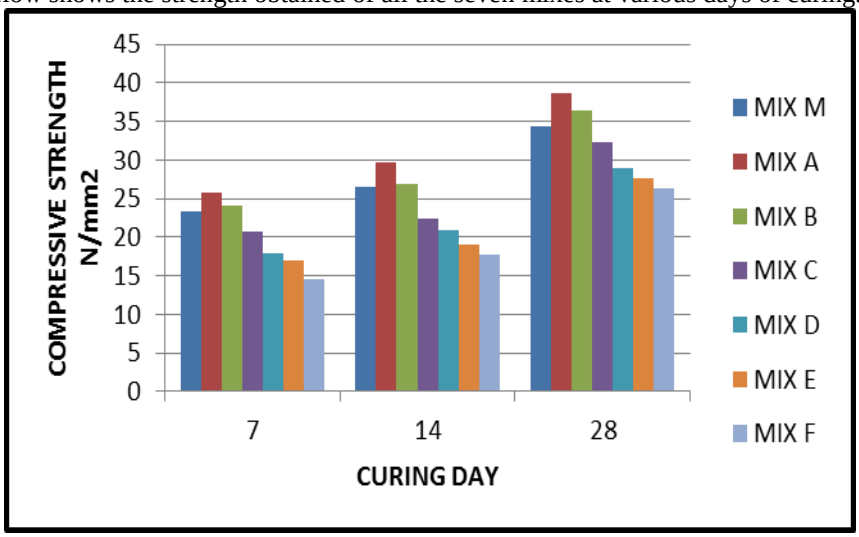


Graph 5: Strength Comparison of Mix M and Mix E



Graph 6: Strength Comparison of Mix M and Mix F

The strength at various days of curing is maximum for Mix-A out of all the seven mixes. Strength obtained for Mix-A at fourteen day is more than the strength obtained by the Mix-D Mix-E and Mix-F at twenty eight day. The test results obtained for Mix-B is also satisfactory, the rate of gain of strength of mix B is more than the rate of gain of strength Nominal Mix-M and Mix-C but less than Mix A .Graph-7 below shows the strength obtained of all the seven mixes at various days of curing.



Graph 7: Strength Comparison of Mix M, Mix A, Mix B, Mix C Mix D Mix E and Mix F

IV. CONCLUSION

The purpose of this study is to the effective ways to apply E-waste particles as coarse aggregate. The study of compressive strength of concrete in E- waste and fly ash gave the following results:-

1) From this study it is found that E- waste can be used as construction material.
2) From the above study the- E- waste is suitable to replace the coarse aggregate but not suitable as fine aggregate.
3) It is observed that the compressive strength of concrete containing E- waste aggregate has increased or decreased as compared to nominal concrete specimen. The E-waste kept constant as 5% and fly ash kept varying from 5% to 30% with the interval of 5% and the strength of concrete increased till 10% and gradually decreased with increase of percentage.
4) Increase of fly ash in the mix gave enough strength index of control mix concrete.
5) Experiment study shows that 10% of fly ash in concrete mix can be used as replacement of cement.
6) Concrete in aggregate are vital unit the aggregate usage of plenty quantities so devastation of mountains hill causing geological and environmental instability.
7) Consumption of E-waste and fly ash reduces the extraction of aggregate, noise blasting vibration, exploitation of rocks.

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