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AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH E-WASTE

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Abstract - The solid waste management is regarded to be one of the fastest arising waste streams in the world, especially the waste from Electric and Electronic equipment's (WEEEs). The waste utilization is sustainable solution to the environmental problem and use of waste materials reduces the cost of concrete in the production of house building environment. The replacement percentages of recycled concrete aggregate(RCA) were 0%, 5% & 7% respectively. The partial replacement of RCA to achieve the mechanical properties (compressive strength) and chemical properties (corrosion resistance and alkali attack) of concrete by utilizing E–waste as compared with the ordinary conventional concrete.

***Key Words*: Electric and Electronic euipment's (WEEES), Recycled Concrete Aggregate(RCA), Compressive strength, Workability.**

1. INTRODUCTION

Concrete is that the most generally used man-made construction material. It's obtained by mixing cement, water, aggregates and admixtures (if needed), in required proportions. The mixture when placed in forms and allowed to cure, hardens into rock – mass referred to as concrete. The strength, durability and other characteristics of concrete depends upon the properties of its ingredients, on the proportions of mix, the tactic of compaction and other controls during placing, compacting and curing. The fat growth in technological world has resulted in tons and plenty of by-product or waste materials or Electronic waste, which may be used as a ingredient in concrete. the utilization of those by-products not only helps to utilize these waste materials but also enhances the properties of concrete in fresh and hardened states. Perhaps the foremost successful Supply Chain Management (SCM) is E-Wast because it improves both strength and sturdiness of concrete to such we can extent that modern design rules involve addition of E-waste materials in concrete brick for design of high strength concrete.

1.1 OBJECTIVE

The objective of the present research work is to find out the different properties of Electronic waste. To reduce the utilization of Coarse aggregate by partial replacement of E-Waste. To enhance the best environmental alternate for cement.

1.2 MATERIAL AND METHODOLOGY

1.2.1 CEMENT

Ordinary Portland Cement (53 grade) conforming to IS: 12269 -1987 and with the specific gravity 3.23 was used for casting all the specimens. Tests conducted on cement are fineness of cement by sieve analysis (using 90 µ sieve), specific gravity using Le-chatlier's apparatus, initial setting time and final setting time using vicat apparatus.

Table-1 properties of cement

Sl.No	TESTS	RESULTS
1	Specific Gravity	3.23
2	Initial Setting Time	37
3	Final Setting Time	535
4	Consistency test	29.5
5	Fineness test	4.93

1.2.2 E-Waste

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Cement is partially

replaced by silica fume by 5%, 10%, 15%. Tests conducted on silica fume are fineness of silica fume by sieve analysis and specific gravity using Le-chatlier's apparatus.

1.2.3 Fine Aggregate

M-Sand is a substitute of river sand for concrete construction. Sand passing through IS 4.75 mm sieve and as per IS: 383-1970 was used for all the specimens. Test conducted on fine aggregate are specific gravity using pycnometer, fineness modulus by sieve analysis.

1.2.4 Coarse Aggregate

Crushed granite aggregate with specific gravity of 2.6 and passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 - 1970 is used for all the specimens.

1.2.5 Water

Casting and curing of specimens were done with the potable water as per IS 456:2000. The test results are compiled as

Table-2 water test

S.NO	WATER	pH VALUE
1.	Sample 1	7
2.	Sample 2	7
3.	Sample 3	7

1.3 MIX PROPORTIONS

The concrete mix design is a process of selecting suitable ingredients and determine their relative proportions with an object of producing the concrete of certain minimum strength and durability as economical as possible. The mix design was proposed by using IS 10262:2009. Concrete cubes of size 230mm x 100mm x 76mm were cast in brick mould using the design mix of with w/c ratio of 0.45. The prism of 230mm X 100mm x 76mm were casted for testing. Three mixes were used i.e. **M0 - Conventional mix**, **M1 – 5% of E-Waste in Coarse aggregate, M2 – 7% of E-Waste in Coarse aggregate**.

1.4 TEST ON SPECIMENS

Testing of specimens plays an important role in controlling the quality and quantity of concrete. All the specimens cast were subjected to testing to study the effect of partial replacement of silica fume and GGBS with respect to cement on strength properties are studied with

- Compressive strength test,
- Water absorption test,
- Hardness test.
- Size, Shape and Color test.

1.4.1 COMPRESSIVE STRENGTH TEST

Compression Testing Machine(CTM)

Compression testing machine use of compress of any material as per show reding. So we know how much load in this material.

Scale:

The scale used in this test for length, birth & depth of brick:

Wooden plate:

This material used for one between brick both side. Because of the edge of a brick safe in CTM(Compression testing machine).

polypropylene fiber concrete at 3 days, 7 days and 28

days for M40 grade concrete are tabulated.

Prework before Compressive strength of brick (brick compressive strength):

Remove observed in the bed faces to provide both smooth and parallel faces by grinding.

Immerse in the water at room temperature for 24 hours (1 Day). Remove drain and specimen out any surplus moisture at room temperature.

Fill all voids and all fog in the bed face flush with cement mortar (clean coarse sand, cement of grade 3 mm down).

Store under the damp jute bag for 24 hours (1 Day), followed by immersion in freshwater for 3 days.

Wipe and Remove out any traces of moisture.

Procedure Compressive strength of brick (brick compressive strength):

Place the specimen with flat and smooth faceshorizontal, and mortar filled face facing upward between two sides 3 thick ply plywood each of 3 mm thickness and carefully centered between plates of the testing machine.

Apply load uniform rate of 14 N/sq.mm.(140kg f/cm2) per minute till failure occurs and notes the maximum load at failure.

Load at failure maximum load in brick at which to produce any further increase in the indicatorread reading on the testing machine.

Calculation of Compressive strength of brick (brick compressive strength)

As below calculation of test report

Compressive test of brick N/sq.mm.(Kgf/ sq.cm.)

= (Maximum load failure in Kgf (N) / Average area of the bed faced in Sq.cm(Sq.mm).

TRAIL-1

Cement - 25%

Coarse Aggregate – 50%

Fine Aggregate -25%

TRAIL-2

Cement-25%

E – Waste – 5%

Coarse Aggregate – 45%

Fine Aggregate -25%

TRAIL-3

Cement-25%

E – Waste – 7%

Coarse Aggregate – 43%

Fine Aggregate -25%

Table-3 Compressive strength

MIX TRAILS	Compressive strength @ 7 days(N/mm²)	Compressive strength @ 14 days (N/mm²)
1	10.269	13.913
2	11.6250	14.20836
3	12.4861	15.5000

Water absorption Test:

To determine water absorption of the specimen by 24 hours immersion in cold water.

Apparatus (Brick water absorption):

Weighing Balance:

Weight machine for use for brick.Actual weight of the brick and after water absorption of brick weight calculation.

Dry oven:

Dry oven use for Absorption test on brick.

Measuring scale:

The scale used in this test for length, birth & depth of brick.

Sample Preparation Absorption test on brick(Brick water absorption):

Dimensions shall be a measure to an accuracy of 1 mm of a test specimen

A dry specimen in an oven at temperature 105-1150C till it attains substantially constant mass. The specimen to room cool temperature and obtain weight – M1.

Procedure Absorption test on brick (Brick water absorption):

Immerse complete dried specimen in clean water at temperature 27+/- 20

Remove specimen after 24 hours and wipe out any traces of water with a damp cloth.

Weigh the specimen within 3 minutes after removing from water – M2.

Calculations & records Absorption test on brick (Brick water absorption):

% Water Absorption = (w2-w1 /w1) x100.

Average of the results obtained shall be recorded.

All results shall be recorded in the respective Format

Dry weight of brick (w1) = 4.262kg

Wet weight of brick (w2) = 4.950kg

= (4.950-4.262)/4.262 x 100

=16.14%

Hardness Test:

In this test a scratch is made on a brick surface with a hard thing. If that doesn't leave any impression on the brick surface then that is good quality brick.

Size, shape and color Test:

Apparatus:

Measuring scale.

The scale used in this test for length, birth & depth of brick.

Procedure Dimension Test on Bricks:

The tolerances (as per below) on the sizes of bricks are fixed by giving minimum and maximum dimensions, not on individual bricks but on batches of 20 bricks chosen at random.

For modular size:

Length 3720 to 3880 mm (3800 ± 80 mm) Width 1760 to 1840 mm (1840 ± 40 mm)

Height 1760 to I 840 mm (1840 ± 40 mm) (For 90 mm high bricks)

760 to 840 mm (800 ± 40mm) (For 40 mm high bricks)

• For non-modular size:

Length 4520 to 4680 mm (4600 ± 80 mm) Width 2240 to 2160 tum (2200 ± 40 mm)
(For 70 mm high bricks) • (For 30 mm high bricks)

Twenty entire bricks shall be selected at random from the sample selected under 8. Loose particles, all blisters of clay and small projections shall be removed.

They shall be arranged upon a level surface successively as indicated in please above figure. 2C, 2B, and 2A in contact with each other and in a straight line. (As per Figure)

The overall (Stright Brick) length of the assembled bricks shall be measured with a tape, other suitable inextensible measure sufficiently (Electronic measurement tape) long to measure the entire row at one stretch.

Measurement by repeated application of short rule or measure shan't be permitted.

If, it is found impracticable to measure bricks in one row, thesample may be divided into rows of ten (10) bricks each which shall bemeasured separately to the nearest mm(millimeter).
Height 1440 to 1360 mm(1400 ± 40 mm)
640 to 560 mm (600 ± 40 mm)

Efflorsence Test:

Apparatus for efflorescence test on brick.

Dry Oven.

Dry oven use for Absorption test on brick.

Procedure Efflorescence Test on Bricks:
After the water has been absorbed, and bricks appear to be dry, place the same quantity of water in the dish, and then allow it to evaporate as before.

After the second evaporation, examine the bricks for efflorescence and report the results.

Conclusion Efflorescence Test On Bricks:
Nil:

When the deposit of efflorescence is imperceptible.

Slight:

When the deposit of efflorescence does not cover more than 10 percent of the exposed area of the brick.

Moderate:

When the deposit of efflorescence is more than 10 percent but less than 50% of the exposed area of the brick.

Heavy:

When the deposit of efflorescence is more than 50 percent, but the deposits do not powder or flake away from the brick surface.

Serious:

When the deposits are heavy and powder or flake away from the brick surface. The specifications limit the efflorescence to be not more than moderate (10–50%) up to class 12.5 and not more than slight (< 10 percent) for higher classes.

All these dimensions shall be added together.

Soundness Test:

In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

1.5. CONCLUSIONS

The present work experimentally investigated the partial replacement of fly ash in the fly ash brick by rice husk ash with the addition of granite powder as a fine aggregate replacement.

The compressive strength test, water absorption test, efflorescence test, hardness test ,size shape test and soundness test were analyzed on the basis of the results from the present study following conclusions are drawn

Based on the test carried out on the three trails the following conclusions has been made:

Replacement of Coarse aggregate by E-Waste can be increased the compressive strength while upto only 7%,more than 7% it reduce the compressive strength due to the excess percent of rice husk ash

From the results obtain it is suggested that

Cement-25%

E – Waste – 7%

Coarse Aggregate – 43%

Fine Aggregate -25%

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