STUDY ON PROPERTIES STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE WITH COPPER SLAG AND CEMENT WITH EGG SHELL POWDER

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ABSTRACT - *Concrete is Considered as generally productive and expected to be more grounded and more solid than some other materials. It is conceivable by use of modern side-effects just as other waste materials in the development of ordinary substantial Large amounts of waste materials are being produced by different businesses and removal of waste materials is causing natural and wellbeing risks. These variables have driven advances in working on the presentation of cement over years and keep on doing as such the requirement for working on the exhibition of cement and worry for the natural effect emerging from the persistently expanding interest for concrete has lead the developing utilization of elective material parts Concrete is in effect generally utilized for the development of the greater part of the structures, extensions and it is otherwise called spine to the framework improvement of a country. An exploratory examination were directed to concentrate on the properties of cement containing copper slag as a halfway substitution of fine totals in the substantial blend plan. Different solidness tests will be directed on such cement of M30 grade and M40 grade to know the compressive strength, split rigidity, flexural strength by shifting extents of copper slag (CS) with fine totals by 0%, 5%, 10%, 15%, 20%,25%,30% and Egg shell powder (ESP) as concrete by 0%, 5%, 10%, 15%, 20%, 25%,30% by weight. The got results will be contrasted and the ordinary cement, there by knowing the progressions in the properties of cement containing copper slag as a fractional substitution of fine totals.*

INTRODUCTION

Concrete is more widely used than any other man-made substance on the planet. As a result, concrete must be used. At the same time, aggregate scarcity has increased dramatically. Nowadays fine aggregate makes up a large portion of concrete, ranging from 25% to 30%. As a result, we utilize a small quantity of copper slag to substitute fine aggregate in concrete, because the qualities of copper slag are similar to those of coarse aggregate. Copper slag qualities were investigated and compared to natural fine aggregate concrete properties. Copper slag aggregate produced by copper plants is also used in asphalt concrete. In most cases, copper slag is created by reducing iron directly in an electric arc furnace. Copper slag has significant size fractions due to sluggish cooling in the environment. Only a little amount of copper slag was used in concrete because copper slag enhanced the concrete's dead load. Because of its durability concrete is a commonly utilised construction material for a variety of constructions. Due to a chemical process called as hydration, concrete hardness solidifies after mixing with water and placement. Water combines with cement, which binds the other components together, resulting in a strong stone-like material. In the building industry, industrial waste has been encouraged because it helps to conserve natural resources. Fly ash, silica fumes, and copper slag were once thought to be waste items.

MATERIALS

Cement:

Cement is a binder, a substance that sets and hardens and can bind other materials together in building. The most common varieties of cement are used in the manufacture of masonry mortar and concrete, which is a mixture of cement and aggregate that forms a strong building material.

Aggregates:

Sand, gravel, crushed stone, slag, recycled concrete, and geo-synthetic aggregates are all examples of construction aggregate, or simply "aggregate." The most mined materials on the planet are aggregates. Aggregates are a crucial component of concrete. They give concrete body, minimize shrinkage, and have an economic impact. Because aggregates account for 70-80% of the volume of concrete, they have a significant impact on the concrete's varied qualities and properties. Below are descriptions of the physical and mechanical properties of fine aggregates and coarse aggregates.

Coarse aggregate

Fine aggregate

Fine aggregates

Copper slag

Copper slag is a waste product created during the smelting process when copper is extracted from its ore. It has a promising future as a whole or partial fine aggregate replacement material in concrete.

Copper slag is commonly used as grit for blast cleaning hard surfaces or removing rust, paint, and other contaminants. It's a granular material that's black and glassy. Copper slag has a bulk density of 1.70 to 1.90 g/cc and a MoH scale hardness of 6 to 7. Copper slag was bought from a dealer of 'Hindustan copper limited' in Moubhandar, Ghatshila, Jharkhand, for this project. Copper slag is available for a wholesale price of about 620/tonne, making it cost-effective to use when it is available.

Copper slag

Egg shell powder The egg shell wastelands in the poultry manufacturing have been highlighted because of its recovery potential. Eggshell consist of several growing layers of caco3 and it is a poultry waste to replace cement can have benefits like minimizing use of cement, conserves natural lime and utilizing waste materials. Egg shell waste is available in huge amounts from the food processing, egg breaking, and shading industries. The food indulgence industry is in need of investigation to find another method for processing and using egg shells waste in an ecological friendly way. There is a need to find a low cost solution.

Egg shell powder

Experimental Work

In this present work, a comprehensive experimental schedule is being formulated to achieve the objective and scopes of the present investigation. At present the whole experimental work is done as follows

1)Tests of materials

(a)Tests of cement

(b)Tests of coarse aggregate

(c)Tests of fine aggregate

2)Selection of mix design

RESULTS AND DISCUSSIONS MATERIAL PROPERTIES

Sl.no	Test	Results	IS code used	Acceptable limit
1	Specific gravity of cement	3.160	IS:2386:1963	3 to 3.2
2	Standard consistency of cement	6mm at 34% w/c	IS:4031:1996	w/c ratio 28%-35%
3	Initial and final setting time	45mins and 10 hours	IS:4031:1988	Minimum 30mins and should not more than 10 hours
4	Fineness of cement	3.00%	IS:4031:1988	<10%

CEMENT

COARSE AGGREGATES

Sl.no	Test	Results	Is code used	Acceptable limit
1	Fineness modulus	6.5	IS:2386:1963	6.0 to 8.0mm
2	Specific gravity	2.90	IS:2386:1963	2 to 3.1mm
3	Porosity	46.83%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.8855	IS:2386:1963	Any value
5	Bulk density	1.50g/cc	IS:2386:1963	-
6	Aggregate impact value	37.5	IS:2386:1963	Less than 45%
7	Aggregate crushing value	26.6%	IS:2386:1963	Less than 45%

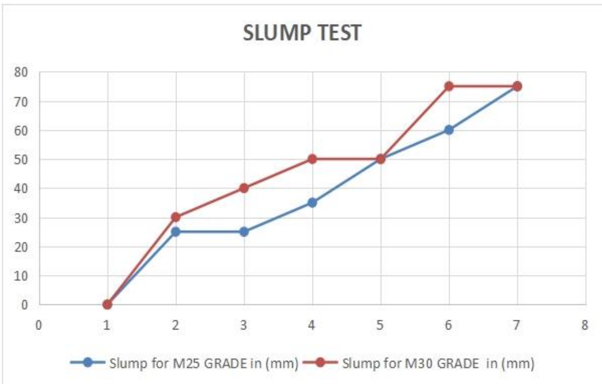
Sl.no	Test	Result	Is code used	Acceptable limits
1	Fineness modulus	4.305	IS:2386:1963	Not more than 3.2 mm
2	Specific gravity	2.43	IS:2386:1963	2.0 to 3.1
3	Porosity	36.6%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.577	IS:2386:1963	Any value
5	Bulk density	1.5424	IS:2386:1963	-
6	Bulking of sand	3.0%	IS:2386:1963	Less than 10%

CONCRETE TESTS

FRESH CONCRETE TESTS, (SLUMP CONE TEST)

S.NO	% Repalcement	Slump for M25 GRADE in (mm)	Slump for M30 GRADE in (mm)
1	0%CS +0%FA	0	0
2	5%CS+5%FA	25	30
3	10%CS+10%FA	25	40
4	15%CS+15%FA	35	50
5	20%CS+20%FA	50	50
6	25%CS+25%FA	60	75
7	30%CS+30%FA	75	75

CS: Copper Slag **FA: Fine Aggregate**

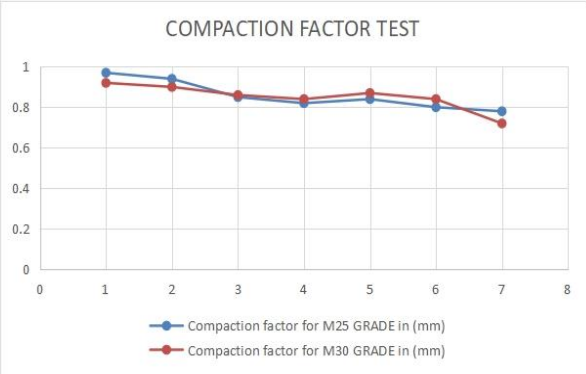


Graph 1.2 Represent Slump test

COMPACTION FACTOR TEST

S.NO	% Replacement	Compaction factor for M25 GRADE in (mm)	Compaction factor for M30 GRADE in (mm)
1	0%CS +0%FA	0.97	0.92
2	5%CS+5%FA	0.94	0.90
3	10%CS+10%FA	0.85	0.86

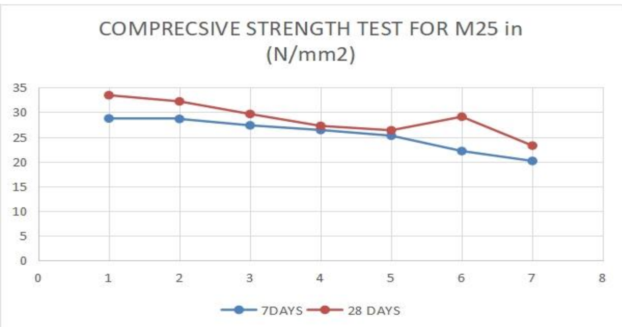
4	15%CS+15%FA	0.82	0.84
5	20%CS+20%FA	0.84	0.87
6	25%CS+25%FA	0.80	0.84
7	30%CS+30%FA	0.78	0.72



Graph 1.4 compaction factor

COMPRESSIVE STRENGTH OF CONCRETE (CS- COPPER SLAG & FA-FINE AGGREGATE) for M25 GRADE.

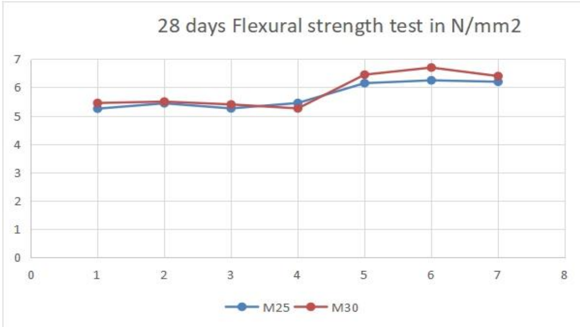
% Replacement	M25 Grade	
	7days	28days
0%CS +0%FA	28.75	33.45
5%CS+5%FA	28.65	34.25
10%CS+10%FA	27.35	29.65
15%CS+15%FA	26.41	27.24
20%CS+20%FA	25.26	26.35
25%CS+25%FA	22.15	29.10
30%CS+30%FA	20.15	23.25



Graph 1.3 compressive strength

COMPRESSIVE STRENGTH OF CONCRETE (CS- COPPER SLAG & FA-FINE AGGREGATE)

% Replacement	M30 Grade	
	7days	28days
0%CS +0%FA	30.24	37.42
5%CS+5%FA	34.44	36.25
10%CS+10%FA	33.40	38.34
15%CS+15%FA	33.30	35.35
20%CS+20%FA	32.50	32.80
25%CS+25%FA	32.24	32.65
30%CS+30%FA	30.40	31.55

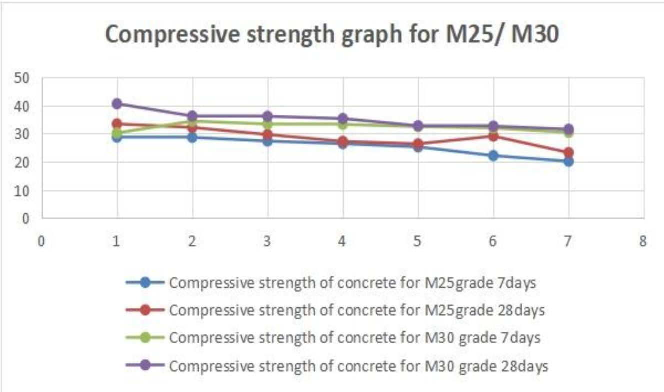


Graph 1.5 compressive strength

COMPRESSIVE STRENGTH OF CONCRETE (CS- COPPER SLAG & FA-FINE AGGREGATE)

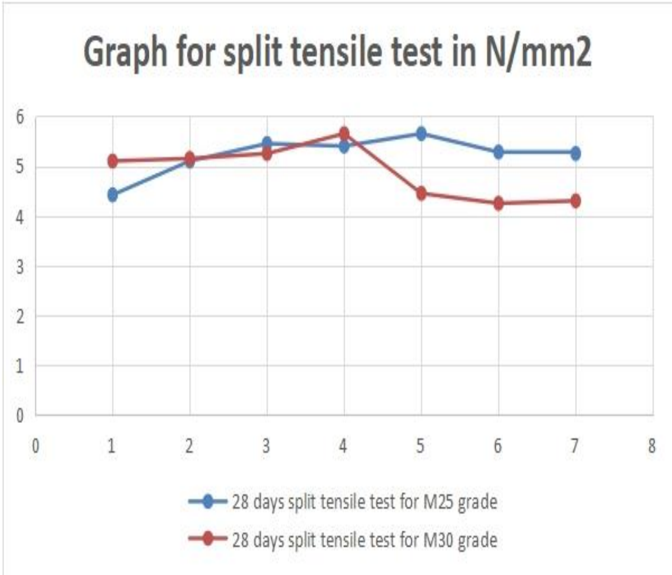
S.NO	% Replacement	Compressive strength of concrete for M25grade		for M30 grade	
		7days	28days	7days	28days
1	0%CS +0%FA	28.75	33.45	30.24	37.42
2	5%CS+5%FA	28.65	32.20	34.44	36.25
3	10%CS+10%FA	27.35	29.65	33.40	38.34
4	15%CS+15%FA	26.41	27.24	33.30	35.35
5	20%CS+20%FA	25.26	26.35	32.50	32.80
6	25%CS+25%FA	22.15	29.10	32.00	32.65
7	30%CS+30%FA	20.15	23.25	30.40	31.55

Graph 4.3 Compressive Strength



SPLIT TENSILE STRENGTH OF CONCRETE (CS- COPPER SLAG & FA-FINE AGGREGATE)

S.NO	% Repalcement	28 days split tensile test for M25 grade	28 days split tensile test for M30 grade
1	0%CS +0%FA	4.42	5.10
2	5%CS+5%FA	5.10	5.15
3	10%CS+10%FA	5.45	5.25
4	15%CS+15%FA	5.40	5.65
5	20%CS+20%FA	5.60	4.45
6	25%CS+25%FA	5.28	4.25
7	30%CS+30%FA	5.25	4.30



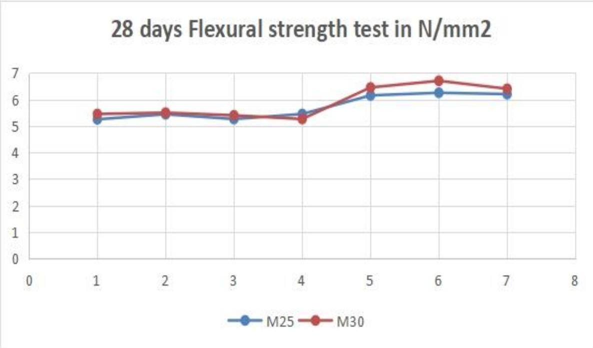
Split tensile strength for M25 & M30 grade concrete

FLEXURAL STRENGTH OF CONCRETE

(CS- COPPER SLAG & FA-FINE AGGREGATE)

S.NO	% Replacement	28 days Flexural strength test for M25 grade	28 days Flexural strength test for M30 grade
1	0%CS +0%FA	5.25	5.45
2	5%CS+5%FA	5.44	5.50
3	10%CS+10%FA	5.26	5.40
4	15%CS+15%FA	5.45	5.26
5	20%CS+20%FA	6.15	6.45

6	25%CS+25%FA	6.25	6.70
7	30%CS+30%FA	6.20	6.40



Graph 4.5 : Flexural strength for M25 & M30 grade concrete

CONCLUSIONS

From the above experimental program the following conclusions were made.

1. Because the cement, fine aggregates, and coarse aggregates material qualities are within permissible limits according to IS code requirements, we will use the materials for study.

2. The value of the slump cone for copper slag concrete grows as the percentage of copper slag increases, making the concrete unworkable.

3. The value of the copper slag concrete compaction factor falls as the percentage of copper slag increases.

4. For M25, the compressive strength achieved after 5 percent replacement of copper slag for 28 days curing was 34.25N/mm2, and for M30, the compressive strength obtained after 10 percent replacement of copper slag for 28 days curing was 34.25N/mm2 38.34N/mm2.

5. Split tensile strength for cylindrical specimens is maximum at 20% for M25 was 5.60N/mm2,and maximum at 15% for M30 was 5.65N/mm2 of replacement of copper slag for 28 days curing.

6. Copper slag concrete has a maximum flexural strength of 6.25 for M25 and 6.70 for M30 after 28 days of curing when copper slag is replaced.

7. So the replacement of 15% to 25% of copper slag is generally useful for better strength values in M30 grade of concrete.

8. The workability of concrete has decreased when compared with ordinary concrete

9. For a 10% replacement, the compressive strength of concrete is raised, however for a partially replaced concrete, the compressive strength is increased at 3 and 7 days and gradually dropped from 14 to 28 days.

10. The replacement of cement with 15% the cubes act as a brittle material when compared to 5% and 10%.

11. The partially replaced act as a admixture which can reduce the setting time.

12. The optimum compressive strength is obtained 12% greater than normal concrete.

13. Egg shells are more resistant to crushing, impact, and abrasion than other materials.

14. By using Egg shells the aggregates provided volume at low cost comprising 27% to 35% of concrete.

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