International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 06, June-2019

MECHANICAL PROPERTIES OF CONCRETE(M40) WITH COPPER SLAG AS FINE AGGREGATE CONVENTIONAL AND NDTT(REBOUND) TESTING

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ABSTRACT-Concrete is widely used material with an increasing rate due to its particular characteristics in construction field. This study was conducted to investigate the properties of concrete fine aggregate partially replaced with copper slag and a comparative study on strength properties was done with Rebound Hammer method and traditional compression testing method.Fine aggregate was replaced with copperslag in 10%,15%and 20% for M40 grade concrete.The strength values are evaluated for compression,split tensile and flexural strength.It was found at 20% replacement of fine aggregate with copper slag given maximum strength .The strength increment was 15.25%compared to nominal mix.

Key words : Fine aggregate, Copper slag,Mechanical Properties,Rebound hammer optimum usage.

INTRODUCTION:

As day by day natural resources were depleting and which is warning to protect the natural sand in this research work natural sand was replaced.At the same time so many Waste products were coming out from various industries ,havebeen using in construction field. Copper slag is a industrial by product In the process of production of copper. In production of a tonne of copper an amount of copper slag produced is 2.2 tonnes to 3 tonnes. This copper slag is dumped in to open lands .By using the copper slag we can avoid dumping of the heavy metals in to the earth.

The copper slag can be used as cementisious material in cement placeasit exhibitspozzolonic properties due to presence of Caoand other Oxides such as Al_2O_3,Fe_2O_3,SiO_2.Copper slagreplacing the place of fine aggregate in concrete production .Replacement of fine aggregate and cement with copper slag will reduce the Disposal cost of copper slag waste.The present study was on variations in strength properties of concrete withfine aggregate partially replaced by copper slag.by using copperslag we can increase the durability and workability properties of concrete.

MATERIALS:

1. Ordinary Portland cementof 53 grade Cement used was in this research work.
2. Fine aggregate locally available river sand of Zone II was used.
3. Copperslag was purchased from locally available shop.
4. Coarse aggregate locally available Granite of nominal size 20mm was used.
5. Super Plasticizer ConplastSP 430

MATERIAL PROPERTIES:

Cement: Ordinary Portland cement of 53 grade was used in casing the specimens for all the tests mentioned is purchased from local cement dealer.Depending on type of cement the water requirement will dependent.

Table:IProperties of cement: IS 12269

S.NO	Properties of cement	Values obtained
1	Fineness of cement	3%
2	Specific gravity of cement	3
3	Initial setting time	45Minutes
4	Final setting time	420Minutes

FINE AGGREGATE : Clean dry river sand of locally available one was used for the research work. Sand passing through IS Sieve no 9 is used to cast all the specimens.

Table-IIProperties of Fine Aggregate :IS 2516-2000

S.NO	Property of sand	Value obtained
1	Specific gravity	2.6
2	FinenessModulus	2.3
3	Water absorption	1.5%

Fig:1Copper Slag

Table:III Properties of Copper Slag:

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S.NO	Properties of copper slag	Value Obtained
1	Specific gravity	3.4
2	Water Obsorption	0.17%

COARSEAGGREGATE : Coarse aggregate of Granite stone which is retained on 4.75mm was used for preparing the concrete mix. In giving strength to concrete In addition to cement paste aggregate cement ratio and aggregate type and shape willhave a great influence on dimensional stability.

Table:IVProperties of Coarse Aggregate

S.NO	**Properties**	**Values**
1	Specific gravity	2.7
2	Size of aggregate	Passing through 20 mm sieve and retained on 4.75mm sieve
3	Fineness Modulus	6
4	Water Absorption	1.8%
5	Impact Test	14.5%
6	Crushing Test	20%

Fig:2 Materials ***for concrete Mix***

***SUPER PLASTICIZER*:** Naphthalene phormaldihydeSulphonated based Superplasticizer Conplast SP 430 was used to reduce the internal friction and increase the workability.

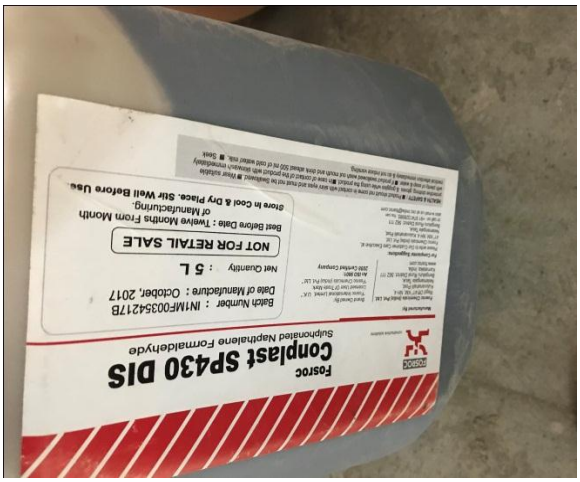


Fig:3 Conplast SP 430

TESTS ON HARDENED CONCRETE: Compressive strength test on cube specimen of 150x150x150 mm ,Split Tensile strength on cylinder specimen of 150x300 mm and Flexural strength on prismatic Specimen of size 100x100x500 mm was found.

METHOD OF TESTING:

Table V Details of testing

Name of Test	Size of Mould	No Of Days
Compression strength test	150x150x150mm	7,14,28
Split tensile strength test	150x300mm	7,14,28
Flexural strength test	100x100x500mm	7,14,28

Fig:4 Compression Testing Machine **Fig:5 Cube After Failure**

The compressive strength test was found on cubes of 150x150x150mm were casted and cured for 7,14,and 28 days .The cube compressive strength was found with the formula

f=P/A

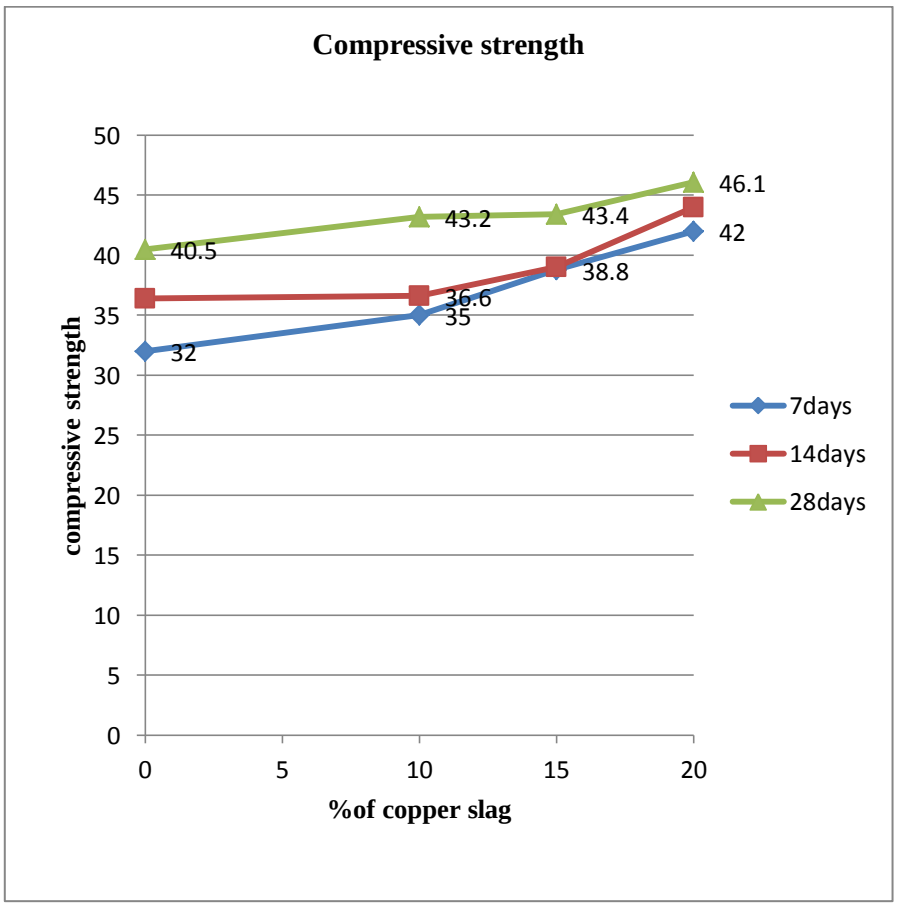
Wheref is compressive strength P is load at failurein N and A are area of crosssection of the cube specimen in mm^2.

REBOUND HAMMER TEST: Rebound hammer is used to find out the compressive strength of concrete as per IS13311(Part-2) –1992.This test is conducted based on the principle that the rebound of an elastic mass depends on the hardness of the surface against which the mass of the hammer strikes.Rebound hammer test is one of the Non Destructive Test using to find out the compressive strength of concrete.Rebound no was noted accordingly the compressive strength was found after calibration. 15 readings were noted and average was taken as Rebound No.After calibratingcompressive strength was found.

Fig:6 Rebound Hammer

Table :VI Test Results of Compression Test:

S.NO	Curing in Days	Average compressive strength Nominal mix in N/mm^2 0% C.S	Average compressive strength of copper slag concrete in N/mm2 With 10%,15% And 20% Of Copper Slag			Average compressive strength in N/mm2 withRebound hammer	Calibration factor for Rebound hammer	Equivalent compressive strength with Rebound Test in N/mm^2
1	7	32	35	38.8	42	44.85	0.92	41.262
2	14	36.4	36.6	39	44	48.3	0.92	43.47
3	28	40.5	43.2	43.4	46.1	51.75	0.92	47.61



COMPRESSIVE STRENGTH TEST RESULTS AND DISCUSSIONS: The average compressive strength of concrete Cubes at different percentages of copper slag percentages at 0%,10%,15% and 20% at 7,14,28 days was found. From the Table values it can be observed that with increment in % of copper slag increasing the compressive strength. Compared to rebound test values evaluated are almost equal to the strength values obtained from compression test. Any way a tolerance of -+ 25% is allowed in finding the compressive strength with Rebound hammer. An optimum strength was obtained at 20% replacement and the percentage increment of strength was 13.82%.

Split Tensile Strength Test: To determine the split tensile strength Specimen of cylindrical 150mm x300mm size was taken .The specimens were kept in curing for a period of 7days,14 days,28 days and kept for open air drying before testing.The specimen was tested in Compression testing machine by proper arrangement.

Split tensile strength was found using the formula

$f=2P/\pi dL$ Where f is split tensile strength

P is Load at failure in mm

d is diameter of specimen in mm

l islength of specimen in mm.

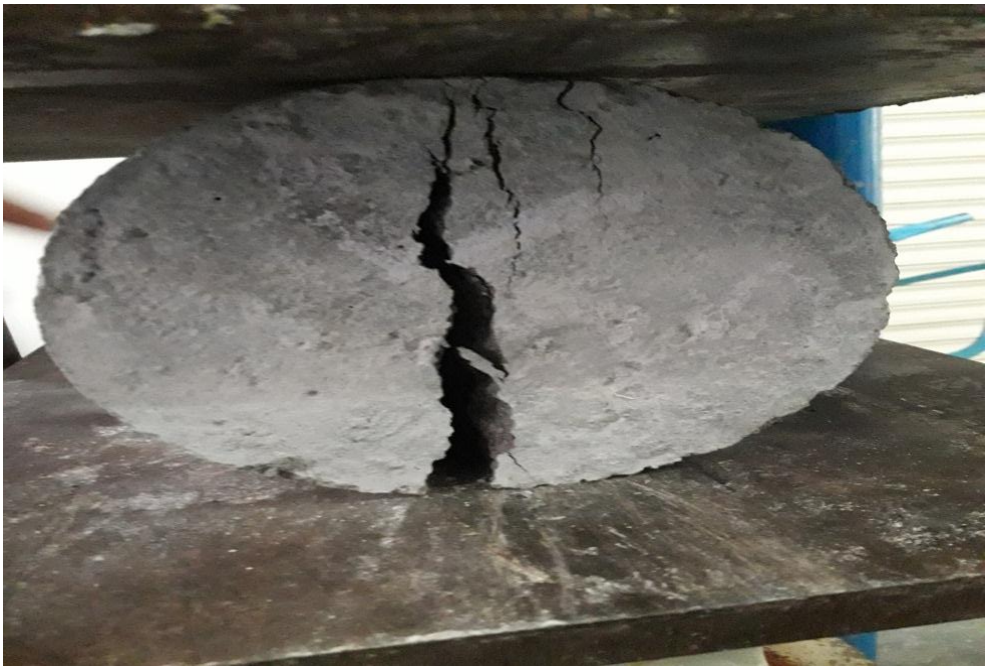
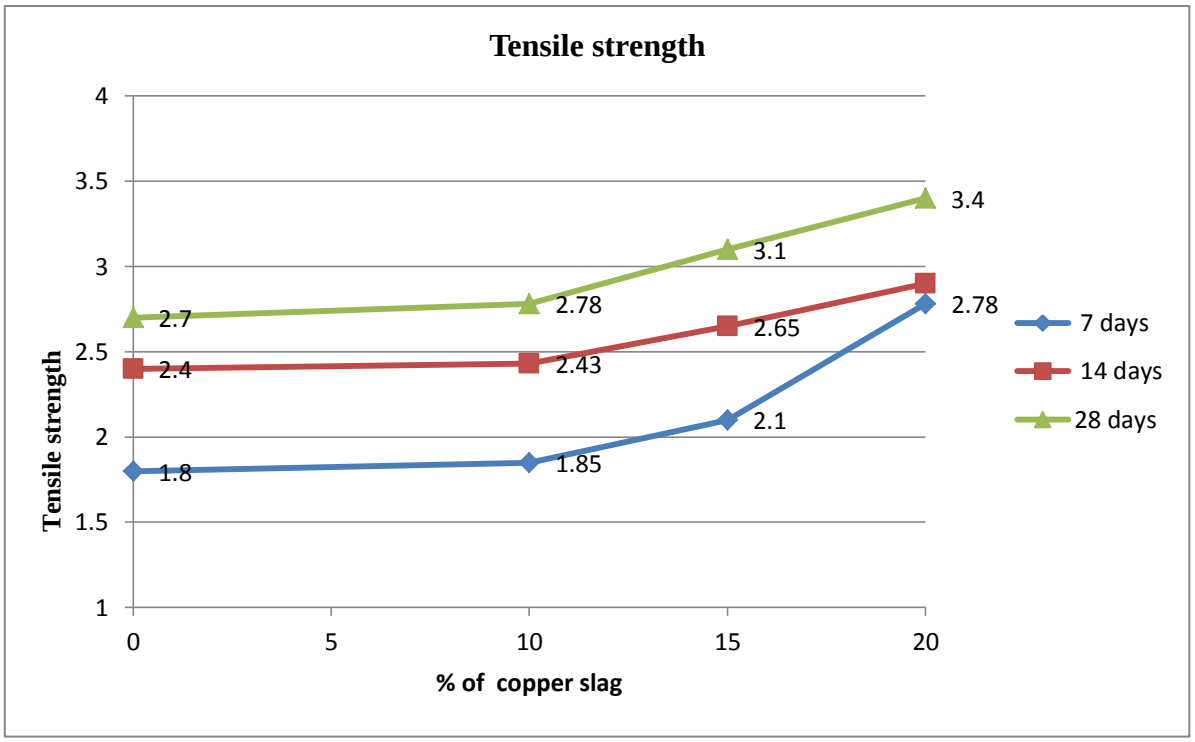


Fig:7Split Tensilestrength test in Compression Testing Machine

Table:VIISplit Tensile strength test Results:

S.NO	Curing in Days	Average Tensile strength Nominal mix in N/mm^2 0% C.S	Average Tensile strength of copper slag concrete in N/mm^2 WITH 10%,15% AND 20% OF Copper slag		
1	7	1.8	1.85	2.1	2.7
2	14	2.4	2.43	2.65	3.1
3	28	2.7	2.78	2.9	3.4



***SPLIT TENSILE STRENGTH TEST RESULTS AND DISCUSSION*:**

The Average Split tensile strength of 7,14,28 was tabulated in the above table and was found that the split tensile strength was increased a little by replacing with copper slag and the graph was drawn comparing with nominal mix.

FLEXURAL STRENGTH TEST : For finding flexural strength of concrete Beams of size 100x100x500mm were casted with above said % of copper slag variation and the flexural strengths were found for 7days,14days and 28 days curingWith Flexure testing machine.

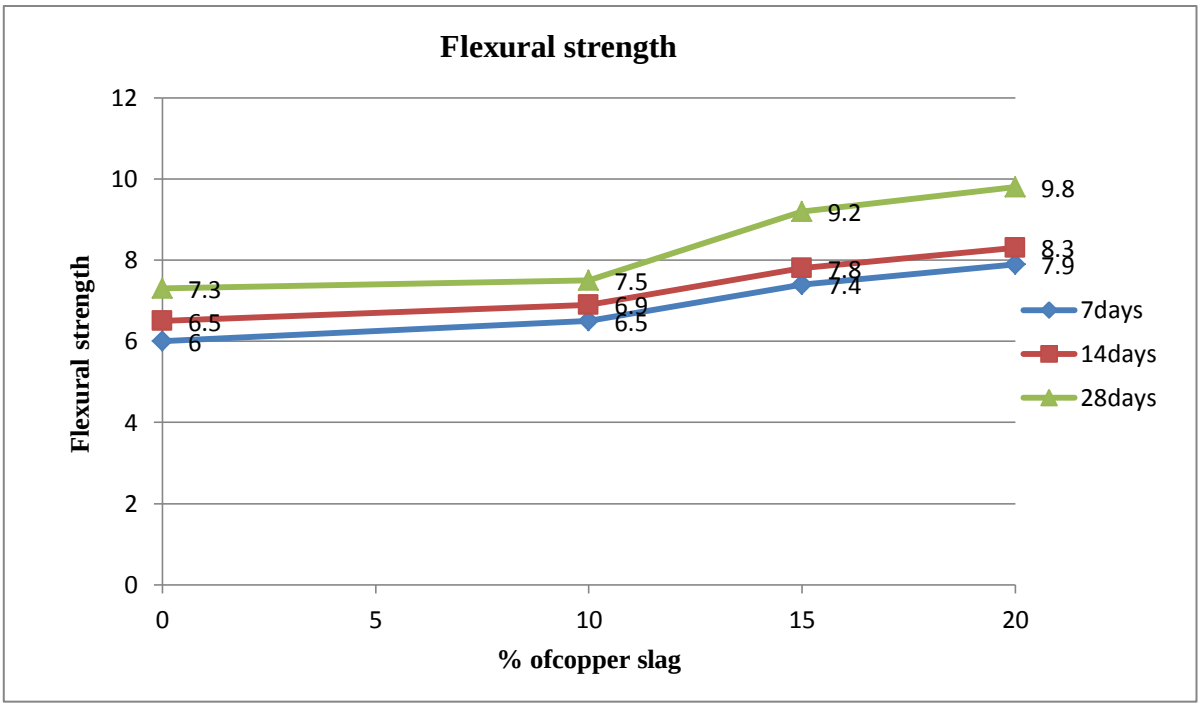
The flexural strength(¬) was obtained by using the formula

$f= PL/bd^2$ (N/mm2)

Fig: 8 Flexural StrengthTest in UT Machine

Table :VIII*Flexural strength test results*

S.NO	Curing in Days	Average Flexural Nominal mix in N/mm^2 0% C.S	Average Flexural strength of copper slag concrete in N/mm^2 With 10%,15% And 20% OfCopper Slag		
1	7	6	6.5	7.4	7.9
2	14	6.5	6.9	7.8	8.3
3	28	7.3	7.5	9.2	9.8



The aveage flexural strength for 0%,10%,15% and 20% was shown in the table.

***FLEXURAL STRENGTH TEST RESULTS AND DISCUSSION*:** The flexural strength was increased with % of copper slag and curing period was found maximum at 20% replacecment.

CONCLUSIONS : As per the experimental study it is observed that the optimum replacement offine aggregate with copper slag is 20%and strength increases to 15.25%..We can extend the study for Durability check also.

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4.IS 456 CODE

5. IS 10262 CODE

6.Concrete Technology by M.S Shetty