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A Study on Characteristic of Concrete with the Presence of Copper Slag and Steel Fiber

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ABSTRACT

Because of Rapid improvement of advancement and masses in India, there is a colossal enthusiasm for advancement material generally for typical sand, as of late over the top use of sand caused regular preservationist anomaly. To vanquish these effects immense changes are being done being developed industry, for instance utilization of by things as a replacement of fine aggregate. In the current examination COPPER SLAG which is an outcome gotten during age of copper by refining is used as a replacement of F.A. What's more, besides to grow the mechanical properties of concrete different sorts of strands are added to the strong mix. The HOOKED END STEEL Fibers are added to the strong to improve the mechanical properties. As a couple of researchers has introduced Steel fiber reinforced concrete(SFRC) for its trademark predominance over run of the mill plain and braced concrete for its higher flexural quality, better versatility and modulus of break, better adaptability and shortcoming impediment, split resistance. This close to assessment is finished on quality properties among SFRC and conventional concrete in light of displacing of F.A with copper slag. An exploratory assessment was finished to evaluate the mechanical properties of Steel fiber fortified cement by replacement of sand (F.A) with copper slag for different evaluations (M30, M40). Tests are coordinated with 1% extension of trapped end steel strands having point extent 60 and replacement of copper slag by 0%, 10%....with an interval of 10% where perfect quality is cultivated at 50%,40%.

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INTRODUCTION

The present study focuses on the effect of copper slag on strength properties of Steel Fiber Reinforced Concrete and Conventional Concrete. Copper Slag as partial replacement of sand in SFRC and Conventional Concrete and results are compared. Comparative study is carried out on steel fiber reinforced and conventional concrete. As the SFRC doesn't undergoes cracking after failure as plain concrete fails due to cracking before failure.

Every ton of copper will generate approximately 2.2-3 tons of copper slag the safe disposal of this waste is a lack, costly and causes environmental pollution. The construction industry is the only area where the safe use of **waste material** (copper slag) is possible. When it is introduced in concrete as a replacement material, it reduces the environmental pollution, space problem and also reduces the cost of concrete.

MATERIALS

STEEL FIBERS:

Steel fibers used for reinforcing concrete are defined as short, discrete length of steel having an aspect ratio (ratio of length to diameter) from about 20 to 100 according to **ACI-544(3R-08)** with any of several cross sections and that are sufficiently small to be randomly dispersed in a unhardened concrete mixture using usual mixing procedures.

COPPER SLAG:

Copper slag is an irregular, black, glassy and granular in nature and its properties are similar to the river sand. Copper slag is used in the concrete as one of the alternative materials. It is the waste product produced in the smelting process during extraction of copper from its ores. Slag from ores that are mechanically concentrated before smelting contain mostly iron oxides and silicon oxides.

CHEMICL PROPERTIES

Chemical Composition Of Copper Slag(by wt)		
Iron Oxide	Fe_2O_3	0.56
Silica	Sio_2	0.34
Aluminum Oxide	Al_2O_3	0.03
Calcium Oxide	Cao	0.002
Magnesium Oxide	Mgo	0.009
Copper	Cu	0.0042
Titanium Di Oxide		0.006
Potassium Oxide		0.0102

Table: 1 EXPERIMENTAL PROGRAM

GRADING LIMITS OF FINE AGGREGATE IN SIEVE ANALYSIS (As Par IS 383-1970):

I.S sieve size	Percentage passing			
	Zone I	Zone II	Zone III	Zone IV
10mm	100	100	100	100
4.75mm	90 – 100	90 – 100	90 – 100	95 – 100
2.36mm	60 – 95	75 – 100	85 – 100	95 – 100
1.18mm	30 – 70	50 – 90	75 – 100	90 – 100
600 µ	15 – 34	35 – 59	60 – 79	80 – 100
300 µ	5 – 20	8 – 30	12 – 40	15 – 50
150 µ	0 – 10	0 - 10	0 - 10	0 – 15

Table-2: SIEVE ANALYSIS OF RIVER SAND:

S.NO	Sieve size	Weight retained (gm.)	Cumulative weight retained (gm.)	Cumulative % wt. retained	% of passing
1	4.75mm	9.5	9.5	0.95	99.05
2	2.36mm	13.4	22.9	2.29	97.71
3	1.18mm	105.5	128.4	12.84	87.16
4	600 µ	126.9	255.3	25.53	74.47
5	300 µ	639.9	895.2	89.52	10.48
6	150 µ	87.3	982.5	98.25	1.75
7	Pan	17.4	999.9	99.99	0.01
Total				**278.37**	

Fineness modulus of sand = (Total cumulative % wt. retained)/100
= 278.37/100 = **2.78**

Table-3: SIEVE ANALYSIS OF COPPER SLAG:

S. NO	Sieve size	weight retained (gm.)	Cumulative weight retained (gm.)	Cumulative % wt. retained	% of passing
1	4.75mm	0	0	0	100
2	2.36mm	21.2	21.2	4.24	95.76
3	1.18mm	97.8	119	23.8	76.2
4	600 µ	161.3	280.3	56.06	43.94
5	300 µ	36.7	317	63.4	36.6
6	150 µ	170	487	97.4	2.6
7	Pan	13	500	100	0
Total				**344.9**	

Fineness modulus of sand = (Total cumulative % wt. retained)/100
= 344.9/100 = **0.449**

Table-4: GRADING LIMITS OF SINGLE SIZED AGGREGATES

IS Sieve	Percentage passing for coarse aggregate (%)			
	20mm	16mm	12.5mm	10mm
40mm	100	-	-	-
20mm	85-100	100	-	-
16mm	-	85-100	100	-
12.5mm	-	-	85-100	100
10mm	0-20	0-30	0-45	85-100
4.75mm	0-5	0-5	0-10	0-20
2.36mm	-	-	-	0-5

Table-5: SIEVEANALYSISOFCOARSE n

S.NO	Sieve size	weight retained (gm)	Cumulative weight retained (gm)	Cumulative % wt retained	% of passing
1	16mm	0	0	0	100
2	12.5mm	350	350	7	93
3	10mm	3050	3400	69	31
4	4.75mm	1500	4900	98	2
5	2.36mm	100	5000	100	0
6	1.18mm	0	-	100	0
7	600 µ	0	-	100	0
8	300 µ	0	-	100	0
9	150 µ	0	-	100	0
10	Pan	0	-	100	0
Fineness modulus	**774**	0			

Fineness Modulus of Coarse Aggregate = (Total cumulative % wt. retained)/100
=774/100 =**7.74**

Table-6 MIX PROPORTION RATIOS FOR M_{30} AND M40:

Grade	Mix Ratio	W/C ratio
M_{30}	1: 1.492: 3.33	0.45
M_{40}	1: 1.36: 3.024	0.43

RESULTS

TABLE-7:SLUMP VALUES FOR M_{30} GRADE CONVENTIONAL CONCRETE & STEEL FIBRE REINFORCED CONCRETE:

Mix proportion	Slump(mm)
CS0	55
CS1	57
CS2	58
CS3	60
CS4	62
CS5	65
CS6	70

TABLE-8: SLUMP VALUES FOR M_{40} GRADE CONVENTIONAL CONCRETE &STEEL FIBRE REINFORCED CONCRETE

Mix proportion	Slump(mm)
CS0+1%SF	53
CS1+1%SF	56
CS2+1%SF	58
CS3+1%SF	60
CS4+1%SF	62
CS5+1%SF	65
CS6+1%SF	68

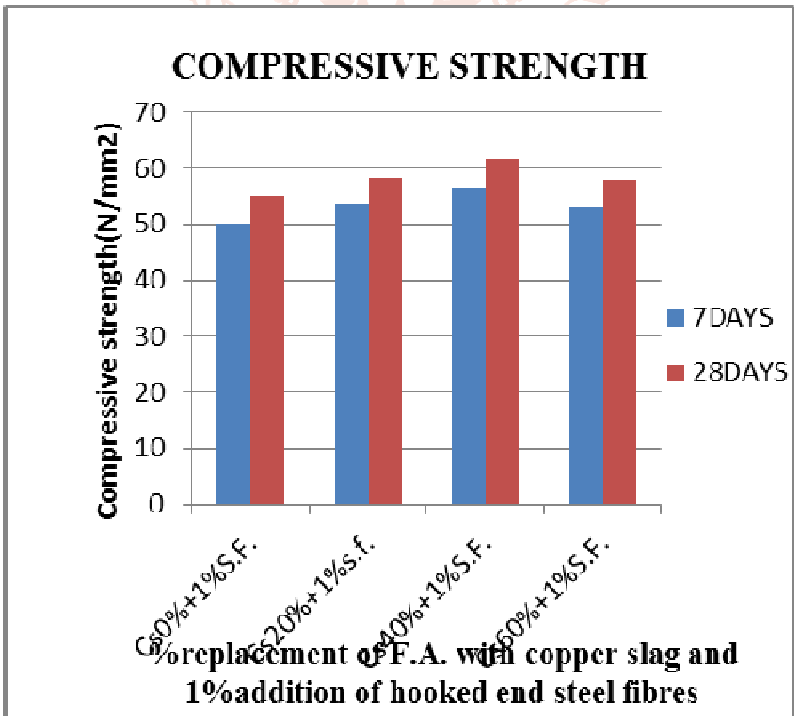
Mix proportion	Slump(mm)
CS0	58
CS1	60
CS2	62
CS3	63
CS4	65
CS5	68
CS6	69

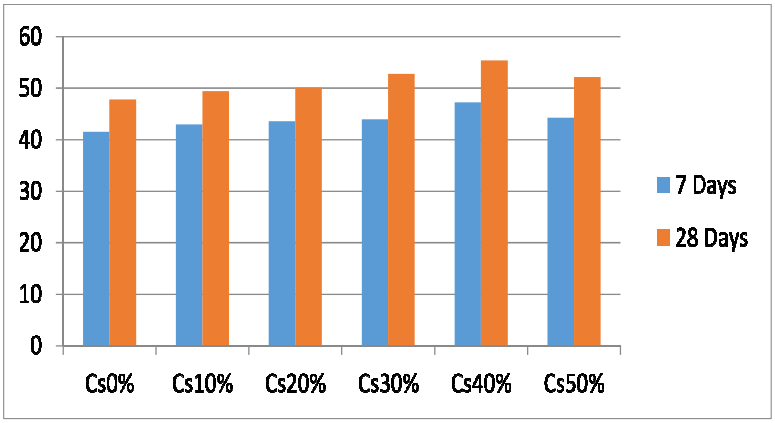
Mix proportion	Slump(mm)
CS0+1%SF	54
CS1+1%SF	57
CS2+1%SF	59
CS3+1%SF	60
CS4+1%SF	63
CS5+1%SF	65
CS6+1%SF	68

TABLE-9: COMPRESSIVE STRENGTH FOR SFRC CONCRETE (MPA)

Mix appellation	Compressive Strength			
	7days		28days	
	Load(KN)	Strength	Load(KN)	Strength
Cs0%+1%S.F	970 920 880	41.18	1090 1070 1020	47.032
Cs20%+1%S.F	1060 1010 970	45.03	1200 1180 1130	53
Cs40%+1%S.F	1220 1190 1130	52.44	1280 1260 1210	55.56
Cs60%+1%S.F	1140 1100 1080	49.705	1200 1180 1150	52.29

Mix appellation	Compressive Strength		
	7days		28days
	Load(KN)	Strength	Strength
Ca0%	890 970 930	41.55	47.7825
Ca10%	1000 970 930	42.96	49.404
Ca20%	1020 990 940	43.56	50.094
Ca30%	1020 1000 950	44	52.8
Ca40%	1090 1070 1030	47.26	55.35
Ca50%	1040 1000 970	44.29	52.2





GRAPH; VARIATION OF COMPRESSIVE STTRENGTH (7 DAYS & 28 DAYS)

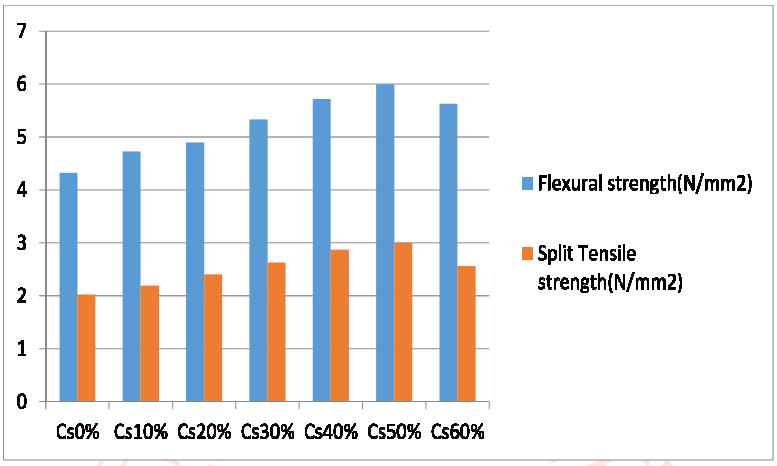


FIG-1: VARIATION OF FLEXURAL STRENGTH AND SPLIT TENSILE STRENGTH WITH COPPER SLAG OF M_{30} GRADE

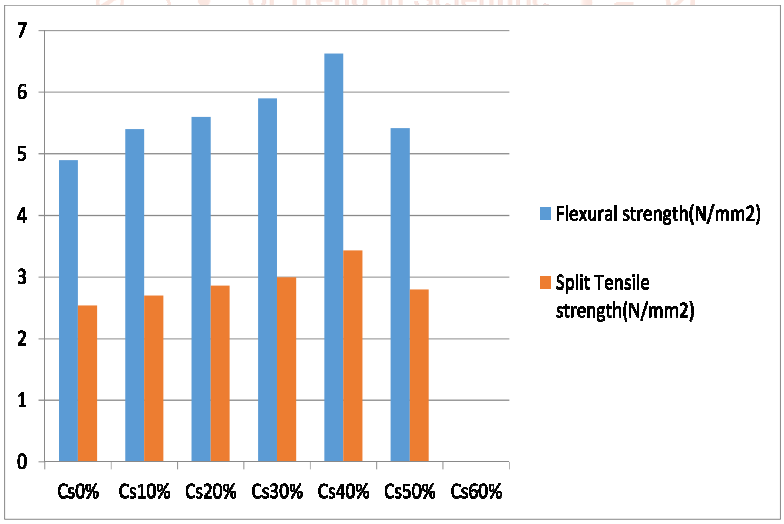


FIG-2: VARIATION OF FLEXURAL STRENGTH AND SPLIT TENSILE STRENGTH WITH COPPER SLAG OF M_{40} GRADE

CONCLUSION

- The optimum strength for M_{30}&M_{40} grade concrete is observed at 50%&40% replacement of copper slag with fine aggregate.
- Due low water absorption nature copper slag there is a increase in the workability of conventional concrete when compared with steel fiber reinforced concrete due addition of hooked end steel fibers.
- Maximum percentage increase of compressive strength for conventional concrete is 29.4where as for steel fiber reinforced concrete is 34.28% for M_{30}.
- Maximum percentage increase of compressive strength for conventional concrete is 20.5% whereas for steel fiber reinforced concrete is 23% for M_{40}.
- Steel fiber reinforced concrete is having an increase in compressive strength is 7%, Flexural strength is50%, Split tensile strength is 68% when compared with conventional concrete.
- So addition of hooked end steel fibers increases mechanical properties of concrete and also provides superior resistance to cracking.
- While testing the specimens, the plain cement concrete specimens have shown a typical crack propagation

pattern which leaded into splitting of member in two piece geometry. But due to addition of steel fibers in concrete cracks gets ceased which results into the ductile behavior of SFRC.

- Increase in replacement of copper slag with F.A beyond the optimum percentage causes increase in workability and causes strength reduction. Increase in fiber content can result in balling effect and reduces workability according to ACI544 (3R-08) it is advisable up to 0.5%-1.5%. Further researches can be carried out to improve the strength and acid resistance by the addition of some admixtures.

REFERENCES

[1] Amit Rana (2013), Some Studies on Steel Fiber Reinforced Concrete, International Journal of Emerging Technology and Advanced Engineering, Volume 3, 120-127.

[2] Binaya Patnaik (2015), Strength and Durability Properties of Copper Slag Admixed Concrete, International Journal of Research in Engineering and Technology, Volume 4, 158-166.

[3] IS 383: 1970, Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian standards, New Delhi, India

[4] IS 10262-2000, recommended guidelines for concrete mix design, Bureau Standards, New Delhi, India

[5] IS: 516-1959, Indian standard methods of tests for strength of concrete, Bureau of Indian standards, New Delhi, India.

[6] Milind V. Mohod, "Performance of steel fibre reinforced concrete", International Journal of Engineering and Science, ISSN: 2278-4721, Vol. 1, Issue 12 (December 2012), PP 01-04.

[7] Leema Rose A & SuganyaP (2015), 'Performance of Copper Slag on Strength and Durability Properties as Partial Replacement of Fine aggregate in Concrete' International Journal of Emerging Technology and Advanced Engineering, vol .5, pp: 434-437.

[8] Nguyan Van Chan H (2002), 'Steel fiber reinforced concrete', Journal of Civil Engineering, Ho Chi Minh City University of Technology, vol.1, pp: 108 -116.