Study of Reinforced Concrete with the Presences of Copper Slag and Steel

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Abstract— As a result of Rapid development of innovation and populace in India, there is an immense interest for development material for the most part for normal sand, recently over the top utilization of sand caused natural conservative irregularity. To conquer these impacts huge alterations are being done in development industry, for example use of by items as a substitution of fine total. In the present investigation COPPER SLAG which is a result gotten during generation of copper by refining is utilized as a substitution of F.A. And furthermore to expand the mechanical properties of cement various kinds of strands are added to the solid blend. The HOOKED END STEEL Fibers are added to the solid to improve the mechanical properties. As a few scientists has presented Steel fiber strengthened concrete(SFRC) for its characteristic prevalence over typical plain and fortified cement for its higher flexural quality, better elasticity and modulus of break, better flexibility and weakness obstruction, split opposition. This near examination is completed on quality properties among SFRC and traditional cement because of supplanting of F.A with copper slag. An exploratory examination was completed to assess the mechanical properties of Steel fiber strengthened concrete by substitution of sand (F.A) with copper slag for various grades (M30, M40). Tests are directed with 1% expansion of snared end steel strands having angle proportion 60 and substitution of copper slag by 0%, 10%....with an interim of 10% where ideal quality is accomplished at 50%,40%.

Keywords: Copper slag, Steel, M_{30}&M_{40}

I. INTRODUCTION

Cement concrete is the most extensively used construction material in the world as it provides good workability and can be moulded to any shape due to plasticity before undergoing setting. Ordinary cement concrete possesses very low tensile strength, limited ductility, and little resistance to cracking

Now-a-days civil engineering constructions have their own intended purposes to attain these purposes modification had brought in traditional concrete. It has been found that different type of fibers added in specific percentages to concrete improves the mechanical properties, durability and serviceability of the structure. It is now established that one of the important properties of Steel Fiber Reinforced Concrete (SFRC) for its superior resistance to cracking and crack propagation. SFRC is now increasingly used in structures such as airport pavement, bridged decks, machine foundations, blast resistant structures, piles, sea protective structures.

A. 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.

B. Composition of Steel Fibres:

- The composition of steel fibers generally includes carbon steel or stainless steel.
- The length dimension ranges from 6.4mm to 76mm while the diameter ranges from 0.25mm to 0.75mm.
- The steel fibers are described by a convenient parameter "Aspect Ratio". The aspect ratio is determined by length to diameter ratio. It varies from 20 to 100 as stated in ACI544, 3R-08.

Fig. 1: TYPES OF STEEL FIBERS

CHEMICAL 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

VALUES OF SPECIFIC GRAVITY FOR DIFFERENT MATERIALS:

MATERIALS	SPECIFIC GRAVITY
CEMENT	**3.09**
FINE AGGREGATE	**2.648**
COARSE AGGREGATE	**2.72**
COPPER SLAG	**3.5**

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

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/
=3.449

II. MIX DESIGN

A. Mix Calculation

Mix calculation for 1m^3 volume of concrete
Volume of concrete = 1m^3
Volume of cement = 0.127 m^3
Volume of water = 0.166 m^3
Volume of C.A&F.A = 0.707
Mass of Coarse aggregate =1297.62Kg/m^3
Mass of Fine aggregate =581.852Kg/m^3
Mix ratio:
Cement: Fine Aggregate: Coarse Aggregates: water
1 : 1.492 : 3.33 : 0.45

: 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

MIX APPELLATION FOR M_{30} GRADE CONCRETE (Kg/m^3)

Mix appellation	Cement	Fine aggregate	% replacement of copper slag	Coarse aggregate	% addition of steel fibers	Copper slag	water
CS0	390	582	0	1298	1	0	175.5
CS1	390	524	10	1298	1	58.2	175.5
CS2	390	465.4	20	1298	1	116.4	175.5
CS3	390	407.3	30	1298	1	174.6	175.5
CS4	390	349.1	40	1298	1	232.7	175.5
CS5	390	290.9	50	1298	1	290.93	175.5
CS6	390	232.7	60	1298	1	349.3	175.5

MIX APPELLATION FOR M_{40} GRADE CONCRETE (Kg/m^3)

Mix appellation	Cement	Fine aggregate	% replacement of copper slag	Coarse aggregate	% addition of steel fibers	Copper slag	water
CS0	420	569.5	0	1278	1	0	180.6
CS1	420	512.5	10	1278	1	56.95	180.6
CS2	420	455.6	20	1278	1	113.9	180.6
CS3	420	398.6	30	1278	1	170.9	180.6
CS4	420	341.7	40	1278	1	227.8	180.6
CS5	420	284.7	50	1278	1	284.8	180.6
CS6	420	341.7	60	1278	1	227.8	180.6

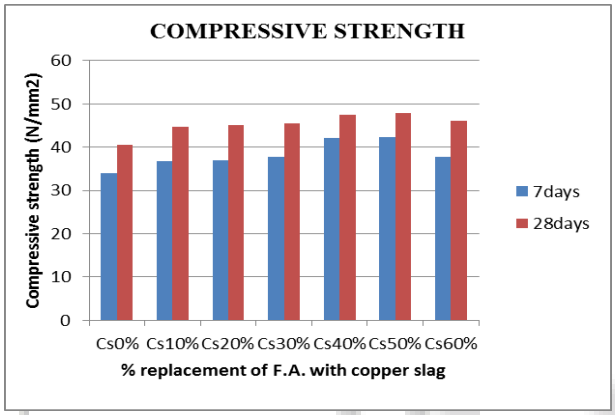
SLUMP VALUES FOR M_{30} GRADE CONVENTIONAL CONCRETE & STEEL FIBRE REINFORCED CONCRETE:

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

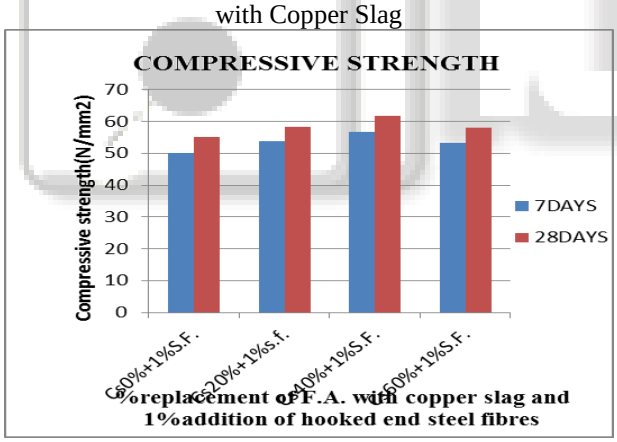
Mix proportion	Slump(mm)
CS0+1%SF	53
CS1+1%SF	56
CS2+1%SF	58
CS3+1%SF	60
CS4+1%SF	62
CS5+1%SF	65
CS6+1%SF	68

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

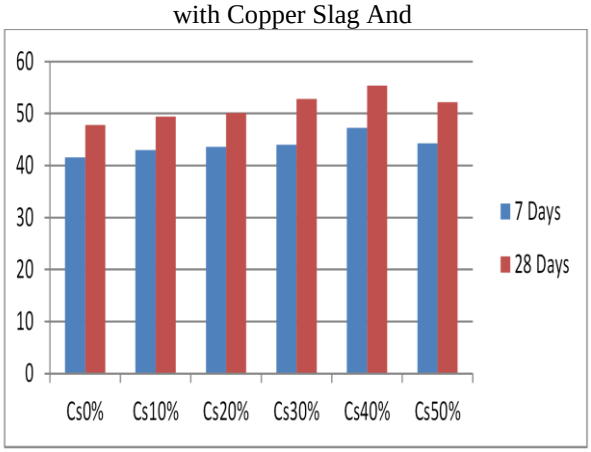
Mix proportion	Slump(mm)	Mix proportion	Slump(mm)
CS0	58	CS0+1%SF	54
CS1	60	CS1+1%SF	57
CS2	62	CS2+1%SF	59
CS3	63	CS3+1%SF	60
CS4	65	CS4+1%SF	63
CS5	68	CS5+1%SF	65
CS6	69	CS6+1%SF	68



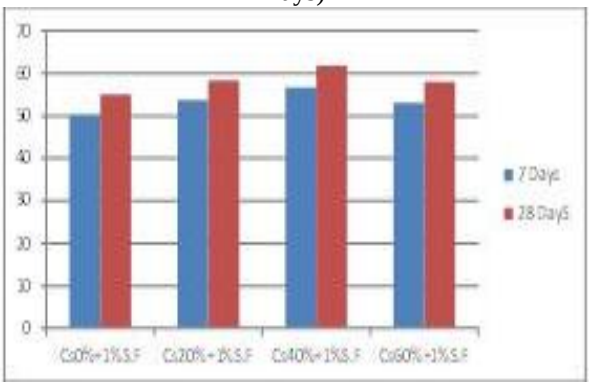
Graph 1: Compressive Strength V/S % Replacement of F.A with Copper Slag



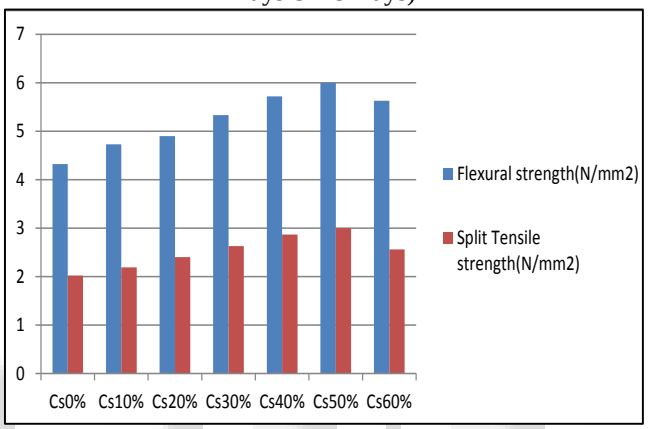
Graph 2: Compressive Strength V/S % Replacement of F.A with Copper Slag And



Graph 3: Variation of Compressive Strength (7 Days & 28 Days)



Graph 4: Variation of Compressive Strength with SFRC (7 Days & 28 Days)



Graph 5: Variation of Flexural Strength and Split Tensile Strength with Copper Slag of M_{30} Grade

III. 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.

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