Performance of Copper Slag and Foundry Sand in Concrete

Kalyani Shinkar[1] Rohan Chhajed[2] Varsha Dhanwade[3] Kishor Shelke[4] Mrs.Renuka Purohit[5]
[1,2,3,4]Student [5]Professor
[1,2,3,4,5]PCCOE, Pune

Abstract— This state of art review represents the development in the field of utilization of foundry sand and Copper slag in cementations concrete. The paper reviews the utilization of Copper slag and foundry sand as the concrete constituent and the noticeable and important findings from the experimental works of various researchers. After a careful study, authors to integrate all the important results for streamlining the potential of this area of research. Based upon historical development on the individual material either copper slag or foundry sand is found as replacement of fine aggregate. The availability of copper slag and Foundry sand is large and causes lots of disposal problems. Even the use of river sand is banned in many of areas across India because of river depletion, so copper slag and foundry sand may be an effective option as a partial replacement of fine aggregate in concrete. The paper summarizes conclusions of experiments conducted for the properties like Compressive strength. It was observed the results have shown positive changes and improvement in strength of the conventional cementitious concrete due to the addition or replacement of fine sand with used foundry sand in different proportions. The best result obtained in present research for compressive strength of concrete are for 50-60% replacement of fine aggregate.

Key words: Fine Aggregate, Copper Slag, Foundry Sand, Compressive Strength, Concrete

I. INTRODUCTION

As demand for the concrete is increasing day by day thus the need for fine sand is also increasing. But the availability of fine sand is limited and also taking river sand from river is banned in many of the areas. Concrete is a composite construction material made primarily with aggregate, cement, and water. There are many formulations of concrete, which provide varied properties, and concrete is the most-used man-made product in the world. Natural resources are depleting worldwide while at the same time the generated wastes from the industry are increasing substantially. The sustainable development for construction involves the use of nonconventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment. One of the effective option may be combining the use of Copper slag and foundry sand in concrete as a replacement in concrete. Copper slag is a by-product created during the copper smelting and refining process. Copper slag blasting grit is manufactured of the granulated slag of copper refineries, and used for blast-cleaning of metal surface. Copper slag is a by-product obtained during the production of copper metal, which can be used as pozzolona in the production of cementing materials. One of the primary advantages to copper slag is the low risk it poses to health and the environment.

II. EXPERIMENTAL PROGRAM

The details of various material used in the experimental investigation are

1) Cement - Opc Grade 43 cement having specific gravity 3.15. Initial and Final setting time of cement are 70 minute and 245 minute respectively.
2) Fine aggregate- Fine aggregate used was sand passing through 4.75mm sieve. Specific gravity was found to be 2.60 with water absorption of 2.15%.
3) Coarse aggregate-Coarse aggregate used was sand passing through 20mm sieve. Specific gravity was found to be 2.78 with water absorption of 0.34%
4) Copper slag- Copper slag used was passing through 4.75mm sieve. Specific gravity was found to be 3.40 with water absorption of 1.83%
5) Foundry sand- Foundry sand used was passing through 4.75mm sieve. Specific gravity was found to be 2.29with water absorption of 3.15%
6) Water - Ordinary clean potable water free from the suspended particles and chemicals were used for mixing and curing.

III. MIX PROPORTIONS AND TEST RESULTS

Concrete proportions of M20 grade for 6cubes

Sr. No.	Material	Nominal mix (Kg)
1.	Cement	10.350
2.	Water	4.77
3.	Fine aggregate	27.178
4	Copper slag	--
5	Foundry sand	--
6	10mm CA	14.605
7	20mm CA	18201

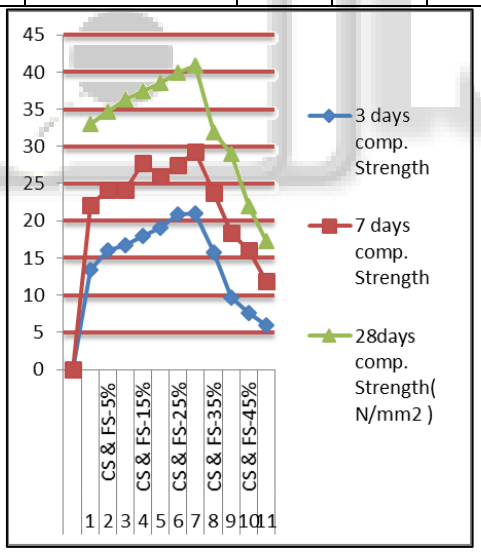
IV. SLUMP RESULTS

Sr. No.	Mix Proportion	Slump (mm)
1.	CS & FS-0%	110
2.	CS & FS-10%	115
3.	CS & FS-20%	125
4.	CS & FS-30%	120
5.	CS& FS-40%	125
6.	CS & FS-50%	130

7.	CS & FS-60%	125
8.	CS & FS-70%	110
9.	CS & FS-80%	105
10.	CS & FS-90%	85
11.	CS & FS-100%	60

– Compressive Strength

Sr. No.	Mix proportion	3day	7day	28day
1	CS & FS -0%	14.56	22.07	33.03
2	CS & FS-10%	14.91	24.22	34.66
3	CS & FS-20%	16.60	24.22	36.36
4	CS & FS-30%	17.96	27.70 25.92	37.48
5	CS & FS-40%	19.09	25.92	38.55
6	CS & FS-50%	20.81	27.55	39.85
7	CS & FS-60%	21.03	29.33	40.88
8	CS & FS-70%	15.70	23.70	31.85
9	CS & FS-80%	9.62	18.37	28.96
10	CS & FS-90%	7.62	15.99	21.92
11	CS & FS-100%	5.92	11.85	17.33



– Compressive Strength 3 days.

Sr. No.	Mix proportion	3day.	Increase in 3days
1	CS & FS -0%	14.56	100
2	CS & FS-10%	14.91	119.41
3	CS & FS-20%	16.60	125.01
4	CS & FS-30%	17.96	134.12 25.92
5	CS & FS-40%	19.09	142.25
6	CS & FS-50%	20.81	155.34
7	CS & FS-60%	21.03	157.06
8	CS & FS-70%	15.70	117.25
9	CS & FS-80%	9.62	71.85
10	CS & FS-90%	7.62	56.9
11	CS & FS-100%	5.92	11.85

– Compressive Strength 7 days.

Sr. No	Mix proportion	7day	Increase in 7days
1	CS & FS -0%	22.07	100.00
2	CS & FS-10%	24.22	109.74
3	CS & FS-20%	24.22	109.74
4	CS & FS-30%	27.70 25.92	125.02
5	CS & FS-40%	25.92	116.08
6	CS & FS-50%	27.55	124.83
7	CS & FS-60%	29.33	132.89
8	CS & FS-70%	23.70	107.38
9	CS & FS-80%	18.37	83.23
10	CS & FS-90%	15.99	73.45
11	CS & FS-100%	11.85	53.69

– Compressive Strength 28 days.

Sr. No.	Mix proportion	28 day	Increase in 28days Comp. ssStrength
1	CS & FS -0%	33.03	100.00
2	CS & FS-10%	34.66	104.93
3	CS & FS-20%	36.36	110.81
4	CS & FS-30%	37.48	113.47
5	CS & FS-40%	38.55	116.71
6	CS & FS-50%	39.85	120.64
7	CS & FS-60%	40.88	123.76
8	CS & FS-70%	31.85	96.43
9	CS & FS-80%	28.96	87.68
10	CS & FS-90%	21.92	66.36
11	CS & FS-100%	17.33	52.46

V. CONCLUSION

– Increase in comp. strength upto 60 %
– Optimum percentage of CS & FS in Concrete = 60-70%
– Comp. strength decreases after 70 % rapidly.
– Reduces environmental hazards by use of Industrial by-products.
– Large replacement of fine aggregate is possible.
– One step towards Green Construction.

A. Future Scope:

– RCC can be considered.
– Durability of concrete cubes can be taken into account.

- Corrosion properties of concrete can be considered.
- High Grade of concrete can be taken into account.
- Variation in percentage of CS & FS individually.
- Special types of concrete can be considered.

REFERENCES

[1] Wei Wu, Weide Zhang, Guowei Ma, Optimum content of copper slag as a fine aggregate in high strength concrete-(School of Civil and Environmental Engineering, Nanyang Technological University, 639798 Singapore, Singapore)
[2] Meenakshi Sudarvizhi. S, Ilangovan. R,Performance of Copper slag and ferrous slag as partial replacement of sand in Concrete.(INTERNATIONAL JOURNAL OF CIVIL AND STRUCTURAL ENGINEERING Volume 1, No 4, 2011)
[3] AS Alnuaimi Department of Civil and Architectural En gineering, Sultan Qaboos University, Al-Khoud, Muscat, Sultanate of Oman (TJER 2012, Vol. 9, No. 2, 90-102) Effects of Copper Slag as a Replacement for Fine Aggregate on the Behaviour and Ultimate Strength of Reinforced Concrete Slender Columns
[4] Khalifa S. Al-Jabri, Makoto Hisada, Salem K. Al-Oraimi, Abdullah H. Al-Saidy (Department of Civil and Architectural Engineering, College of Engineering, Sultan Qaboos University, P.O. Box 33, Al Khodh 123,Oman.Department of Civil Engineering, Tohoku University, 6-6-06 Aoba, Sendai, Japan) Copper slag as sand replacement for high performance concrete
[5] AS Alnuaimi Department of Civil and Architectural Engineering, Sultan Qaboos University,Al-Khoud, Muscat, Sultanate of Oman (TJER 2012, Vol. 9, No. 2, 90-102) Effects of Copper Slag as a Replacement for Fine Aggregate on the Behaviour and Ultimate Strength of Reinforced Concrete Slender Columns-
[6] M. Najimi, J. Shobhani, A. R. Pourkhorshidi Durability of copper slag contained concrete exposed to sulphate attack
[7] Tarun Naik and his fellows ,Performance of fresh and hardened concrete containing discarded foundry sand in place of fine aggregate.
[8] Eknath, Comparitive study of the properties of fresh & hard concrete containing ferrous and non ferrous foundry waste sand replaced with fine aggregate-
[9] Kumbhar, Mechanical properties of concrete containing use foundry sand.
[10] .ISCode 10262
[11] .ISCode 456-2000
[12] .ISCode 393-1987
[13] .ISCode 393-1970

