International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Study on Replacement of Fa by Copper Slag in Concrete (M30)

Latif Miyan[1], G. R. Krishnamurthy[2]

[1]M.Tech (Structural Engineering), Sambharam Institute of Technology, M.S.Palya Jalahalli East, Bangalore

[2]Assistant professor, Department of civil engineering, Sambharam Institute of Technology, M.S.Palya Jalahalli East, Bangalore

Abstract: ***The main objective of this project is to study the mechanical properties of copper slag as a partial replacement of fine aggregate for manufactured sand (m-sand) at different proportions (0%,10%,20%,30%and 40%) of Copp1er Sla1 g. Copp2er sla8 g is the alternative material resulted during the process of matte smelting and improving the copper. To obtain 2.2-3 tons of copper slag about 1 ton of co5pper is required. Whereas quarry dust or stone dust which is producing during quarry activity and it is a by-product material in this project we are using completely manufactured sand (m-sand). In the present investigation it is proposed for the using of factory waste materials which has encouraged in construction industry for production of concrete as it contribute in the reduction of usage of artificial sources. For this research work, M30 grade concrete was used and tests were conducted. Various concrete mixtures were prepared with different proportion of copper slag as fine aggregates replacement. Concrete mixtures were evaluated for workability, compressive strength, splitting tensile strength and mortar compressive strength after 7, 14, and 28 days at ambient room temperature curing. The result for concrete indicted that workability increases with increase in percentage of copper slag. A substitution of about 20% of copper slag as a fine aggregate gives higher compressive and split tensile strength and is case of the mortar cubes the higher strength for compressive and split tensile was obtained at the 40% replacement of copper slag as fine aggregate.***

Keywords: Copper Slag, Compressive strength test, Split Tensile Test, Manufactured Sand

1. Introduction

In India, there is incredible request of aggregates basically from structural designing industry for street and building developments. In any case, now a days it is exceptionally troublesome issue for accessible of fine aggregates. So specialists created squander administration techniques to utilize as the substitution for aggregate as per the requirement. Common methods are getting exhaust all over the world but the produced squanders from the business are developing periodically the economical advancement for development includes the usage of nonconventional, artistic materials& reusing of trash materials so as to remunerate the lack of normal assets &to define the voluntary ways of rationing the earth. One of the promising waste material which can be used in the development field in some amount or complete amount for aggregate is Copper Slag. It is the alternative material considered during the heating, purifying and refining of copper. To discharge 2.2 to 3 tons of copper slag as waste material about one ton of copper is used.

During the process of smelting the larger sized particles gets settled at the bottom and the finer particles stay at the top layer and within the shorter period of time the finer particles travels to the water bowl which is at the lower temperature and gets hardened and further processed to the crusher for next process.

Copper slag is adopted as a part of my project work was brought from "Sterlite Industries Ltd (SIL), Tuticorin, TN, India". As of now, around 2600 tons of copper slag is generated each day and an aggregate amassing of about 1.5MT. Utilization of c8opper sla0g in materials, like, cement and aggregates has three overlay points of interest of dispensing with the expenses of dumping, lessening the cost of cement, and limiting air contamination issues.

Quarry dust is named fine aggregate obtained from the smelting procedure after quarrying from the quarry site. Quarry dust will be considered as byproduct for the river sand.

2. Objective

The study is focused on,

- Aggregate substitution of characteristic sand by fabricated sand.
- To concentrate the mechanical properties of copper slag as a halfway substitution of M-sand.
- To make full utilization of the focal points offered by Quarry tidy and copper slag shape a reason for plan of other blend extents for different classes of cement.
- To make utilization of the waste material (quarry clean and copper slag) to expand the quality and cut the cost.
- To advance the locally accessible material like quarry tidy, copper slag, and so on.

The main objective of this project is to determine the mechanical properties of a M30 grade Concrete. For the different percentage replacement of copper slag for M Sand as fine aggregate.

3. Materials and Methodology

Sand is an actually happening granular material made out of finely isolated shake and mineral particles. The most generally adopted constituent of sand, in inland mainland conditions and non-tropical regions, is SiO2, for the most part as quartz which, as a result of its compound inactivity

and extensive hardness, is the most well-known mineral impervious to weathering. It is utilized as fine aggregate in cement.

In this project, the solid of M30 review will be set up by using OPC with various amount of replacement of Fine Aggregate by copper slag and coarse aggregate. We have taken the percentage of fine aggregate with copper slag taking reference of a few related research papers as 0%, 10%, 20%, 30%, 40%, and 50%. The exact concrete mixes will be considered only after trial and error method.

The concrete mix will be tested for following strengths.
1) Compressive strength of cubes after 7, 14 and 28 days
2) Split tensile strength after 7, 14, 28 days.
3) Compressive strength mortar cubes after 7, 14 and 28 days

3.1 Mix Design

The mix design for the M30 grade concrete is carried out by the Indian standard code. Hence for my work, for the value of the slump is taken as 100mm, the fine aggregate of Zone II, coarse aggregate of 20mm size and below.

- Cement = 450 Kg
- Water = 198 Kg (0.4)
- Fine Aggregate = 595 Kg
- Coarse Aggregate = 1160 Kg
- The proportion for the mix is **1:1.322:2.576**

3.2 Experiential Investigation

The slump test was the fresh property test carried out to determine the workability of concrete. The result obtained for the slump cone test is:-

Slump Values of different mixes		
Mix	Combination of the Mix	Slump Value (MM)
1	10%CS + 90% MS	72
2	20%CS + 80% MS	76
3	30%CS + 70% MS	79
4	40%CS + 60% MS	80
5	50%CS + 5 0% MS	85

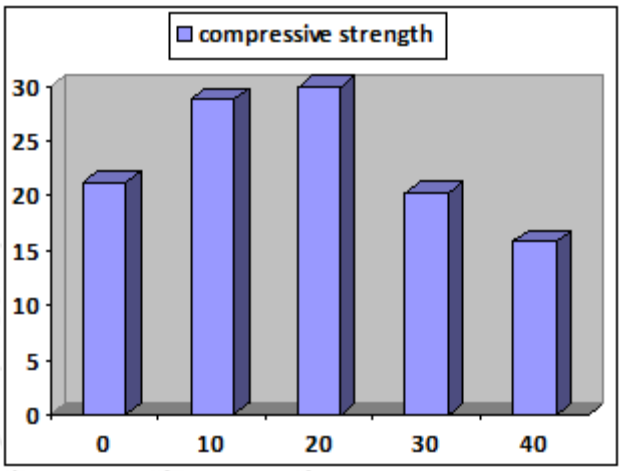
The casting of the specimens for my work is of different types and is of different quantities of the ingredients. The specimens casted are cubes and cylinders. The specimens are casted for different proportions of the mix quantities. The replacement of the copper slag to M Sand is in a percentage of 10%, 20%, 30%, 40% and 50% as fine aggregate. The cubes casted are of 150 x 150 x 150mm in dimension. The cylinders are of 150mm in diameter and 300mm in length. The cubes and cylinders are kept for curing for the duration of 7, 14 and 28 days in water.

4. Experimental Results

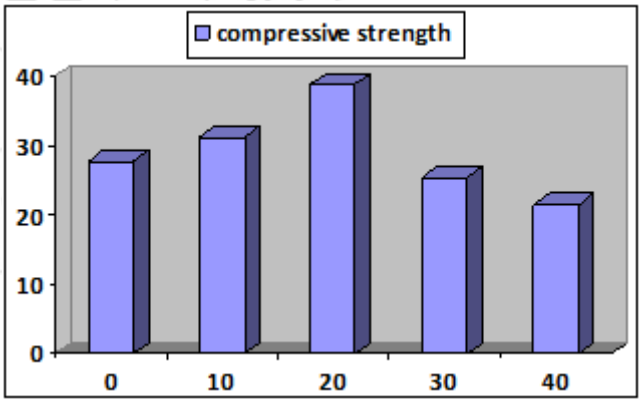
The strength test that are considered for are Compressive strength and split tensile.

4.1 Compressive Strength Test

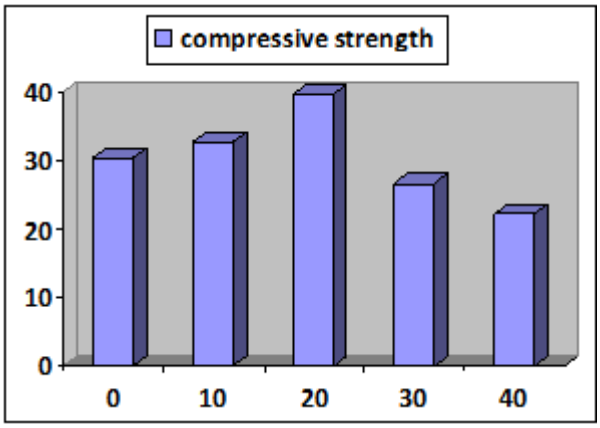
Compressive strength for 7 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	476.667	21.185
10	646.666	28.74
20	673.33	29.926
30	456.66	20.296
40	356.667	15.851



Compressive strength for 14 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	625	27.778
10	703.333	31.259
20	873.33	38.814
30	575	25.556
40	481.667	21.407

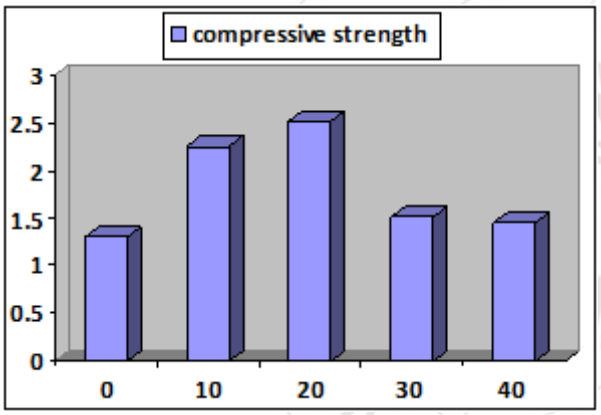


Compressive strength for 28 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	680	30.22
10	731.667	32.518
20	890	39.556
30	600	26.667
40	503.33	22.237

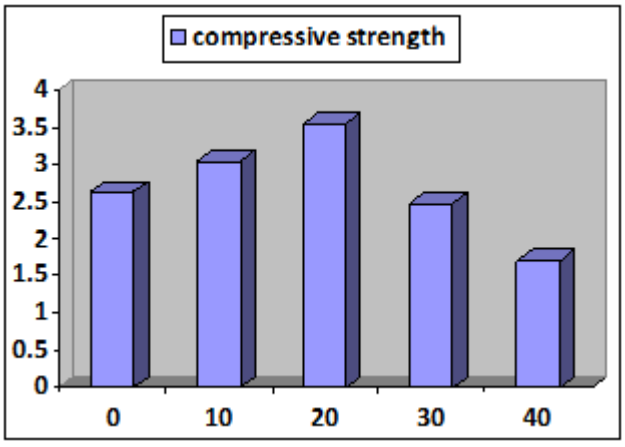


4.2 Split tensile strength

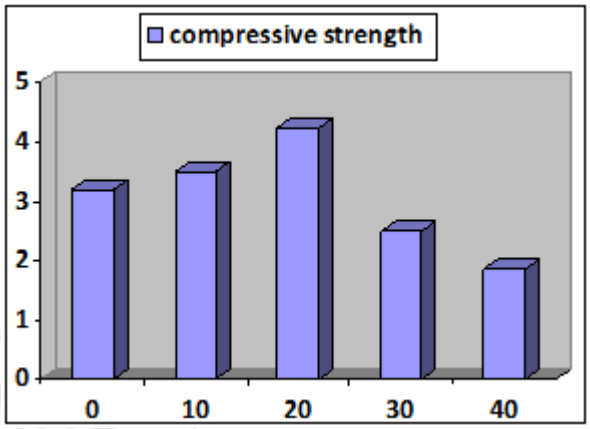
Split Tensile Strength for 7 days		
Mix proportion	Average Strength of concrete	Split Tensile Strength of Cylinder
0	58.33	1.296
10	101.667	2.259
20	113.337	2.518
30	68.334	1.518
40	65	1.444



Split Tensile Strength for 14 days		
Mix proportion	Average Strength of concrete	Split Tensile Strength of Cylinder
0	118.33	2.629
10	136.667	3.037
20	160	3.555
30	111.667	2.481
40	76.667	1.703

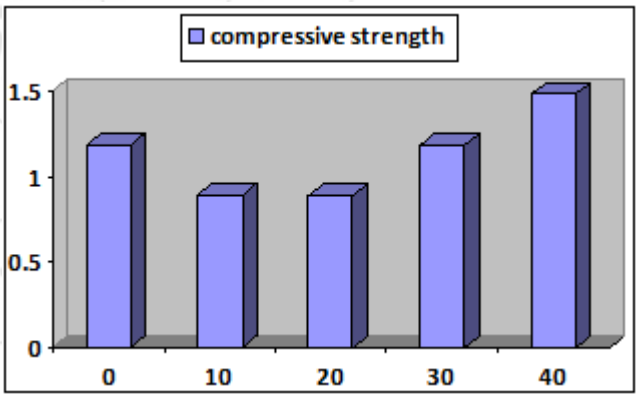


Split Tensile Strength for 28 days		
Mix proportion	Average Strength of concrete	Split Tensile Strength of Cylinder
0	143.333	3.185
10	156.667	3.481
20	190	4.222
30	111.667	2.481
40	83.333	1.851

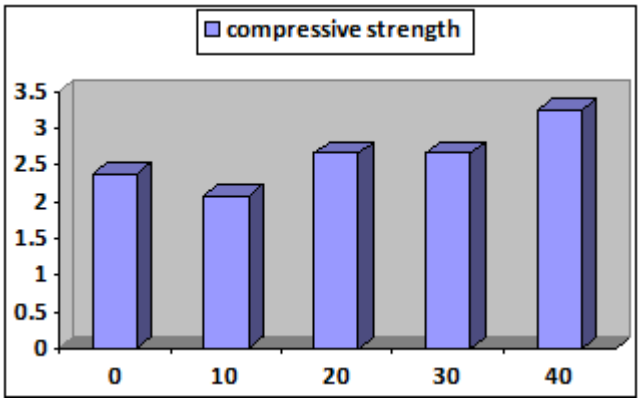


4.3 Compressive Strength of the mortar:

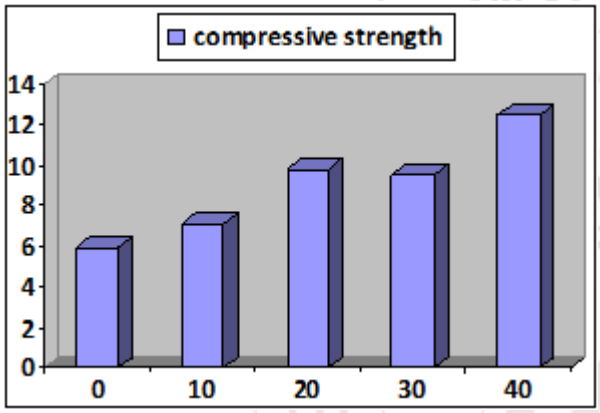
Compressive strength of mortar for 7 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	6.667	1.18
10	5	0.888
20	5	0.888
30	6.666	1.18
40	8.333	1.481



Compressive strength of mortar for 14 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	13.333	2.370
10	11.667	2.074
20	15	2.667
30	15	2.667
40	18.333	3.259



Compressive strength of mortar for 28 days		
Mix proportion	Average Strength of concrete	Cube Compressive strength
0	33.333	5.925
10	40	7.111
20	55	9.777
30	53.33	9.481
40	70	12.444



5. Conclusion

In view of the exploratory examination we can reason that the quality of solid increments with the halfway supplanting of m-sand with copper slag without exhausting the regular assets.

- By doing this venture we have aggregately supplanting the normal sand by M-sand with copper slag.
- By supplanting the M-sand with 10%, 20%. 30% and 40% of copper slag we are distinguishing at which rate of substitution we get the most extreme quality of cement.
- The utilization of copper slag in solid gives great workability, than the solid without supplanting copper slag.
- To accomplish quality, no need of utilizing super plasticizer while get ready cement with copper slag.
- We get most extreme quality by supplanting the fine aggregate M-sand with copper slag by 20% in compressive and split rigidity test.
- In mortar of 1:3 extent the compressive quality test, we get the most extreme quality at 40% swap of copper slag for M-sand.

References

[1] Saha, p. use of copper slag as sustainable aggregate. ASCE India section, oct 17-18, 2014,Hitex, Hyderabad,Telangana, India, 2014
[2] Chavan, R. R. and Kulkarni, D.B. performance of copper slag on strength properties as partial replace of fine aggregate in concrete mix design. International journal of advanced engineering research and studies. 95-98, 2014.
[3] Nataraja, M. C. concrete mix design using copper slag as fine aggregate. International journal of civil engineering, 5(9), 90-99, 2014.
[4] Singh, H, use of copper slag as fine aggregate –A case study. International journal of innovations in engineering research and technology, 2(5),1-7, 2015
[5] Maheswari, M. mechanical and durability properties of RC beams using copper slag as fine aggregate in concrete. International research journal of engineering and technology, 3(3), 2016.

Author Profile

Latif Miyan is M.Tech Structural Engineering, Sambharam Institute of Technology, Bangalore

Krishna Murthy.G.R is Assistant Professor, Department of Civil Engineering, Sambharam Institute of Technology, Bangalore