A Study on Copper Slag as Replacement of Fine Aggregate with Addition of Red Soil

Ms. K. Pandeeswari [1], J. Kalaignanam, A.Kalithmohammad, C.Manikandan [2]
[1]Assistant Professor, Department of Civil Engineering, Sethu Institute of Technology, Virudhunagar
[2]UG student, Department of Civil Engineering, Sethu Institute of Technology, Virudhunagar

Abstract

This paper reports an experimental program to investigate the effect of using copper slag as a complete 100% replacement of sand on the property of fine aggregate. Addition of red soil in ratio 0%, 5%, 10% in cement.M25 mix design has been used. Concrete mixes were evaluated for compressive strength and split tensile strength. With two different composition of 7 days and 28 days. This result indicates that the 10% addition of red soil to cement and 100% replacement of copper slag show the greater results in both split tensile strength and compressive strength than compared to the conventional concrete. Whereas the addition of 5% red soil to cement causes the result in reduction of compressive strength and split tensile strength, however it shows the greater result when compared to the conventional concrete.

Key Words - *Copper slag, Red soil*

I. INTRODUCTION

In modern world there is speedy growth of development in the construction due to this large amount of natural resources is been destroyed by clearing and dumping the surface so the natural resources are been depleting worldwide. At the same time waste from the industries are increasing significantly. The sustainable development for construction involves a use of non-conventional and inventive materials and recycling of waste material. In order to dump them and throw it to affect the natural resources and to find the alternative ways for conserving the environment aggregates are been considered as one of the main ingredient of concrete. In order to reduce demand on natural aggregate as the main source of aggregate in concrete, artificially manufactured aggregate and waste from industrial provides alternative way for construction industry. Utilization of aggregate from industrial waste can be alternate to the natural and artificial aggregate.

For many years there is a research for the replacing the construction material, such as fine aggregate by copper slag.

Similarly the research has been published with regret to material such as coal, fly ash, copper slag and silica fumes. Copper slag is an abrasive blasting grit (by-product) made of granulated slag from metal smelting process and refining of copper in which sulphur dioxide is released.

To produce every ton of copper approximately 2.2 -3.0 ton of cols are generated.

This would also lead additional benefits in terms of reduction in cost, energy saving promoting ecological balance and conservation of natural resources. Thus the research was performed to evaluate the potential use of copper slag as sand replacing.

II. Material

A. Cement

The cement used in this study was Portland pozzolana cement from Ramco cements.

B. Fine Aggregates

Fine aggregate of 10mm fine m-sand from Madurai region.

C. Copper Slag

Copper slag is the byproduct material produced from the process of manufacturing copper. The copper slag used here is been bought from the Thoothukudi Sterlite.

D. Red soil

10 mm fine red soil is been used.

E. Coarse Aggregate

Coarse aggregate used in this are size of 15 cm. It is from original bed rocks. They are available in different irregular shape. It should be free from organic impurity dirt content.

III. LABORATORY TESTING PROGRAM

A. Mix design and sample preparation

The concrete mixtures have been made with 100% replacement of copper slag and partial replacement of red soil in cement as 0%, 5%, and 10%. First the constituents are weight according to the m25 mix ratio in separate bucket. Over all time taken for mixing the concrete was about 5 min. The mix was been completely tamped in specimen and filled with tamping rod. The specimens were remolded after 24 hrs cured in water and then tested in room temperature at required ages.

B. Experimental work

1. Sieve analysis

The experimental work starts with the sieve analysis. IS specified sieves of varying sizes are used as shown in table 3.1.

Table 3.1 Sieve analysis of Fine Aggregate

Sieve size	*Empty weight of sieve*	*Retained weight of sieve*	*Retained weight of soil*	*Cumulative weight retained*	*Cumulative %retained*	*% finer*
4.75	*367*	*382*	*15*	*15*	*1.5*	*98.5*
2.36	*346*	*426*	*80*	*95*	*9.5*	*90.5*
1.18	*345*	*698*	*353*	*448*	*44.8*	*55.2*
1	*363*	*466*	*103*	*551*	*55.1*	*44.9*
600	*298*	*350*	*52*	*603*	*60.3*	*39.7*
300	*300*	*469*	*169*	*772*	*77.2*	*22.8*
150	*309*	*490*	*181*	*953*	*95.3*	*4.7*
pan	*300*	*347*	*47*	*1000*	*100*	*0*

Fineness Modulus of Sand = 2.73

2. Physical Properties of Materials

By physical properties analysis the copper slag has a specific gravity of 3.6, which is higher than that for sand of 2.55, and OPC of 3.15. It can results in higher density when used as sand substitution. It is expected that the free water content in concrete matrix will increase as the copper slag content increases which consequently will lead to increase in the workability of the concrete.

C. Compressive strength

While testing the compressive strength addition of red soil to the cement of 10% shows the greater the result than compared to conventional concrete. 5% and 10% of red soil and replacement of copper slag as shown in table 3.3

Table 3.3 Compressive Strength of Concrete With 5% & 10% Replacement of Red Soil

S.No.	*Conventional Concrete*	*0%Red soil 100%COSL*	*5% Red Soil 100% COSL*	*10% Red soil 100 % COSL*
1.	*17.4*	*20.07*	*21.5*	*23.38*
2.	*15.54*	*20.68*	*22.4*	*25.74*
3.	*15.83*	*21.8*	*22.8*	*19.98*
Average	***16.26***	***20.85***	***22.23***	***23.03***

Fig 3.3.1 Compressive Strength Testing

D. Split tensile strength

While testing the split tensile strength addition of red soil to the cement of 10% shows the greater the result than compared to conventional concrete. 5 % and 10% of red soil and replacement of copper slag as shown in table3.5

Table 3.5Split Tensile Strength of Concrete With5% & 10%Replacement of Red Soil 7 days

S.No.	*Conventional Concrete*	*0%Red soil 100%COSL*	*5% Red Soil 100% COSL*	*10% Red soil 100 % COSL*
1.	*1.57*	*1.98*	*1.85*	*2.01*
2.	*1.74*	*2.02*	*1.83*	*1.91*
3.	*1.71*	*2.01*	*1.86*	*2.15*
Average	***1.67***	***2.00***	***1.85***	***2.02***

Fig 3.4.1 split tensile strength testing

IV. RESULTS AND DISCUSSION

A. Compressive Strength

Addition of red soil. to the cement of 10% shows the greater the result than compared to conventional concrete.

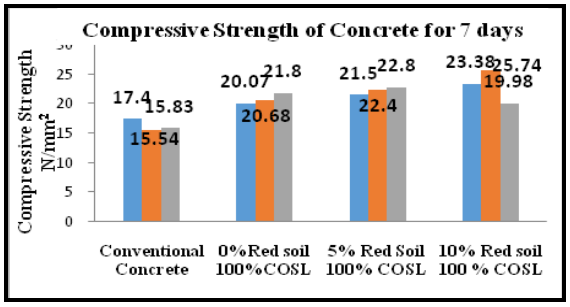

Fig. 4.1 Compressive strength of Concrete for 7 days

B. Split tensile strength

Split tensile strength it showed the result with higher percentage for 10% of red soil and 100% replacement when compared to the conventional concrete

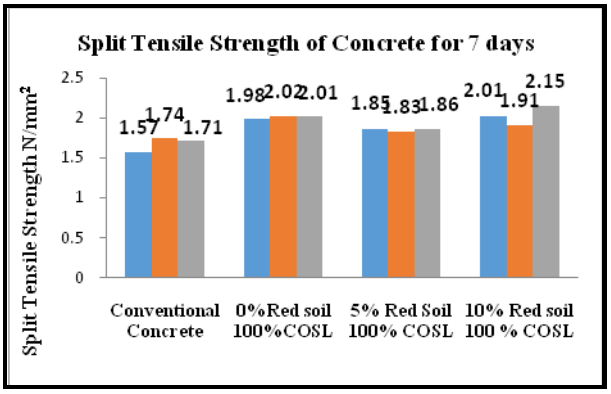

Fig. 4.2 Split Tensile Strength of Concrete for 7 days

V. CONCLUSION

The following conclusion is drawn from the study that the

- The maximum compressive strength is been obtained while adding 10% of red soil to the 100% replacement of copper slag, thus the Concrete gain more strength than conventional concrete.
- It is observed that all percentage replacement of fine aggregate by copper slag the compressive strength of concrete is more than conventional concrete.
- The compressive strength and split tensile strength is increased due to high toughness of copper slag.
- It is recommended that 10% addition of red soil to 100% replacement of copper slag can be used as it has good properties.

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