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INNOVATIVE USE OF COPPER SLAG IN DESIGN MIX CONCRETE

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ABSTRACT: Sustainability and resource efficiency are becoming increasing important issues within today's construction arch study reports industry the possible use. of This copper slag replacement for sand in concrete mixes. Many countries are attesting a express growth in the construction industry, which involves the use of natural resources for the augmentation of infrastructure. This growth poses a intimidation to natural resources. Copper slag is considered as waste material and can be used as replacement of fine aggregates. The possibility of substituting natural fine aggregate with industrial by-products such as waste foundry sand and bottom ash offers technical, economic and environmental advantages which are of great importance in the present context of sustainability in the construction sector. The research study investigated the effect of copper slag as partial replacement of fine aggregates in various percentages, on concrete properties such as mechanical (compressive strength, flexural strength), and durability characteristics of the concrete. For this dissertation work, we design the mix by IS recommended guidelines. In this project, concrete ingredients are use by locally available materials
Keywords: workability, copper slag, density, strength.

I. INTRODUCTION

In India, there is great demand of aggregates mainly from civil engineering industry for road and concrete constructions. But now a days it is very difficult problem for available of fine aggregates. So researchers developed waste management strategies to apply for replacement of fine aggregates for specific need. Natural resources are decreasing worldwide while at the moment the generated wastes from the industry are increasing extensively. The feasible development for construction involves the use of nonconventional and innovative materials, and waste materials in order to remunerate the lack of natural resources and to find alternative ways support the environment. The rapid increase in the natural aggregates consumption every year due to the increase in the construction industry worldwide means that the aggregates reserves are being depleted rapidly, particularly in desert countries such as Arabian Gulf region. It has been reported that, without proper alternative aggregates being utilized in the near future, the concrete industry globally consume 8-10 billion tons of natural aggregates after some years.

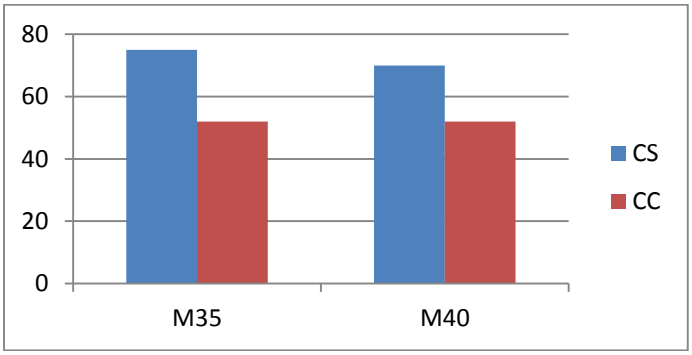
II. COPPER SLAG

Copper slag is a by-product material produced from the process of manufacturing copper. As the copper settles down in the smelter, it has a higher density, impurities stay in the top layer and then are transported to a water basin with a low temperature for solidification. The end product is a solid, hard material that goes to the crusher for further processing. Copper slag is one of the materials that are considered as a waste material which could have a promising future in construction industry as partial or full substitute of either cement or aggregates. It is a by- product obtained during the matte smelting and refining of copper. To produce every ton of copper, approximately 2.2–3.0 tons copper slag is generated as a by-product material. In India copper slag is produced by many industries one of them is Sterlite Industries Ltd (SIL), Tuticorin Tamil Nadu. It is producing Copper slag during the manufacture of copper metal.

III. TEST AND RESULT

3.1 Slump Test

Fresh concrete or plastic concrete is a freshly mixed material which can be moulded into any shape. The relative quantities of cement, aggregate and water mixed together to control the properties of concrete in the wet state as well as in the hardened state. Tests adopted for measurement of workability in the present investigation is Slump test. Slump values 75 mm and 70 mm for copper slag replaced (CS40) M35 and M40 grade concrete and 52 mm and 50 mm for conventional M35 and M40 grade concrete which shows good workability of slag replaced concrete than conventional concrete.



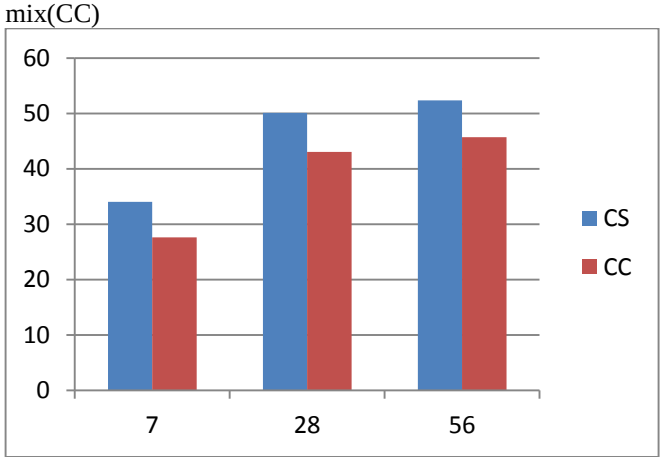
3.2 Compressive Strength Test

M35 Grade Concrete: The compressive strength at the age of 7 and 28 days curing Conventional concrete mix(CC) having 27.22 MPa and 38.04 MPa respectively while in Copper slag replaced with sand 40% (CS40) mix concrete having 34.04 MPa and 44.75 MPa strength which is higher than Conventional concrete mix(CC) but if we consideration results of 56 and 90 days the Copper slag replaced with sand 40% (CS40) mix concrete having 48.35 MPa and 48.62 MPa which is comparatively constant and in Conventional concrete mix(CC) having 41.71 MPa and 43.06 MPa. Result

conclude that for M35 grade of Copper slag replaced with sand 40% (CS40) mix concrete 7, 28,56 days compressive strength increasing respectively 17.63%,15.92% and 12.91% than Conventional concrete mix(CC).

M40 Grade Concrete

The compressive strength at the age of 7 and 28 days curing Conventional concrete mix(CC) having 27.59 MPa and 43.07 MPa respectively while in Copper slag replaced with sand 40% (CS40) mix concrete having 34.04 MPa and 50.10 MPa strength which is higher than Conventional concrete mix(CC) but if we consideration results of 56 and 90 days the Copper slag replaced with sand 40% (CS40) mix concrete having 52.33 MPa and 52.76 MPa which is comparatively constant and in Conventional concrete mix(CC) having 45.68 MPa and 46.28 MPa. Result conclude that for M40 grade of Copper slag replaced with sand 40% (CS40) mix concrete 28,56 and 90 days compressive strength increasing 16.32%,14.55% and 14.00% than Conventional concrete mix(CC)



3.3 Durability Test

The durability of cement concrete is defined as its ability to resist weathering action, chemical attack, abrasion, or any other process of deterioration. Durable concrete will retain its original form, and serviceability when exposed to its environment. When designing a concrete mix or designing a concrete structure, the exposure condition at which the concrete is supposed to withstand is to be assessed in the beginning with good judgment. The environmental pollution is increasing day by day and industrial atmospheres. It is reported that in industrially developed countries over 40 percent of total resources of the building industries are spent on repairs and maintenance. In India, the money that is spent on repair of the building is also considerable.

3.4 Water absorption test

Experimental results for Sorptivity and water absorption of concrete on specimen size of 100mm dia and 50mm thick for both types of concretes are shown graph below; The Sorptivity can be determined by the measurement of the capillary rise absorption rate on reasonably homogeneous material.

IV. CONCLUSION

The utilisation of copper slag in concrete provides additional environmental as well as technical benefits for all related industries. Partial replacement of copper slag in fine aggregate reduces the cost of making concrete. The initial and final setting time of copper slag admixed concrete is higher than control concrete. The results of compressive strength, flexural strength test have shows that the strength of concrete increases with respect to the percentage of copper slag added by the weight of fine aggregate up to 40% (CS40). Further additions of copper slag caused reduction in strength due to an increase of free water content in the mix. There was more than 15% improvement in the Compressive strength of concrete cubes with 40% (CS40) copper slag replacement for sand. There was more than 42% for M-35 and 27% for M-40 grade concrete improvement in the flexural strength of concrete beams with 40% (CS40) copper slag replacement for sand after 56 and 90 days of curing. For control mixes, travel time of ultrasonic waves in Conventional concrete mix is greater and hence pulse velocity in Conventional concrete mix is relatively less when compared to Copper slag replaced with sand 40% (CS40) mix concrete. So, Quality of CS40 mix concrete is better than Conventional concrete.

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