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A Review on "Partial Replacement of Cement and Fine Aggregate by Alternatives for Eco Friendly Concrete"

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Abstract – *Concrete is one of the most versatile building material. It can be cast to fit any structural shape from a cylindrical water storage tank to a rectangular beam or column in high rise building. In India by product and waste are being generated by various type of industries. Many researchers found that concrete made with waste and by product like fly ash, silica fume, copper slag, etc. Hence in this project copper slag and artificial aggregate are taken to investigate its suitability as partial replacement for cement and fine aggregate while making concrete.*

Key Words: Concrete, copper slag, artificial aggregate,

1.INTRODUCTION

Concrete is a composite material composed of water coarse aggregate, fine aggregate, embedded in a hard matrix of material.In the present scenario, as result of continuous growth in population rapid industrialisation and the accompanying technologies involving waste disposal, the rate of discharge of pollutant into the atmosphere, copper slag is one of the industrial waste which comes out from blast furnace during metal extraction process. The amount of concrete used worldwide, ton for ton, is twice that of steel, wood, plastic, and aluminium combined. When copper slag is introduced in concrete as a replacement material it reduced, the environmental pollution, space problem and also reduce cost of concrete. Artificial aggregate is manufactured by crushing machine by some suitable boulders and rocks. As per environmental concern are also being raised against uncontrolled extraction of natural sand. This is the situation for the construction industry today and most will agree that it will not change dramatically in the foreseeable future.

2. Literature Review

2.1 R. Citra, et al; (2017) studied, different mix proportions by replacing different percentage of ceramic powder and copper slag. From the experimental results, it was observed that compressive strength was increased about 35.80% when compared to conventional concrete. The above experimental data shows that addition of the ceramic powder and Copper slag improves the physical properties. These results are of greater importance because this kind of innovative concrete requires large amount of fine particles. In this study, the percentage of cement and percentage of fine aggregate is replaced with ceramic powder and Copper slag with different proportions. From the result it was found to be very effective in compression strength, there is an increase in compressive strength achieved by 35.80% (approx. 36%) of nominal mix (M30). it is suggested that replacement of cement and fine aggregate by ceramic powder for 20% and Copper slag for 20% is effective and can be used in the construction activities.

2.2 K Aswani, et al; (2015), performed different attempts minimize the cost of cement and sand with concrete mix grade M25 by studying the mechanical behavior of these concrete mixes by partial replacing with advanced mineral admixture such as Copper slag in concrete mixes as partial replacement of cement and sand. In this study, partial replacement of Cement and fine aggregate with Copper Slag considered. Experimental study is conducted to evaluate the workability and strength characteristics of hardened concrete, by partially replacing the cement and sand by various percentages of copper slag for M25 grade of concrete at different ages. The mixes were designed using IS Code method. In this project, properties of concrete have been assessed by partially replacing cement and sand with Copper slag is separately done in two different phase.

The cement has been replaced by Copper slag accordingly in the range of 0% (without Copper slag), 5%, 10%, 15%, and 20% is one phase and sand has been replaced by Copper slag accordingly in the range of 0% (without Copper slag), 10%, 20%, 30%, 40% and 50% is second phase by weight of cement for M25 mix. Concrete mixtures were produced, tested and compared in terms of compressive, flexural and split strength with the conventional concrete.The Compressive strength of concrete for partial replacement of fine aggregate with copper slag increased by 17.5% with 40% partial replacement and decreased by 9.02% with 50% partial replacement while compared with control Specimen. The Compressive strength for partial replacement of cement with copper slag increased by 15.4% with 15% partial replacement and decreased by 3.86% with 20% partial replacement while compared to with control specimen. The Flexural strength for partial replacement of cement with copper slag increased by 20.31% with 15% partial replacement.

2.3 M. Fadaee, et al; (2015), uses the slag of Sarcheshmeh mineral copper complex as part of cement for producing SCC and also, investigating the chemical and physical properties of slag material and mechanical properties of SCC, including its compressive strength. Therefore, the physical and chemical analyses were performed on the slag and cement. Then by making 10 cm sample cubes with different percentages of waste namely: 20%, 25%, 30%, 35% and 40% of slag, the SCC pasty phase tests such as J-Ring and V-Funnel were performed on fresh SCC and finally, to achieve the optimum mix design (the most appropriate percentage of slag material share of total cementitious materials), compressive strength tests were done on cubic samples and their mechanical properties were studied. In experimental studies, it was observed that by using 20% of Sarcheshmeh mineral complex copper slag, the 28 day compressive strength of self compacting concrete samples was almost the same as the samples without copper slag (85 percent of compressive strength of self compacting concrete without slag). The strength was obtained 510 kg/cm^2 which was above the desired final compressive strength. When the copper slag is used to replace part of the cement, self compacting concrete containing different percentages of copper slag have good performance compared to the self compacting concrete containing cement only. Replacement of copper slag instead of cement causes reduction of compressive strength for the percentages above 20% at different ages. In self compacting concrete pasty phase special tests with the use of various amounts of copper slag instead of cement, no significant changes in self compacting concrete functionality was observed.

2.4. Meenakshi Sudarvizhi **(2011),** investigated the effect of using CS and FS as partial replacement of sand. The strength characteristics of conventional concrete and slag concrete such as compressive strength, tensile strength were found .Six series of concrete mixtures were prepared with different proportions of CS and FS ranging from 0% to 100%. The test results of concrete were obtained by adding CS and FS to sand in various percentages ranging from 0%, 20%. 40%, 60%, 80% and 100%. All specimens were cured for 7, 28, 60 & 90 days before compression strength test and splitting tensile test. The results indicate that workability increases with increase in CS and FS percentage. The highest compressive strength obtained was 46MPa (for 100% replacement) and the corresponding strength for control mix was 30MPa. The integrated approach of working on safe disposal and utilization can lead to advantageous effects on the ecology and environmental also. It has been observed that up to 80% replacement, CS and FS can be effectively used as replacement for fine aggregate. Further research work is needed to explore the effect of CS+FS as fine aggregates on the durability properties of concrete.

2.5 K. S. Al Jabir (2006), carried out the study of the potential use of copper slag as fine aggregate on the strength of both normal and high strength concrete. Concrete mixtures were prepared using different proportions of copper slag as partial and full replacement of fine aggregate. The percentage of copper slag added by weight ranged between 10- 100% of sand used in concrete. For each concrete mixture, six 150mmx150mmx150mm cubes, three 300mmx150mm dia. cylinders and three 100mmx100mmx500mm prisms were cast. Density, compressive, tensile and flexural strengths were determined at 28-day of curing. Cube compressive strength was also determined at 7-day of curing. Results demonstrated that there is general an increase in the density and workability of both normal and high strength concretes as copper slag quantity increases. Also results showed that the compressive strength of concrete is generally improved, compared with the control mix, with the increase of copper slag up to a certain copper slag content beyond which the strength generally reduces. Mixes with large copper slag percentage showed signs of bleeding and segregation due to the significant increase of workability.

4. ADVANTAGES OF COPPER SLAG AND ARTIFICIAL AGGREGATE IN CONCRETE MIX DESIGN

4.1. Disposing of copper slag in environment is hazardous for the environment, so using of copper slag in construction practices will reduce the effect of copper slag on the environment.
4.2. Copper slag reduces the heat of hydration.
4.3.Due to proper grading of the artificial aggregate, the interlocking property of sand is better than the natural sand.
4.4. The porosity of artificial sand is comparatively low as compared to natural sand.

3. CONCLUSIONS

From the previous studies, it has been concluded that by using copper slag as a replacement of cement and artificial sand as a replacement of fine aggregate, the compressive strength of the mix design increases as compared to the nominal concrete and the tensile strength of the mix design also get enhanced.

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