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EXPERIMANTAL INVESTIGATION OF PARTIAL REPLACEMENT OF FINE AGGREGATE WITH COPPER SLAG AND CEMENT WITH EGGSHELL POWDER

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Abstract - *Concrete is usually expected to be stronger and more durable than within the past while being cost and energy efficient. Moreover the main advantages that concrete possesses over the development materials should be conserved. The likelihood of being fabricated practically anywhere, the power to create the shape imposed by the form of a mold and an occasional cost of components and manufacture. These factors have driven advances in improving the performance of concrete over years and still do that the need for improving the performance of concrete and concern for the environmental impact arising from the continually increasing demand for concrete has lead the growing use of different material components.*
An experimental investigation are going to be conducted to review the properties of concrete containing copper slag as a partial replacement of fine aggregates and eggshell powder by cement within the concrete mix design. Various durability tests are going to be conducted on such concrete of M25 grade to understand the compressive strength, flexural strength by varying proportions of copper slag (CS) with fine aggregates by 0%, 10%, 20%, 30%, 40% and Egg shell powder (ESP) as cement by 0%, 7%, 14%, 21%, 28% by weight. The obtained results are going to be compared with the traditional concrete, there by knowing the changes within the properties of concrete containing copper slag as a partial replacement of fine aggregates and eggshell powder by cement

Key Words: Egg shell powder, Copper slag, Waste, Compressive strength, Split Tensile strength, Flexural strength.

1. INTRODUCTION

It is a pressing need today for the concrete industry to produce concrete with lower environmental impact, these-called green concrete. This can be achieved in three ways.

The first one is by reducing the quantity of cements one tone of cement saved will save equal amount of CO_2 to be discharged into atmosphere. As Concrete is a mixture of different materials like binder (cement), fine aggregate, coarse aggregate and water. Use of concrete is very large so availability of natural material is reduced and there is no material which plays the role of this ideal material. So to fulfill the requirement of industries we have to replace fully or partially all the materials. The utilization of industrial waste or secondary materials has encouraged the production of cement and concrete in construction field. New by-products and waste materials are being generated by various industries. Dumping or disposal of waste materials causes environmental and health problems. Therefore, recycling of waste materials is a great potential in concrete industry.

Copper slag is an industrial by-product material produced from the process of manufacturing copper. For every ton of copper production, about 2.2 tons of copper slag is generated. It has been estimated that approximately 24.6 million tons of slag are generated from the world copper industry. Although copper slag is widely used in the sand blasting industry and in the manufacturing of abrasive tools, the remainder is disposed of without any further reuse or reclamation. Copper slag possesses mechanical and chemical characteristics that qualify the material to be used in concrete as a partial replacement for Portland cement or as a substitute for aggregates. For example, copper slag has a number of favorable mechanical properties for aggregate use such as excellent soundness characteristics, good abrasion resistance and good stability reported by Copper slag also exhibits pozzolanic properties since it contains low CaO. Under activation with NaOH, it can exhibit cementitious property and can be used as partial or full replacement for Portland cement. The utilization of copper slag for applications such as Portland cement replacement in concrete, or as raw material has the dual benefit of eliminating the cost of disposal and lowering the cost of the concrete. The use of copper slag in the concrete industry as a replacement for cement can have the benefit of reducing the costs of disposal and help in protecting the environment. Despite the fact that several studies have been reported on the effect of copper slag replacement on the properties of Concrete, further investigations are necessary in order to obtain a comprehensive understanding that would provide an engineering base to allow the use of copper slag in concrete.

Calcium rich egg shell is a poultry waste with chemical composition nearly same as that of limestone. Use of eggshell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, conserving natural lime and utilizing waste material. According to a study eggshell waste generation in India, the United States and the United Kingdom is 190000, 150000 and 11000 tons per annum respectively. Eggshell waste can be used as fertilizer, animal feed ingredients and other such uses. However, majority of the eggshell waste is deposited as

landfills. Eggshell waste in landfills attracts vermin due to attached membrane and causes problems associated with human health and environment

2. Concrete Mix Design

Grade	Proportion by	Cement	Sand	Grit 10mm	Kapachi 20mm
M-25	Weight	1	1.86	1.30	1.98
M-25	Volume	1	1.60	1.22	1.95

Table No. 2.1 Cement Consumption Per m^3

Sr No.	Parameters	M-25
1	Cement Consumption (Kg/m^3)	372
2	W.C. Ratio	0.50
3	Water Content, lit/cum	186
	Slump Observed, mm	60

3. Mix Combination

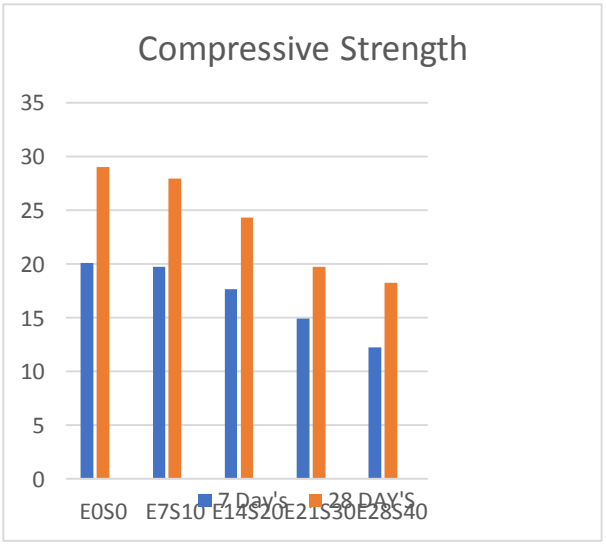
The following mix combination as per IS code 10262 – 2009 by trial and error combination are to be casted and tasted by replacing egg shell powder up to 7,14,21,28 % and replacing sand with copper slag by 10,20,30,40 % by its weight.

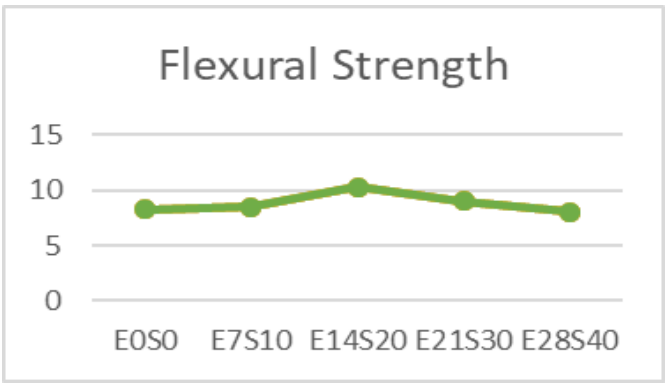
Mix combination	ESP (%)	Copper slag (%)
E0S0	0	0
E7S10	7	10
E14S20	14	20
E21S30	21	30
E28S40	28	40

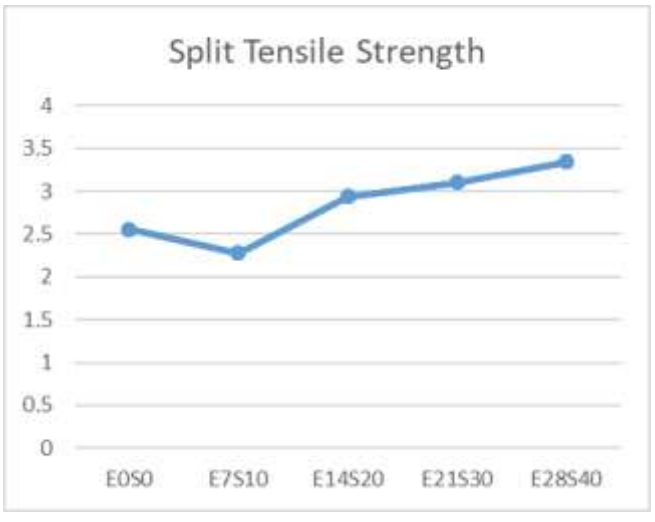
4. Test Results

The testing is been done as per I.S Specification

Name of Test	Size of Mould
Compression Test	150x150x150 mm
Splite Tensile Strength	Ht-300 & Dia-150 mm
Flexural Strength	500x100x100 mm







5. CONCLUSIONS

The following conclusions may be drawn from the results of the following research:-

1. Workable concrete can be formed with replacement of ESP and Copper Slag based concrete.
2. The workability of concrete has been found to be decrease with increasing the ESP and Copper Slag more than 14% ESP and 20% Copper Slag.
3. Maximum Flexural strength is obtained at 28 days at 14% ESP and 20% Copper Slag.
4. Maximum split tensile obtained at 28 days at 28% ESP and 40% Copper slag.
5. It has environmental benefits.
6. In mass construction where river sand is not available easily, cost of construction will reduce.

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