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EXPERIMENTAL INVESTIGATION ON EFFECTIVE REPLACEMENT OF CEMENT AND FINE AGGREGATE BY COPPER SLAG

[1]Pathlavath Balaji Naik, PG Scholar, Dept Of Structural Engineering, Geethanjali College Of Engineering And Technology, Nannur, Kurnool,

[2]M.Mujahid Ahmed, Assistant Professor, Dept Of Civil Engineering, Geethanjali College Of Engineering And Technology, Nannur, Kurnool.

Abstract:

This work reports an experimental procedure to investigate use of Copper Slag and Quarry Dust as partial replacement for Fine aggregate. The Copper Slag (CS) and Quarry dust in concrete provides environmental as well as economic benefits for all related industries. Because of the scarcity of fine aggregate for the preparation of mortar and concrete, partial replacement of Copper Slag and Quarry Dust with Fine aggregate have been attempted. Copper Slag is the by-product obtained during matte smelting and refining of Copper Slag. The strength characteristics of conventional concrete and slag replaced concrete such as compressive strength, split tensile strength and flexural strength has to be determined. In this work concrete were tested by adding Copper Slag and Quarry Dust to Fine aggregate in various percentages ranging from 0%, 10%, 20%, 30%, 40%, 50%. M40 Grade concrete specimens were cured for 7 to 28 days and to be tested for compression strength, split tensile strength and flexural strength.

Keywords: Copper slag, Quarry dust, concrete, compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

Concrete is the most popular building material in the world. However, the production of cement has diminished the limestone reserves in the world and requires a great consumption of energy. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but over use of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increase in the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably by products. Quarry dust has been proposed as an alternative to river sand that gives additional benefit to concrete. Quarry dust is known to increase the strength of concrete over concrete made with equal quantities of river sand, but it causes a reduction in the workability of concrete. Granulated copper slag (or) copper slag which is a by-product of metallurgical operations in Sterlite industries (India) Ltd., Tuticorin was used for the experimental investigation. For every tone of metal production, about 2.2 ton of waste slag is generated. Dumping or disposal of such huge quantities of slag cause environmental and space problems. During the past two decades, attempts have been made by several investigators and copper producing units all over the world to explore the possible utilization of copper slag. The physical and mechanical properties of granulated copper slag shows that it can be used to

make products like coarse and fine aggregates, cement, fill, ballast, roofing granules, glass, tiles etc. Large scale efforts are required for reducing the usage of the raw material that are present, so that large replacement is done using the various by-product materials that are available in the present day. The other material that can be used is quarry dust which is made while in the processing of the Granite stone into aggregates, this is formed as a fine dust in the crushers that process the coarse aggregates, which is used a earthwork filling material in the road formations majorly.

2. RELATED WORK

The Quarry Dust is the by-product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes. Quarry Rock Dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Quarry dust is fine rock particles. When boulders are broken into small pieces quarry dust is formed. It is gray in color and it is like fine aggregate. Quarry dusts are produced during the extraction and processing of aggregates. The utilization of quarry fines is seen as a way to minimize the accumulation of unwanted material and at the same time to maximize resource use and efficiency. Natural resources are depleting worldwide while at the same time the generated wastes from the industry are increasing substantially. The sustainable development for construction involves the use of nonconventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways to conserve the environment. Due to the recent researches in the field of concrete technology it is possible to utilize industrial byproducts as well as other waste materials in the production of normal concrete and high strength concrete as partial or full replacement of cement or aggregate. Also, it has been demonstrated that many of the produced concrete made with wasteland industrial resources possesses superior properties compared with the conventional concrete in terms of strength, performance and durability.

3. LITERATURE SURVEY

Shruthi.H et al, found the replacement of cement with SBA at 5, 10, 15 and 20% for M25 grade concrete with water to cement ratio of 0.5 Up to 10% of the compressive strength, split tensile strength and flexural strengths increase and beyond that, strength was found to decrease.

Lavanya.R et al, found the Experimental study on the compressive strength of concrete by partial replacement of cement with SBA as a partially replaced for up to 30% of cement with varying w/c ratio of 0.35, O.4, 0.45.The found to maximum strength properties increase at 15% with 0.35 w/c ratio.

Brindha.D et al, found the Utilization of copper slag as a partial replacement of fine aggregate in concrete of Copper slag at 5, 10, 15, 20, 30, 40 and 50% for M25 grade concrete. Up to 40% of the compressive strength, split tensile strength and flexural strengths increase.

Deepak.R et al, foud the Experimental study on flexural behavior of reinforced concrete beams by replacing fine aggregate with Copper slag replace at 35, 40 and 45% and concrete mix of M30.The optimum level of replacement of copper slag was found to be 40%.

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4. IMPLEMENTATION

It is important that the constituent material of concrete remain uniformly distributed within the concrete mass during the various stages of handling and that full compaction is achieved, and making sure that the characteristics of concrete which affect full compaction like consistency, mobility and compatibility are in conformity with relevant codes of practice. The tests were carried out in accordance with relevant IS Standards. The aggregates were tested for physical properties such as specific gravity and particle distribution test.

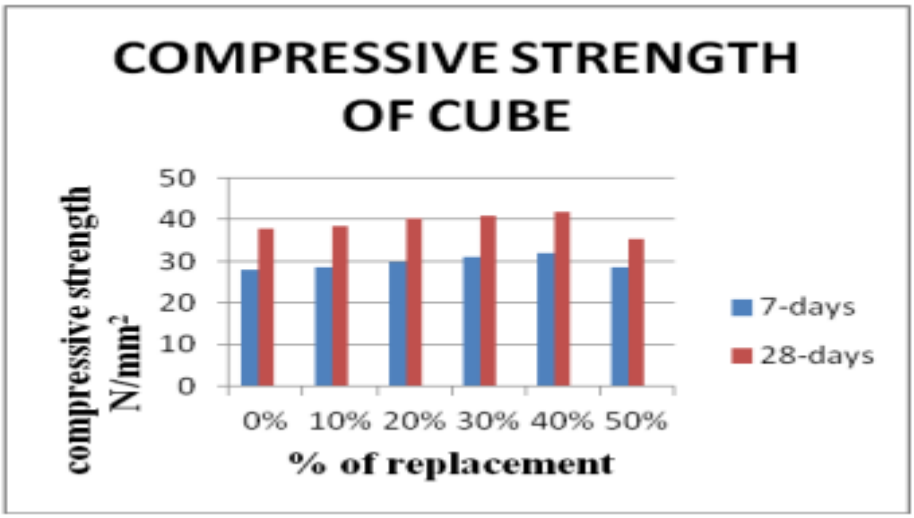

Fig.1.Implementation

All the mixes were prepared by mixing the concrete in laboratory mixer with water. For compressive strength 72 NOS cube specimens of size 150 mm x 150 mm x 150 mm, for flexural strength studies, 72 NOS prism specimens of size 100 mm x 100 mm x 500 mm and 72 NOS cylinder specimens of size 300 mm height and 150 mm diameter for split tensile strength studies were prepared. For durability properties specimens were cast and cured for 28 days as per standard curing methods. The water used to make concrete must be clean and free from organic matter. Water acceptable for drinking is preferable for making concrete. Salt water may be used if fresh water is not readily available, but it will reduce the strength of concrete by about 15 percent. Enough water is needed for the hydration reaction too much water leads to a reduction in strength. Hence only the quantity of water needed is to be added. During the current research, cement was replaced with SBA.

5. ANALYSIS

There will be significant reduction in the cost of concrete if phosphogypsum is added to it. The scarcity of cement and its increased cost are serious problems faced by construction industry. Use of phosphogypsum in concrete will be an appropriate solution to these problems. The stack of phosphogypsum dumped by the fertilizer plants is a serious waste disposal problem. Effective utilization of phosphogypsum in concrete reduces the intensity of problems caused by its dumping. Thus phosphogypsum which is a by-

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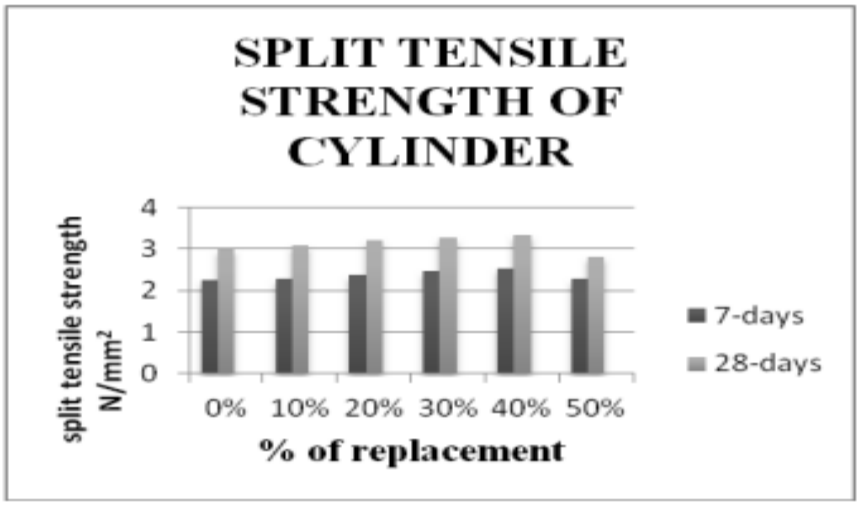

Fig.2.Spilit Tensile

The important parameters of coarse aggregate that influence the performance of concrete are its shape, texture and the maximum size. Since the aggregate is generally stronger than the paste, its strength is not a major factor for normal strength concrete. From the sieve analysis if is found that aggregates are confirming to single sized aggregates of nominal size 20mm.product of fertilizer plant and chemical industries can be effectively utilized by partial replacement of cement in concrete with phosphogypsum. This method is surely a step toward sustainable development and is important in engineering, environmental and economic point of view.

CONCLUSION

The stack of phosphogypsum dumped by the fertilizer plants is a serious waste disposal problem. Effective utilization of phosphogypsum in concrete reduces the intensity of problems caused by its dumping. Thus phosphogypsum which is a by-product of fertilizer plant and chemical industries can be effectively utilized by partial replacement of cement in concrete with phosphogypsum. This method is surely a step toward sustainable development and is important in engineering, environmental and economic point of view.

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