An Experimental View on Effects on Workability of Glass Fiber Reinforced Concrete by Partial Replacement of Cement and Sand With Industrial By- Products

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Abstract

Silica fume as partial replacement with cement as 15% and 30% where sand is replaced with Pond ash by 10% and 20%. I will prepare cubes, cylinders and finally slump test, compressive strength test, splitting tensile strength test and flexible test will be conducted to obtain the necessary results. A large number of trial mixes are required to select the desired optimum replacement of cement and sand by silica fume and pond ash.

Keywords— *Glass fiber reinforcement, workability , cement , sand*

I. INTRODUCTION

India depends upon primarily on coal for the requirement of power and its power generation is likely to go up from 1, 12, 090 MW to 2, 12,000 MW in the year 2012. The pond ash generation in Indian Thermal Stations is likely to shoot up to 200 million tones in 2012from the present level of 120 million tonnes. The current annual production of coal ash worldwide is estimated around 600 million tonnes. Hence worldwide research work was focused to find alternative use of this waste material and it use in concrete industry is one of the effective methods of utilization. Increase in demand and decrease in natural resource of fine aggregate for the production of concrete has resulted in the need of identifying a new source of fine aggregate. Most of the peoples of Chhattisgarh state are tribal, suffering from housing storage, resulting from population growth. In rural areas, houses should be built as economical as possible and at the same time should be durable and functional. Hence, it has become necessary to seek for structural building elements, which have the structural phenomena of prefabricated elements in terms of ease of handling, light, minimum maintenance and low cost. It is with these in mind, elements of structural system are made from fiber reinforced concrete with Silica Fume and Pond Ash. The cement industry consumes a significant amount of natural resources and energy. The use of alternative cementitious materials like pond ash can decrease the environmental impact of wastes, decreases CO_2 emissions, reduce waste handling costs and save money for the cement industry. Also extraction of sand from different river beds of Chhattisgarh state is unlimited due to high rate of construction. Therefore the scarcity of sand increases day by day and its price reaches to sky. Also there is certain limit to extract sand from river bed is decided by Govt. It is found that pond ash, silica fume, slag and rice husk ashes, which are industrial waste products, were possessing cementitious properties due to presence of siliceous materials. In this project cement are replaced with silica fume up to 60% and sands are replaced with pond ash up to 20%. Pond ash is available in free of cost. So it becomes very economical.
The following are the main objects of our project

a) To understand the workability of glass fiber reinforced concrete with silica fume and pond ash in local condition.
b) Increasing of life structure by addition of fiber in concrete.
c) Saving of cement and sand by using silica fume and pond ash.

II. MATERIAL AND METHODOLOGY

Present study is an attempt to investigate experimentally the effect of replacement of cement with silica fume and sand with pond ash taking constant volume fraction of glass fibre (i.e. 0.05%). Ten sets of mixture proportions were made. First was control mix (without pond ash, silica fume and fibre) i.e. concreteM45, and other nine mixes of concrete contained silica fume, glass fibre and pond ash obtained from BSP, Bhilai. The proportion of binder to aggregate mortar with ratio 1:3. Use of silica fume as partial replacement with cement as 15% and 30% where sand is replaced with pond ash by 10% and 20%. The details

of material used in project are given below. The total ten mixes are denoted in the form of C_{x-y}, $F_{x-y}$where C denotes control concrete mix and F denotes the Fiber reinforced concrete mix, first suffix 'x' denotes the percentage of replacement of cement with silica fume and second suffix 'y' denotes the percentage of replacement of sand with pond ash.

a) Cement: Locally available ordinary Portland cement (OPC) 43 grade is used in the present investigation. This cement satisfied nearly all requirements of the IS 12269-1987.
b) Sand: Locally available sand from Mahanadi River is used as a fine aggregate. Sieve analysis of fine aggregate is carried out in the laboratory as per IS 383 and tested as per IS 2386.
c) Coarse aggregate: Locally available crushed coarse aggregate of size 10 mm is used. Sieve analysis of the coarse aggregate is carried out in the laboratory as per IS 383 and tested as per IS 2386
d) Water: According to IS 3025 water used for mixing and curing are free from injurious or deleterious materials. Potable water is generally considered satisfactory. In the present investigation, tap water is used for mixing and curing purpose.
e) Fiber: Glass fibers with constant volume of fraction i.e. 0.05% of total volume are used in the present investigation.

The objective of the research is to investigate the workability of new eco-friendly engineered cement composites like slump value, compaction factor by replacing cement and sand partially with silica fume and pond ash. The above three tests of workability's are carried and tabulated in previous chapter. From Table-3.1 it is seen that the slump value of composites are very less. When the sand replacement material increases slump value gradually decreases. This phenomenon happens due to water demanding of pond ash. High volume of sand absorbs water on its surface; hence the slump cone material does not subside with higher percentage. The lower value slump indicates the harassment of material. Figure-4.1 indicates the slump value of different mixes of new fiber reinforced concrete. As the silica fume increases, the lubrication action in between the particles of composite accelerates. Replacement 30% fly ash with cement gives higher value of slump as well as percentage of flow as shown in Figure 4.1 and 4.3. Similarly greater value of compaction factor is obtained for control volume. As the percentage of cement and sand replacement material increases the compaction factor decreases gradually. The weight density of sand is more than the weight density of fly ash and pond ash. Therefore the partial compaction of sand due to freely falling of its own weight is more than the partial compaction values of fly ash and pond ash. The numerator value of compaction factor is more for control volume results the highest value of compaction factor. Silica fume does not affect the compaction factor seriously, but the replacement of pond ash decreases the compaction factor. As the pond ash replaced 20% the compaction factor gives lower value.

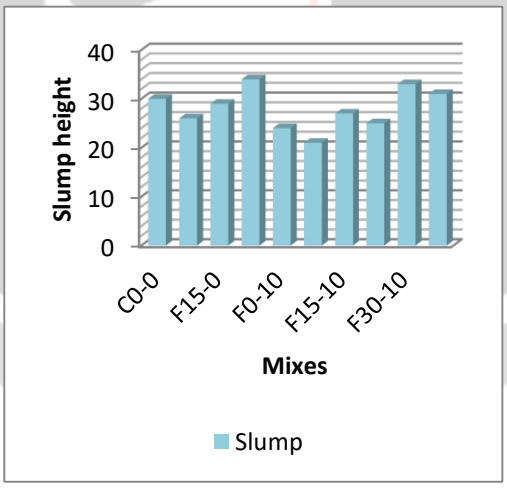

Figure-4.1: Test Results of Slump Value for Different Mixes

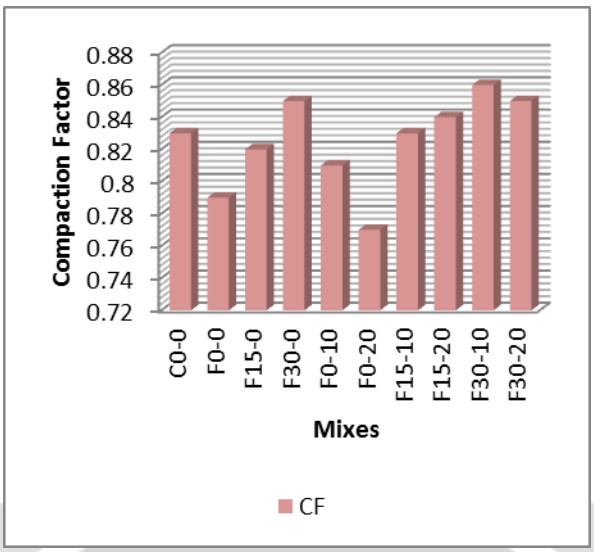

Figure-4.2: Test Results of Compaction Factor for Different Mixes

III. CONCLUSION

(i)

1. The fly ash and pond ash act as best sustainable material in Engineered Cement Concrete.
2. Fly ash increases the workability of concrete. As the percentage of replacement of cement with fly ash increases, the slump cone value and the percentage flow increases correspondingly.
3. Replacement of sand with pond ash demands water more in concrete. As the percentage of pond ash increases, the slump value and percentage of flow decreases gradually. It also decreases the compaction factor value.
4. For workability point of view the percentage of fly ash may increase above 60% but the percentage of pond ash should not be increase more than 20%. Beyond the 20% replacement of sand with pond ash makes the concrete harsh.
5. So it is the better option to replace cement and sand should be replaced simultaneously. The water demand due to addition of pond ash may counter balance with the addition of fly ash.
6. The surface area of glass fiber is more. Therefore it also absorbs more water on its surface than other fiber, which hampers on workability. So ECC will act as best in lower volume of fraction of glass fiber.
7. The other disadvantage of glass fiber is mixing process with dry materials of concrete. It requires separating small fibers from the fiber lumps. The spinning action of glass fiber takes more time to prepare the concrete. It also does not mix homogeneously in concrete.
8. As the amount of sand is more in Engineered Cement Concrete, it requires more cement. Therefore ECC is an expensive material. So it is suggested to replace cement and sand with fly ash and pond ash partially solves the problem of sustainability and makes the concrete economic.

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