Mechanical Properties of Polymer Fly Ash Concrete and Silica Fume

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Abstract : In this present paper the experiments for mechanical properties such as compressive strength and split tensile strength of polymer concrete with constant proportion of fly ash and varying percentage of epoxy and silica fume was studied. The result shows that the concrete with 9.5% of epoxy and 10% of silica fume showed better strength when compared with other mixes.

Key words : Epoxy, Fly Ash, Silica fume and mechanical properties

I. INTRODUCTION

Concrete is the most widely used man made construction material. It is obtained by mixing of cement, water, fine & coarse aggregate in required proportions. Concrete construction is generally expected to give trouble free services throughout its intend design life. However, these expectation are not realized in many constructions structural deficiency, material deterioration, unanticipated overloading of physical damage, cyclic temperature variations, chemical attack due to environmental etc., The strength, durability and other characteristics of concrete are depends on the proportion of mix, the method of compaction and other controls during placing, compaction and curing. Kou Shi-Cong et al (2013), A novel polymer concrete (PC) was synthesized by mixing epoxy resins and waste glass as aggregates. In this study, metakaolin (MK) and fly ash (FA) were used as filler and compositions with 0%, 10% and 15% by weight of recycled glass sand (<2.36 mm) were prepared to investigate the mechanical properties of the PC. In this study the resin content 13% by weight of cement. The results indicated that all compositions assessed in this study display high strength and modulus of elasticity values. MK and FA have a significant effect on the compressive strength, the flexural strength and the modulus of elasticity of the PC. Ali Reza Bagheri et al (2012) In this study, the effect of incorporation of silica fume in enhancing strength development rate and durability characteristics of binary concretes containing a low reactivity slag has been investigated. Binary concretes studied included mixes containing slag at cement replacement levels of 15%, 30% and 50% and mixes containing silica fume at cement replacement levels of 2.5%, 5%, 7.5% and 10%. Ternary concretes included combinations of silica fume and slag at various cement replacement levels. The results show that simultaneous use of silica fume has only a moderate effect in improving the slow rate of strength gain of binary mixes containing low reactivity slag. Using appropriate combination of low reactivity slag and silica fume, it is possible to obtain ternary mixes with 28 day strength comparable to the control mix and improve durability particularly in the long term. Ternary mixes also have the added advantage of reduced water demand. A.A.Ramezanianpour et al (2012) this paper presents the influence of metakaolin as supplementary cementing material on strength and durability of concrete. Local kaolin with high kaolinite content was thermally treated by a special furnace at 800˚C and 60 min burning time to produce metakaolin. This study investigates the performance of concrete mixtures containing local metakaolin in terms of compressive strength, water penetration, sorptivity at 7, 28, 90 and 180 days. The percentages of metakaolin that replace PC in this research are 0%, 10%, 12.5% and 15% by mass. The results show that concrete incorporating metakaolin had higher compressive strength and metakaolin enhanced the durability of concretes and reduced the chloride diffusion. The replacement rate of 15% gives the best result when compared to other results. W.P. Lokuge et al (2010), In this experimental program, two types of resins (vinyl ester and epoxy resin) combined with fly ash and sand were used to make polymer concrete mortar. The effect of resin (binder), and fly ash contents on the compressive strength, flexural strength, split tensile strength and modulus of elasticity of vinylester and epoxy resin based polymer filler is reported. It has been found that epoxy resin based polymer concrete and vinylester based polymer concrete can achieve compressive strengths of 75MPa and 113MPa respectively. Vinylester polymer concrete showed 4% ultimate strain, while that for epoxy polymer concrete was 8%. Tensile strengths were as high as 15MPa for both types of polymer concrete. It was found that the optimum polymer content varied from 12 to 13%.

II. MATERIALS

For concrete mix, ordinary Portland cement of 53 grade has been used. Grade depends on the strength of cement at 28 days. Fly ash is the most extensively used by product materials in the construction field resembling Portland cement. It is an inorganic, noncombustible, finely divided residue collected or precipitated from the exhaust gases of any industrial furnace. Most of the fly ash particles are solid spheres and some particles are hollow, called ceneospheres. Plerospheres are particles which contain smaller spheres inside. Silica fume is a very fine non-crystalline silica, produced in electric arc furnaces as a by product of the production of elemental silicon or alloys containing silica. It is also known as condensed silica or microsilica. Epoxy Resin, is the resin was the main binding material for the polymer concrete and was required to be mixed with a catalyst. The purpose of incorporating the catalyst was to chemically start the curing process of the resin and hence harden the mix into a polymer concrete. Concrete can be considered as two phase materials for convenience, paste phase and aggregate phase.

A. Mix proportion

The concrete proportion of 1:1.32:2.83 is used as reference mix. The following table shows the mix proportion in percentage.

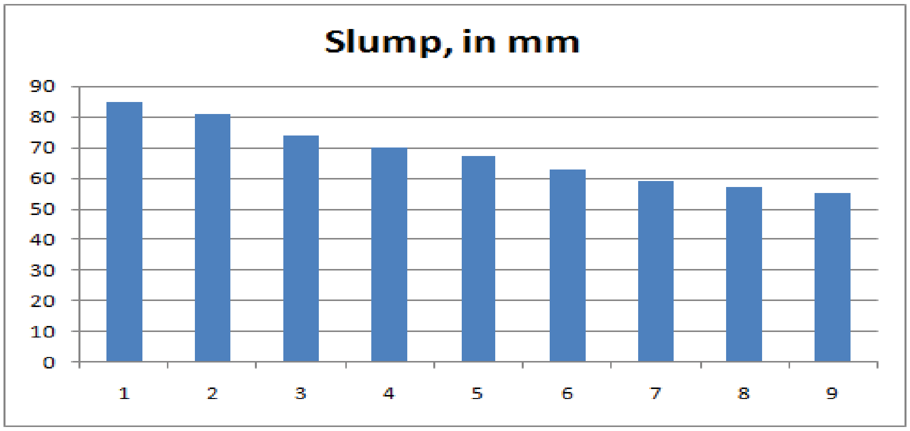
Mix	Cement (%)	Epoxy Resin (%)	Fly Ash (%)	Silica fume (%)
Referrance	100	0	0	0
M1	60.0	-	25	10
M2	60.0	-	25	7.5
M3	60.0	-	25	5
M4	52.0	8	25	10
M5	52.0	8	25	7.5
M6	52.0	8	25	5
M7	50.5	9.5	25	10
M8	50.5	9.5	25	7.5
M9	50.5	9.5	25	5

In this experiments the cement is replaced with 25% of fly ash constantly and three different proportion of silica fume in concrete (5, 7.5, 10) percentages for cement simultaneously with epoxy of (0, 8.0, 9.5) percentages for cement simultaneously respectively.

III. RESULTS AND DISCUSSION

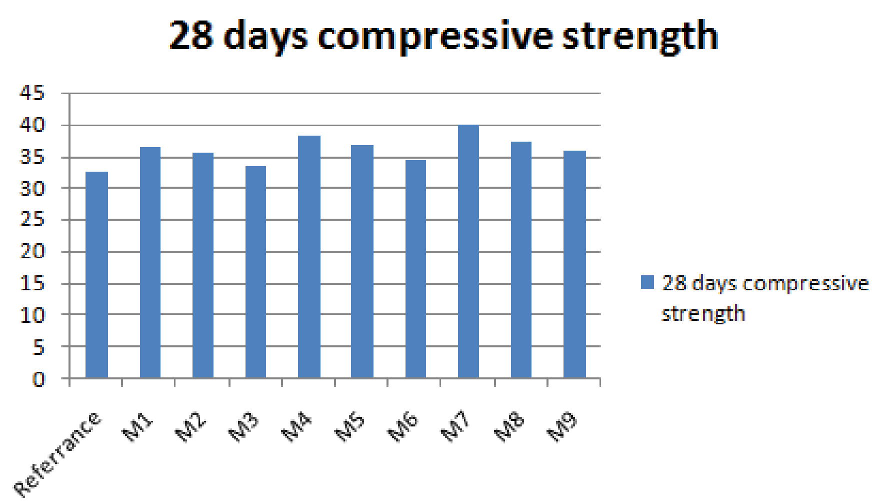
A. Slump test

The workability of concrete mix reduces from 85mm to 55 mm as shown in the graph above. Due to varying increase in epoxy with higher silica fume content.



B Compressive strength

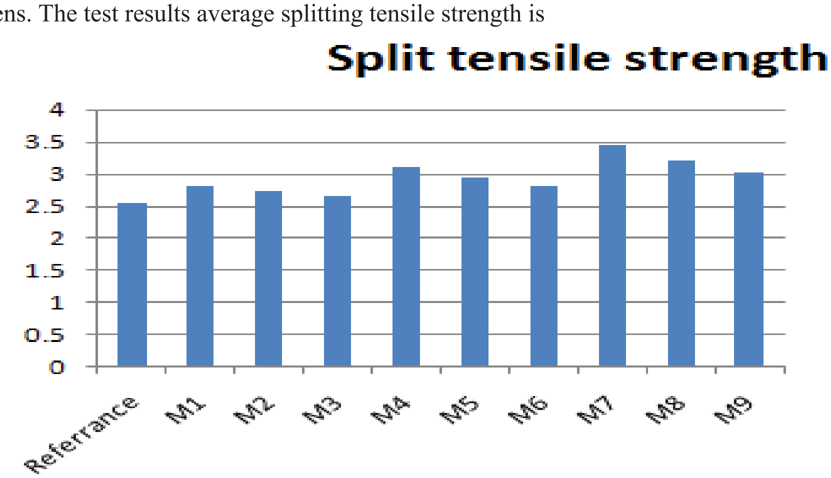
The cube compressive strength according to IS 516 was conducted for 150mm. The test results average compressive strength is



The above given graph shows the 28days cured cube compressive strength. From the test results it is found that the compressive strength increases due to increase in silica fume and also with epoxy simultaneously.

C. Split Tensile Test

The cylinder split tensile strength according to IS 516 was conducted for 150mm diameter and 300mm height specimens. The test results average splitting tensile strength is



The above given graph shows the 28days cured cylinder split tensile strength. From the test results it is found that the split tensile strength increases due to increase in silica fume and also with epoxy simultaneously.

IV. CONCLUSION

It was found that the concrete mix M7 with 9.5% of epoxy and 10% of silica fume shows higher compressive strength and splitting tensile strength when compared with reference mix. And all other mixes when compared with reference mix is higher. It is concluded that the replacement of cement with epoxy and silica fume will increase the strength.

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