The Experimental Study of Strength Properties of Polymer Concrete by using Manufactured Sand

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Abstract— This project deals with study of strength of polymer concrete by using manufactured sand. These studies involved high strength concrete HSC, were highly dependent on the quality of ingredient– materials. The objectives of this study were to reduce the production cost, time required and to improve HSC properties by providing control mixes and using Orthophthalic polyester resin as partial cement replacement. This was done by experimentally investigating the HSC production using 8%, 10% and 12% replacement of cement by Orthophthalic polyester resin and selecting the optimum replacement content. Orthophthalic polyester resin additions further improved the workability. The concrete specimens were subjected to different tests such as compressive strength test, flexure strength test.

Keywords: Normal Concrete, Polymer concrete, Orthophthalic polyester resin, compressive strength and flexural strength

I. INTRODUCTION

This paper presents the effect of different polymers on structural and mechanical properties of concrete. The aim of this study is to investigate the mechanical and flexural properties of polymer modified concrete. It is the mixture of orthophthalic polyester resin, manufactured sand, fly ash and coarse aggregate. In this project experimentation has been done to improve the quality of concrete by replacing cement and water by **"**UNSATURATED ORTHOPHTHALIC POLYESTER RESIN**"** as a POLYMER.

II. POLYMER CONCRETE

Polymer concrete (PC) is a composite material formed by combining mineral aggregates such as sand or gravel with a monomer. Due to its rapid setting, high strength properties and ability to withstand a corrosive environment, PC is increasingly being used as an alternate to cement concrete in many applications, construction and repair of structures, highway pavements, bridge decks, waste water pipes and even structural and decorative construction panels. PC is produced by using dry aggregates and monomers (binders) which undergo polymerization (hardening) after the addition of additives, catalysts and accelerators. Its composition will depend on its intended application. Polyester Resin is a type of polymer concrete. And polyester resin can be further devided into two types orthophthalic (ortho) and isophthalic(iso).

III. SCOPE OF POLYMER CONCRETE

- High tensile, flexural and compressive strength.
- Rapid curing at ambient temperature.
- Good adhesion property.
- Good durability and faster in hardening.
- Good resistance against corrosion.
- May be used in wood or steel formwork.

IV. OBJECTIVE OF THE PROJECT

- The main objective to analyze the mechanical properties of polymer concrete by using orthophthalic polyester resin and manufacture sand.
- Investigations on the effect of varying percentage of polymer content on compression, flexural capacity of polymer concrete.
- To study the behavior of polymer concrete and its constituent material.
- To compare the conventional concrete to polymer concrete by its mechanical properties as well cost.

V. METHODOLOGY

1) Estimating quantity of Orthophthalic polyester resin, manufactured sand, fly ash and aggregate required for preparing one block.
2) Casting of cube size(15cmx15cmx15cm) with orthophthalic polyester resin in proportion 8%, 10%, 12%. replace by cement for compressive strength test.
3) Casting of beam size (50cmx10cmx10cm) with orthophthalic polyester resin in proportion 8%, 10%, 12%. replace by cement for flexural strength test.
4) cube specimen are tested for compressive strength test and beam specimens are tested for flexural strength test.

VI. MIX PROPORTION FOR M20 GRADE CONCRETE

Water	Cement	Sand(fine aggregate)	Coarse Aggregate
154 kg/m^3	385 kg/m^3	633.13 kg/m^3	1136.85 kg/m^3
0.4	1	1.64	5.29

Table 1: Compressive Strength

VII. TESTING

A. Compressive Strength Test:

The compression strength test is conducted on a specimen of size 15cmx15cmx15cm concrete cube for 8%, 10%, 12% ortho. Resin of total volume and the test result can be compared with that of nominal concrete cube 28 days curing respectively. Specimens 1 day after casting and then cured in open air until testing was carried out at 1 , 3 and 7 days' age. Three specimens of each mixture were tested and the mean value was reported.

Fig. 1: Compression test on concrete

B. Flexure Strength Test:

The flexural strength was determined at 7 days on beams of size 150 x 150 x 700 mm are cured in air. Three specimens of each mixture were tested and the mean value was reported. The performance of the polymer concrete increases as the polymer dosage increases from 8% to 12%.

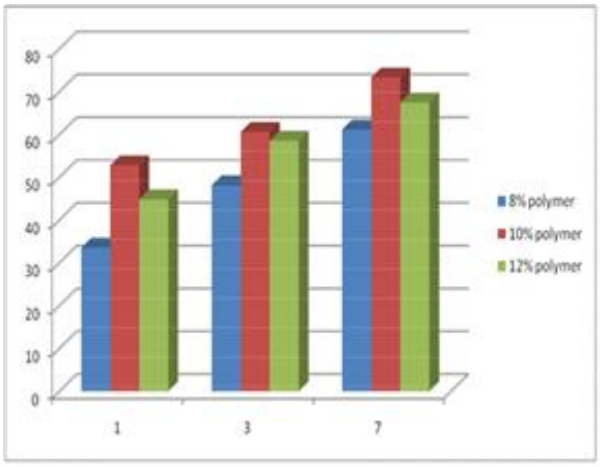
Fig. 2: Flexural test on concrete

VIII. RESULTS

A. Compressive Strength Test:

Age in Days	Compressive strength in (MPa)		
	8% polymer	10% polymer	12% polymer
1	33.53	52.77	44.81
3	48.12	60.60	58.53
7	61.17	73.32	67.42

Table 2: Compressive Strength

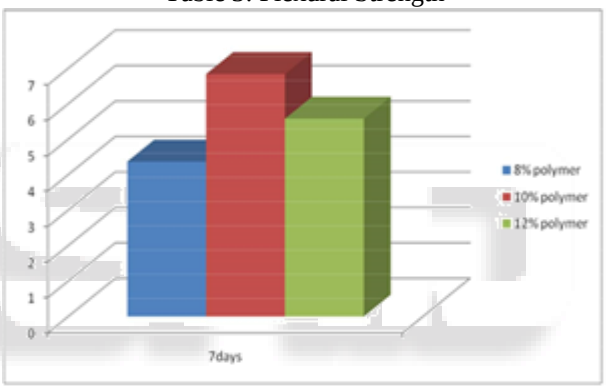


Graph 1: Compressive strength

B. Flexure Strength Test:

Age in Days	Flexural strength in (N/mm^2)		
	8% polymer	10% polymer	12% polymer
7 days	4.37	6.84	5.58

Table 3: Flexural Strength



Graph 2: Flexural Strength

IX. CONCLUSION

1) Polymer concrete does not required special type of curing; air curing is enough.
2) Proper precautions 3 are to be taken while handling the polymer, accelerator and hardener.
3) Polymer concrete is costlier than conventional concrete but setting time is less i.e. 24 hours.
4) Due to hard hardening properties it is useful in highway, bridge, runways, column repairs.
5) Polymer concrete is good water repellent.
6) The compressive strength acquired by conventional concrete in 28 days is acquired by polymer concrete in only 1 day i.e. 24 hrs.
7) The tensile strength obtained by polymer concrete in 7 days is greater than the tensile strength obtained by conventional concrete in 28 days.

REFERENCES

[1] Mandel, J. A. and Said, S. (1990), Effect of the addition of an acrylic polymer on the mechanical properties of mortar, ACI Materials journal, 87(1), 5461.

[2] Kim, J.H., Robertson, R. E. and Naaman, A. E.(1995), Structure and properties of poly (vinyl alcohol)modified mortar and concrete, Journal of Cement and Concrete research, 29, 407415.
[3] Aggarwal, L. K., Thapliyal, P.C. and Karade, S. R.(2007), Properties of Polymer modified mortars using epoxy and acrylic emulsion, Journal of Construction and Building Materials, 21(2), 379383.
[4] Muthukumar, M. and Mohan D.(2005), Studies on furan polymer concrete, Journal of Polymer Research, 12, 231–241.
[5] Joshua, B.K.(1997),Polymer modified concrete: Review, Journal of materials in Civil Engineering, ASCE,8592.
[6] ACI Committee 211, 1993, _Guide for Selecting Proportions for High Strength Concrete with Portland Cement and Orthophthalic polyester resin ', ACI 211, 4R-93, ACI Materials Journal, Vol.90, No. 3, pp. 272-283.
[7] Mehta, P.K, and R.W.Burrows, 2001, "Building Durable Structures in the 21st Century." Concrete International 23(3), pp. 57-63.
[8] Vengata G. K.B., 2009, _High volume Orthophthalic polyester resin concrete for pavements', M.E. Dissertation, Department of Civil Engineering, Anna University, Chennai, India.
[9] Adams, T. H., 1988, "Marketing of Orthophthalic polyester resin concrete", MSU seminar: Orthophthalic polyester resin applications to concrete (January), 1.10, 5.10, East Lansing: Michigan State University.

