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Mechanical Properties of Hybrid Fiber Reinforced Polymer Mortar

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Abstract-The paper is about the experiment to investigate the mechanical properties such as compressive strength ,tensile strength of hybrid fiber reinforced polymer concrete with constant proportion of fly ash ,sand and varying combination of fibers such as micro steel, AR Glass fiber and chopped carbon with 0.5% of fibers added to the mortars.

Index terms-mechanical properties, polyester resin.

1. INTRODUCTION

A Fiber Reinforced Polymer (FRP) composite is defined as a polymer (plastic) matrix, either thermo set or thermoplastic, that is reinforced with a fiber or other reinforcing material with a sufficient aspect ratio to provide a discernable reinforcing function in one or more directions. This paper includes fly ash, sand and polyester with different fibers (single and hybrid).

Table 1- Abbreviation for the specimen names.

Specimen names	Abbreviation
CC	Control concrete
PF	Polyester resin + sand + fly ash
PFS	Polyester resin + sand + fly ash + micro steel fiber
PFC	Polyester resin + sand + fly ash+ carbon fiber
PFG	Polyester resin + sand + fly ash + glass fiber
PFSC	Polyester resin + sand + fly ash + micro steel & carbon fiber
PFCG	Polyester resin + sand + fly ash + carbon & glass fiber
PFGS	Polyester resin + sand + fly ash + glass & micro steel fiber

2. MATERIALS USED

2.1 Fly ash

Class F fly ash, pozzolanic in nature, and contains less than 20% lime (Cao) is used as filler material.

2.2 Aggregate

The sand is used as fine aggregate and it is collected from nearby area. The sand has been sieved in 2.36 mm and used.

2.3 Polyester resin

Polyester resin are low cost, low viscosity, good work ability resin and catalyst used is methyl ethyl ketone peroxide [MEKP] and promoters used is Cobalt Octate [CO]. Methyl ethyl ketone peroxide is added with 2% of resin and Cobalt octate is added with 1% of resin.

2.4 Fibers

Fiber used as a reinforcement material.

2.4.1 AR glass fiber:

The length of the fiber is 13 mm and width is 0.5µm and it was collected from Chennai.

2.4.2 Carbon fiber:

The length of the carbon fiber is 6 mm and width is 0.5µm and it was collected from Gujarat.

2.5.3 Micro-steel fiber:

The length of the steel fiber is 8mm and width is 0.5µm and it was collected from Chennai.

3. SPECIMEN PREPERATION AND CURING

The mix contains resin, filler and fine aggregate. The mix proportion by weight of the resin mortar consisting of binder, filler and aggregate was 1:1:4.This ratio was adopted according to "Japanese Industrial Standard method of making polymer resin concrete" JIS-A1181.The moulds also prepared as per Japanese code. The size of the cube is 40mm x 40mm x 40 mm, dog bone is symmetrical I-section with web 80 x 20 mm and flange 100 x 20 with thickness of 40 mm. All specimens are going to cured by air for the period of 3,7,28 days.

Table 2 Materials volume required for specimens for preparing cube and dog bone shape for 3, 7 and 28 days

MATERIALS	VOLUME(g)
Fly ash	2849
Sand	11354
Resin	2849
MEKP (2%)	43.4
CO (1%)	29.4
Micro steel fiber	150.5
AR glass fiber	150.5
Carbon fiber	150.5

4. TESTING:

Three cubes and dog bone were cast to find out the compressive and tensile strength of the specimen. The test was conducted in Universal Testing Machine for 3, 7 & 28 days.

5. DISCUSSION ON RESULTS

5.1 Compressive strength

The table 3 shows the compressive strength of 3, 7 & 28 days with different fibers.

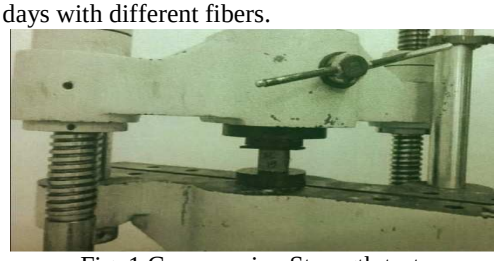
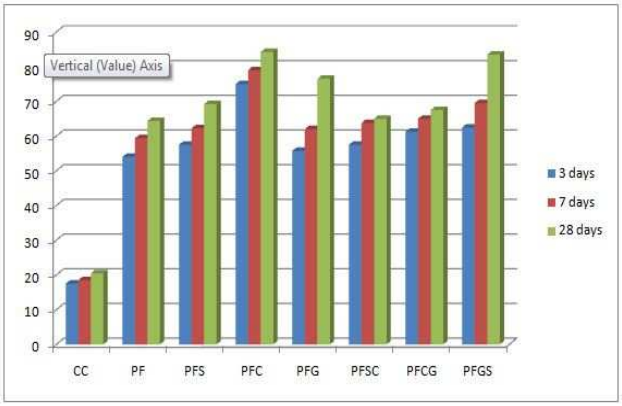


Fig. 1 Compressive Strength test

Table 3 Compressive strength result (N\mm2)

Specimen	3 days	7 days	28 days
CC	17.5	18.5	20.5
PF	54	59.38	64.38
PFS	57.5	62.25	69.25
PFC	75	79	84.25
PFG	55.75	62	76.5
PFSC	57.5	63.75	65
PFCG	61.25	65	67.54
PFGS	62.5	69.5	83.5



COMPRESSIVE STRENGTH

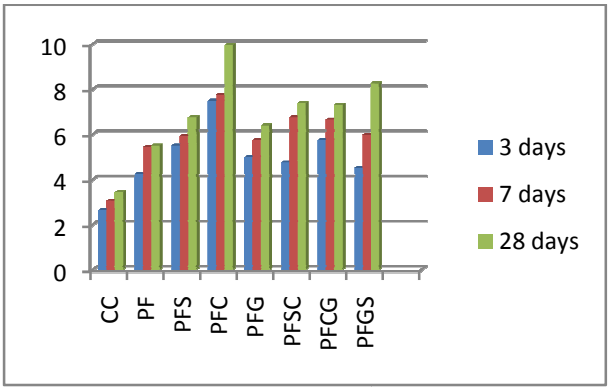
5.2 Tensile strength

The table 4 shows the tensile strength of 3, 7 & 28 days with different fibers.

Fig. 2 Tensile strength test

Table 4 Tensile strength results (N\mm^2)

Specimen	3 days	7 days	28 days
CC	2.63	3.06	3.44
PF	4.25	5.44	5.50
PFS	5.50	5.94	6.75
PFC	7.50	7.75	9.95
PFG	5	5.75	6.4
PFSC	4.75	6.75	7.38
PFCG	5.75	6.65	7.3
PFGS	4.50	5.98	8.25



TENSILE STRENGTH

8. CONCLUSION

From the present study following conclusion can be drawn

- The compressive strength of PFC for 28 days increased up to 310% for CC and increased up to 31% for PF.
- The tensile strength of PFC for 28 days increased up to 189% CC and increased up to 81% for PF.

Acknowledgement

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