A STUDY ON EFFECT OF ACID ATTACK ON STRENGTH AND DURABILITY OF FRFC WITH PARTIAL REPLACEMENT OF CEMENT WITH MARBLE DUST

Mr. Rohit Chouhan, Er. Mahendra Saini

1Student, M. Tech, 2Assistant Professor,
Dept. of Civil Engineering, Kautilya institute of Technology and Engineering, Jaipur, Rajasthan, India

Abstract: Concrete is the base of any construction, without concrete no construction could ever exist. Concrete consists of Cement, Sand (Fine Aggregate), Gravels (Coarse Aggregate), Water, Admixtures, Additives. In this study partial replacement of cement is done by Marble Dust in certain percentage (10%) replacement and with addition of various percentages of polypropylene fiber (0%, 0.5%, 1%, 1.5% & 2%) in concrete.

I. INTRODUCTION

Since the plain, unreinforced concrete is a brittle material, with a small tensile strength and a small strain capacity. Sometimes concrete structures have to survive in adverse conditions under chemical attacks like chloride attack, sulphate attack and acid attack. These chemical attacks affect the durability of concrete structure. For hardened reinforced concrete chloride attack is considered as a cause for corrosion. Chemicals percolate through the cracks developed in the concrete structures and corrode the reinforcement provided in the concrete and thus the deterioration of structure starts and the durability of structure get affected. The use of fibres in concrete is from ancient times, to increase the tensile strength and flexure strength of concrete various researchers investigate the effect of fibres on various possessions of concrete. Since then Fibres such as steel, glass, carbon and polypropylene are use in concrete. Addition of fibre in concrete also influences its brittle behaviour and ductility.

1.1 Polypropylene Fibre

Polypropylene Fibre is a thermoplastic polymer due to its thermoplastic nature it contribute in adhesive forces which hold the concrete mix together thus reduce the rate of bleeding, plastic shrinkage and crack. The function of randomly dispersed fibers is to bridge crossways the cracks that provides around post cracking ductility. If the fibers like polypropylene fibers which are strong enough and perfectly bonded to the material, permits the FRC to carry noteworthy stresses in excess of a relatively large strain capacity in post cracking state. Different types of polypropylene fibers can be castoff to reinforce concrete. Use of polypropylene fibers reduces the generation of cracks.

The addition of polypropylene fibers in concrete improve various properties of concrete mix such as toughness, flexural strength, tensile strength and impact strength as well as mode of failure. The purpose of using polypropylene fiber is it tends to bind the concrete mix together, slows the settlement of coarse aggregate and decreases the bleeding which means a leisurelier rate of drying thus fewer shrinkage. In hardened concrete, polypropylene fibers act crack arresters like any other subordinate reinforcement, the fiberrest cracks from broadcasting by holding the concrete together so...
cracks cannot feast wider or raise longer. However, since polypropylene fibers are distributed through the concrete, they are in effect close to where cracks start at the aggregate paste interface.

1.2 Objectives of Study
The main objective of this study is addition of polypropylene fiber and partially replacement of cement with marble dust to gain the best result in conjunction with the compressive strength, split tensile strength, flexural strength and workability etc.

• To reduce the crack developed in concrete due to shrinkage of concrete.
• To upsurge the compressive, tensile and flexural strength of concrete using polypropylene fiber.
• To reduce the freezing and thawing damage in concrete and fire damage also.
• To increase in resistance to failure due to impact load in concrete.
• To analyze workability of fresh concrete.

II. LITERATURE SURVEY

[1] Rani B, Priyanka N (2017) conducted an experimental study on the behavior of mechanical properties of self-compacting concrete using polypropylene fiber which includes compressive and flexural strength. Comparison of polypropylene fibers mix and conventional mix was also done. From the study the maximum quantity of fiber in SCC was 0.75% to 1% of the total cement content per mix found.

[2] Yeswanth M, Ragavan T.R, Amarapathi G (2016) investigated the effect of polypropylene fiber on concrete with addition of fibers and fly ash. Different volume of fiber 0%, 0.05%, 0.1%, 0.15%, 0.2%, 0.25%, 0.30%, 0.35%, 0.40% were used to the volume of concrete and fly ash of 0%, 10%, 20%, 30%, 40% of volume of cement were used. It has been found that the addition of PPF has a little adverse effect on the workability of concrete containing fly ash while the addition of polypropylene fiber and fly ash has greatly improved the strength of hardened concrete. There was also increase in cracking resistance when compared to other concrete composites without fiber and fly ash.

[3] Alsadey (2016) investigated and analyzed the belongings of use of Polypropylene fiber in the mechanical possessions of cement mortar. An investigational study was carried out on the cement mortar reinforced by the dissimilar percentages of polypropylene fiber as 0%, 0.5%, 1% & 1.5%. Flow table test and compressive strength at age of curing 28 days was conducted on normal mortar and polypropylene fiber reinforced mortar specimens. The investigations display that the use of PPF stretches an improvement in properties of concrete and thus the optimum percentages for PPF have been taken into consideration.

[4] Pansuriya and Shinkar (2016) examine on mechanical properties of M30 grade concrete by adding polypropylene fibers in the blend at measurements of 0.5%, 1%, 1.5%, 2%, 2.5% by weight of cement added to the mix. For the analysis purpose a comparison has been carried out for normal concrete to that of the fiber reinforced concrete in relative to compressive, tensile and flexural strengths. Because of mounting oil costs and a more tightly pecuniary environment, cement is turning into a extra alluring choice for base venture comprehensively juxtaposed with conformist bituminous asphalts.
III. RESULT AND DISCUSSION

3.1 Compressive Strength Test

![Comparative Compressive Strength of M25 Grade](image1)

![Comparative Compressive Strength of M30 Grade](image2)

3.2 Split Tensile Strength of Concrete

![Comparative Splitting Tensile Strength of M25 Grade](image3)
3.3 Flexural Strength of Concrete

![Comparative Splitting Tensile Strength of M30 Grade](image1)

![Comparative Flexural Strength of M25 Grade](image2)

![Comparative Flexural Strength of M30 Grade](image3)
3.5 Durability of concrete

A. For M25

**Fig 3.7 Comparative analysis of loss in moisture of M25 Grade**

- Observation Table and Calculations: (Resistance against Alkali Attack)

| Sample | % Loss in Moisture |
|--------|--------------------|
| MD 10% | 0.92               |
| MD 10% +0.5%PF | 0.95             |
| MD 10% +1%PF  | 1.07              |
| MD 10% +1.5%PF | 1.40             |
| MD 10% +2%PF  | 1.73              |
| MD 10% +2.5%PF | 1.89             |

**Fig 3.8 Comparative analysis of loss in moisture of M25 Grade**

- Observation Table and Calculations: (Resistance against Acid Attack)

| Sample | % Loss in Moisture |
|--------|--------------------|
| MD 10% | 0.26               |
| MD 10% +0.5%PF | 0.31             |
| MD 10% +1%PF  | 0.39              |
| MD 10% +1.5%PF | 0.46             |
| MD 10% +2%PF  | 0.51              |
| MD 10% +2.5%PF | 0.55             |

B. FOR M30

i) Observation Table and Calculations: (Resistance against Acid Attack)

**Fig 3.9 Comparative analysis of loss in moisture of M30 Grade**

| Sample | % Loss in Moisture |
|--------|--------------------|
| MD 10% | 0.96               |
| MD 10% +0.5MDH0% | 1.09             |
| MD 10% +1MDH0%  | 1.22              |
| MD 10% +1.5MDH0% | 1.55             |
| MD 10% +2MDH0%  | 1.89              |
| MD 10% +2.5MDH0% | 1.93             |
iii) Observations Table and Calculations: (Resistance against Alkali Attack)

![Graph showing percent loss in moisture of M30 Grade](image)

**Fig 3.10 Comparative analysis of loss in moisture of M30 Grade**

![Graph showing compressive strength vs acid concentration](image)

**IV. CONCLUSION**

A. **FOR M25**

1. The compressive strength increased as the percentage (%) of polypropylene-fiber (0% to 1.5%) after 1.5% of PPF compressive strength decreases for both 14 days & 28 days cube strength.
2. The minimum split tensile strength was obtained at 0% addition of polypropylene-fiber while optimum split tensile strength was obtained at 1.5% addition of polypropylene-fiber at 14 and 28 days curing of cubes.
3. It was concluded that optimum percentage increment in flexural strength of concrete was 30.76% at 28 days curing respectively.

4. **Durability:**

   It was concluded that the percent loss of weight of cube specimens for resistance against acid attack was found to be -
   - For MD 10% at 90 days - 0.92 %
   - For MD 10% and PF 0.5% to 2.5% at 90 days found increasing - 0.95 to 1.79 %

The results revealed that the percent loss of weight of cube specimens for resistance against alkali...
attack was found to be -

- For MD 10% at 90 days - 0.26%
- For MD 10% and PF 0.5% to 2.5% at 90 days found increasing - 0.31 to 0.55%

REFERENCES

I. Yeswanth M, Ragavan T.R, Amarapathi G (2016), Experimental Investigation on Polypropylene Fiber Reinforced Concrete with Addition of Fly Ash, Journal of Applied Physics and Engineering Volume 1, pn 1-4

II. Rani B, Priyanka N (2017), Self Compacting Concrete using Polypropylene Fibres, International Journal of Research Studies in Science, Engineering and Technology Volume 4(Issue 1), pn 16-19

III. Ramujee K (2013), Strength Properties of Polypropylene Fiber Reinforced Concrete, International Journal of Innovative Research In Science, Engineering And Technology, Volume 2, pn 3409-3413

IV. Mohod M (2015), Performance of Polypropylene Fiber Reinforced Concrete, IOSR Journal of Mechanical and Civil Engineering, Volume 12 (Issue 1), pn 28-36