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EFFECT OF PET FIBER ON GEOPOLYMER CONCRETE USING FLY ASH AND GGBS

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ABSTRACT

In this experimental study the fly ash and GGBS is used to make the geopolymer concrete and PET fibers were added in it with different percentage. The fly ash and ggbs based geopolymer concrete was used with equal quantity (50% fly ash and 50% ggbs) and PET fibers were used in it (volume fraction of fine aggregates/weight percentage of fine aggregates),with different percentage i.e. 2%,3%,4% to study the mechanical and durability properties. Geopolymer concrete containing PET Fibers were cured with two methods i.e Oven curing (24 hours at 60^0C) and ambient curing. The PET fibers dimensions was used corresponding to 45 aspect ratio 90x2 (length x breadth).The prepared samples were tested at 7 days and 28 days. The study has been done on the fresh property, compressive strength, tensile strength and flexure strength of PET fiber encapsulated geopolymer concrete. The compressive strength improved a little with the incorporation of PET fibers, tensile strength and flexural strength tests gave significant improvement over controlled specimen.

Key words: Geopolymer concrete, fly ash, ggbs (Ground-granulated blast-furnace slag), alkaline solution, PET fiber (Polyethylene terephthalate fiber)

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1. INTRODUCTION

Concrete's versatility durability in India uses about 7.3 huge amounts of cement per annum and because of this the expense of development increments and causes condition contamination. As of late, Global warming and ecological obliteration have turned out to be

serious issues. Uplifting worry about worldwide natural issues, changeover the vast scale producing, mass-usage, mass-squander, society of the past to a zero-emanation society is by and by observed as basic and it has a low rigidity, little impenetrability and constrained

Pliability to breaking in now daily's utilization of cement possesses second spot the world over other than the water. Common Portland concrete basically comprises of bond, totals (course& fine) and water. In this, bond is utilized as an essential folio to create the customary Portland concrete. Because of expanding of advancements in framework, the use of regular solid will be more and just as the interest of bond would be increments later on. Roughly it is assessed that the utilization of bond is more than 2.2 billion tons for each year (Malhotra, 1999).

Then again, the utilization of Portland bond may make the some natural issues, for example, a worldwide temperature alteration, nursery impact and so forth. Since these issues may create because of expanding of carbon dioxide (CO_2) present in the environment, from the past outcomes almost one tone of Portland bond discharges measure up to amount of carbon dioxide (CO_2). So as to stay away from these ecological issues related with Portland bond , there is have to utilize a few options, for example, fly fiery debris, ground granulated impact heater slag (GGBS), rise husk powder and so on are as the covers to make the ecofriendly concrete. The totals (course and fine) are the most imperative element of cement possessing right around 70-80% of its complete volume and legitimately influence the properties of cement. Along these lines, there is have to utilize a few options, for example, coal cinder, heater slag, fiberglass squander materials, elastic waist, squander plastics, work ooze pellets and so forth.

In this regard, Davidovits [1988] proposed an elective cover for the solid innovation and it demonstrates a decent outcomes. These covers are delivered by an antacid fluid responds with the silica (Si) and aluminum (Al) present in the source materials. The innovation proposed by the Davidovits is normally called as Geo-polymers or Geo-polymer innovation.

1.1. Polyethylene terephthalate fiber (PET)

PET is one of the most significant and vital product which is used extensively in the domestic life, as per the estimates India produces around 500000 tons of PET waste every year. At the end of the twentieth century it use in various walk of the life has increased at the much fast rate which resulted in the accumulation of the enormous quantities of the non-biodegradable waste, which have grown in leaps and bounds. The concrete has a unique property that it is good at compression and at the same time weak in tension. The limitation is circumvented by using the steel reinforcement in the concrete which allow the concrete to tolerate the tensile forces and prevents cracking due to load as well as contraction and expansion.

2. MATERIALS AND METHODS

2.1. Material Used

The Class F fly ash and GGBS was used to produce the geopolymer concrete. Fly ash was obtained from Ropar Thermal Power Plant. The specific gravity was calculated as 2.24g/cc. GGBS was obtained from Ecogen industries, Dehradun and specific gravity of 2.86 g/cc. alkaline solution was made with the combination of sodium hydroxide and sodium silicate in 1: 2.5. The solution was prepared one day before the casting and sodium hydroxide was used with 12M and the solid content present in sodium silicate was 55.5 %.PET Bottles were obtained from local scrap dealer and then they cutted into aspect ratio of AR45. Coarse

Aggregates were used of size 20mm and 10mm with specific gravity 2.54 g/cc and fine aggregates were used of Zone II with specific gravity of 2.68 g/cc.

2.2. Mixing Procedure and Curing

The mixing of Fly and GGBS based geopolymer concrete is made by the use of alkaline solutions which are made one day before the casting. The raw material are mixed homogeneously and alkaline solutions are mixed with the ingredients and the amount of solid content present in the solution is fulfilled by adding water to it. The powder to alkaline ratio was 0.46 and when the cubes, beams cylinders are casted they are kept in oven for 24 hours for curing at 60^0C temperature and then specimens are kept at normal room temperature for curing. To compare the strength criteria of normal room temperature curing and oven curing cubes were casted to check the difference between the compressive strength.

2.3. Test Procedure

Tests were conducted to inspect the mechanical and durability properties Geopolymer concrete contain's different percentages of PET Fiber.

2.3.1. Compressive strength

Compressive strength is one of the most important property of concrete which forms a basic property for analysis and calculations. For this test, cubes of dimension 150x150x150mm were casted and cured and three cubes were taken for each testing of concrete for 7 days and 28 days for various percentage of PET Fibers for two curing metods(oven dry and ambient). These cubes were tested on Compressive testing machine and Rate of loading should be applied approximately 140 Kg/sqcm/min as per IS 516. Failure load was noted. Three cubes were tested for each test period and their average is reported.

2.3.2. Flexural strength of Beam

Flexural strength is one measure of the flexural strength of concrete. It is measured by loading an beam of size 100x100x500mm were cased and mean of three beams for each percentage of PET fibers and 48 beams were casted for to curing methods(oven dry and ambient). The sample reading is noted from the Universal Testing Machine and load should be applied 400 Kg/min as per IS 516. Two point loading machine is used and failure load is noted to calculate the flexural strength of geopolymer concrete for 7 days and 28 days.

2.3.3. Split Tensile Strength

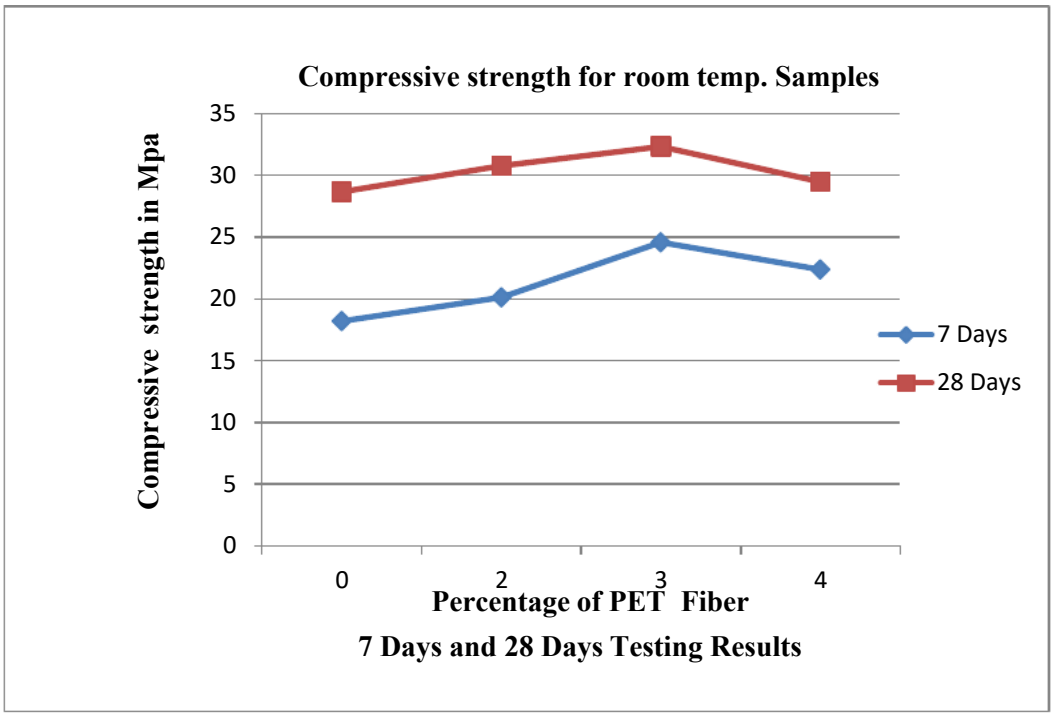
Cylinder specimen was used of diameter 150mm and length 300mm to find out the split tensile strength of geopolymer concrete by casting three samples for each percentage of PET Fibers for two curing methods (oven dry and ambient) and 48 cylinders were casted to check the specimens strength when tested after 7days and 28days.

3. RESULTS AND DISCUSSIONS

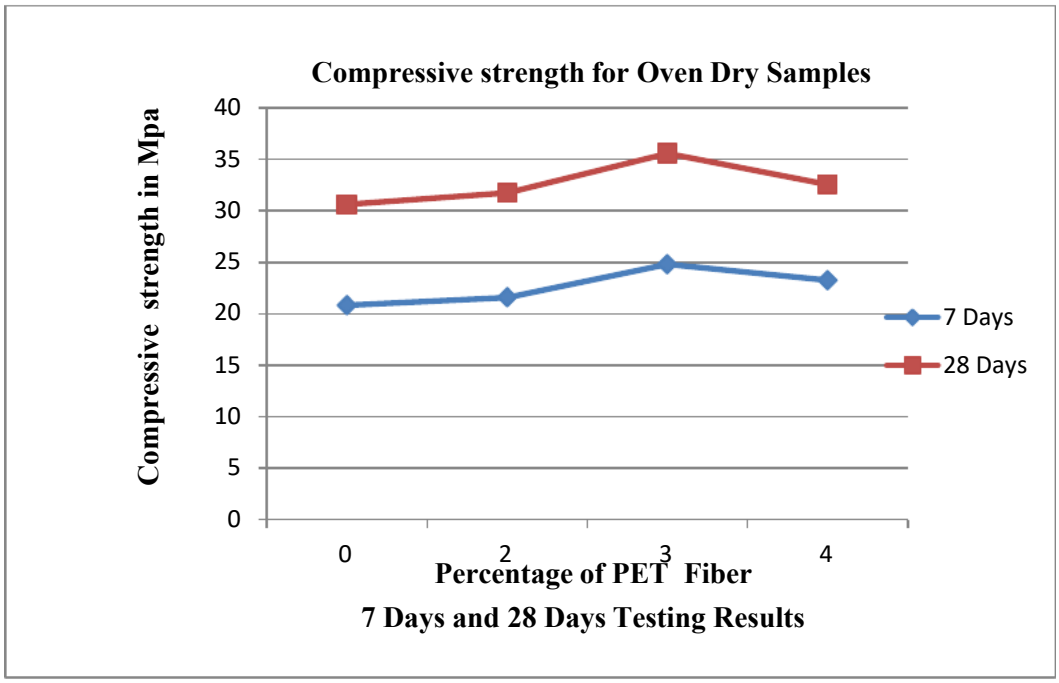
3.1. Compressive Strength

Compressive strength was calculated for PET fibers contained geopolymer concrete and it was seen that seen that the geopolymer concrete PET fibers show good increase in compressive strength upto 3%, after 3% the strength was start decreasing as show in graph 1 and 2.The compressive strength for room temperature for 2%, 3% increases as follows 10.49%, 33.9% for 7 days and 7.35%, 12.7% for 28 days. At 4% the strength is increases

compare to normal geopolymer concrete i.e. 22.9% for 7 days and 3.6% for 28 days, but it decreases as compare to 3% as show in graph 1. The compressive strength for oven dry curing for 2%, 3% increases as follows 3.6%, 19.06% for 7 days and 3.65%, 16.23% for 28 days. At 4% the strength is increases compare to normal geopolymer concrete i.e. 11.62% for 7 days and 6.37% for 28 days, but it decreases as compare to 3% as show in graph 2.



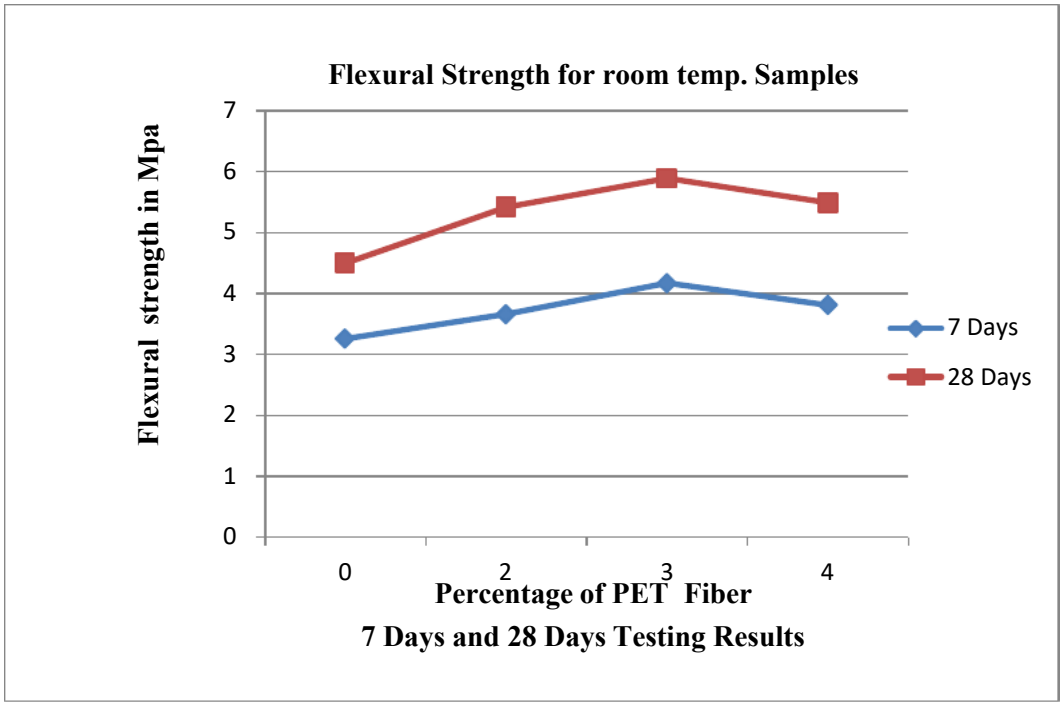
Graph 1 Compressive Strength for oven dry samples



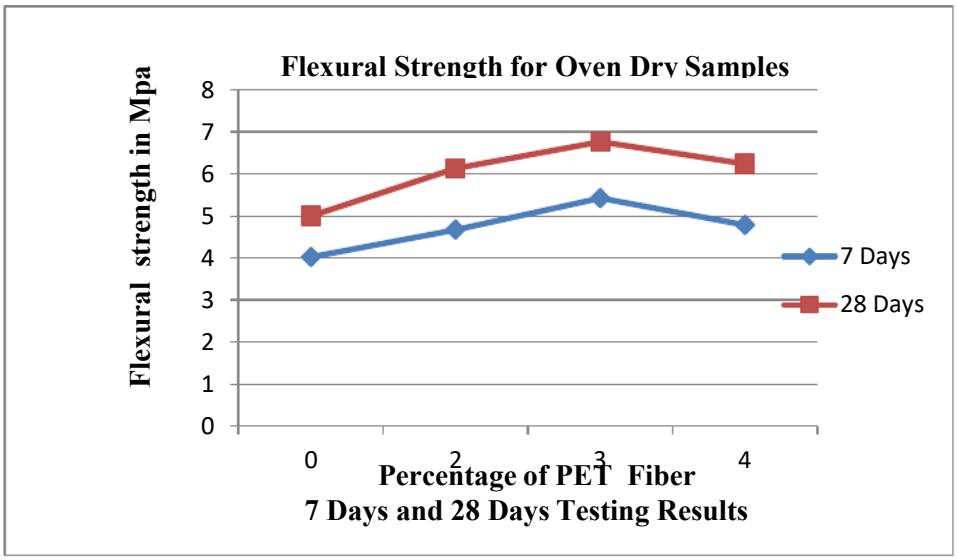
Graph 2 Compressive Strength for oven dry samples

3.2. Flexural Strength

Flexural Strength for PET fibers contained geopolymer concrete samples attained higher flexural strength than the samples without PET Fiber. Strength increase with the increase in percentage of PET Fiber upto 3% and it start's decreasing after it as shown in graph. Maximum flexural strength was obtained at 3% PET fiber. Compare room temperature curing oven dry curing give more strength. At 4% strength start's decreasing as show in graph 3 and 4. Percentage incremental increase in flexural strength for room temperature curing for 2%,3% swas increase by 10.9%,27.9% for 7 days and 26%,30.88% for 28 days. At 4% the tensile strength is increases compare to normal geopolymer concrete i.e. 16.8% for 7 days and 26% for 28 days, but it decreases as compare to 3% as show in graph 3. Percentage incremental increase in flexural strength for oven dry curing for 2%,3% as follows 11.1%,38.44% for 7 days and 22.6%,34.82% for 28 days. At 4% the tensile strength is increases compare to normal geopolymer concrete i.e. 18.9% for 7 days and 28.6% for 28 days, but it decreases as compare to 3% as show in graph 4.



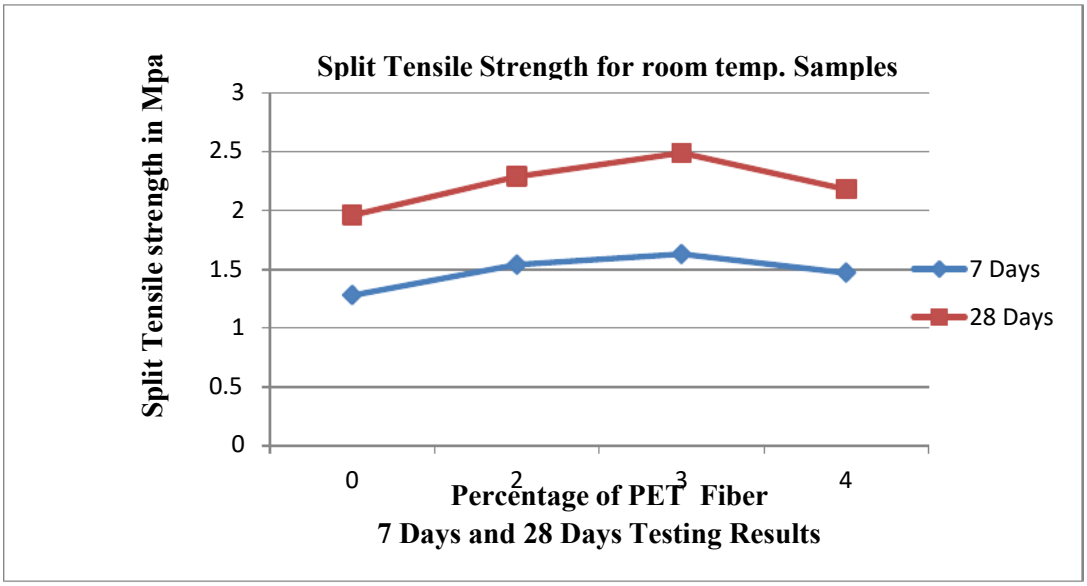
Graph 3 Flexural Strength for room temperature curing samples



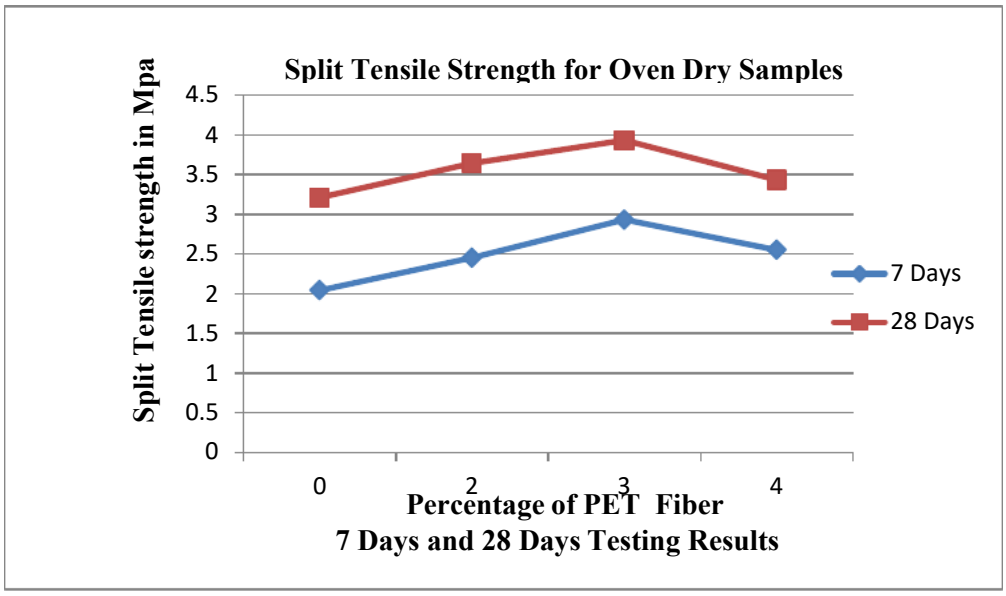
Graph 4 Flexural Strength for Oven dry curing samples

3.3. Split Tensile Strength

Split Tensile Strength for PET Fiber contained geopolymer concrete attained higher strength with the increase in the percentage of PET Fiber up to 3%.After it the strength was start decreasing. At 7 Days of test the strength was increase for 2%,3% as follows 20.3%,27.3% .For 28 Days test the strength for 2%,3% as increases as follows 16.83%,27.04% for room temperature curing. At 4% the tensile strength is increases compare to normal geopolymer concrete 14.84% for 7 days and 16.83% for 28 days, but it decreases as compare to 3% as show in graph 5. For Oven Dry curing strength increases for 2%,3% as follows 20.13%,40.23% for 7 days and 13.39%,22.52% for 28 days. At 4% the tensile strength is increases compare to normal geopolymer concrete 24.9% for 7 days and 7.07% for 28 days, but it decreases as compare to 3% as show in graph 6. The strength was decreases at 4% of PET Fiber as shown in graph 5 and 6.



Graph 5 Split Tensile Strength for room temperature curing samples



Graph 6 Split Tensile Strength for Oven dry curing samples

4. CONCLUSIONS

The PET fiber reinforced concrete properties evaluated in this experimental study. The result shows that the PET fiber reinforced concrete improved over geopolymer concrete without fiber. The following conclusion drawn from this experimental study

1. The PET fiber act as a crack arrester for the concrete during the loading. It helps to delay the propagation of crack.
2. The compressive strength for room temperature for 2%,3% increases as follows 10.49%,33.9% for 7 days and 7.35%,12.7% for 28 days . The compressive strength for oven dry curing for 2%, 3% increases as follows 3.6%, 19.06% for 7 days and 3.65%,16.23% for 28 days. At 4% the strength was decreasing in both of the curing procedure.
3. Percentage incremental increase in flexural strength for room temperature curing for 2%,3% was increase by 10.9%,27.9% for 7 days and 26%,30.88% for 28 days. Percentage incremental increase in flexural strength for oven dry curing for 2%,3% as follows 11.1%,38.44% for 7 days and 22.6%,34.82% for 28 days. . At 4% the strength was decreasing in both of the curing procedure, but not as much compare to concrete without fiber.
4. Split tensile strength for room temperature curing at 7 days of test the strength was increase for 2%,3% as follows 20.3%,27.3% .For 28 Days test the strength for 2%,3% as increases as follows 16.83%,27.04% for room temperature curing. For Oven Dry curing strength increases for 2%,3% as follows 20.13%,40.23% for 7 days and 13.39%,22.52% for 28 days.

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