

EXPERIMENTAL INVESTIGATION ON GEOPOLYMER CONCRETE WITH HYBRID FIBERS

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ABSTRACT

The binding material in concrete is Cement. But cement production is more emission of CO₂. To find the alternative of cement may introduce as Geo Polymer Concrete (GPC). In this research, six different mixes are used to calculate the optimum mix of concrete. The mixes are FA+CA, FA+CA+0.5% Polypropylene fibre(PPF)+ 1.5% Sisal Fibre(SF) , FA+CA+1% Polypropylene fibre(PPF)+ 1% Sisal Fibre(SF), FA+CA+1.5% Polypropylene fibre(PPF)+ 0.5% Sisal Fibre(SF). FA+CA+2% Polypropylene fibre(PPF), FA+CA+2% Sisal Fibre(SF). The of results are compared with conventional concrete. Applications of GPC are many areas like casting of pipes, railway sleepers, bricks, tiles, hollow blocks, electric poles, etc.

Key words: Polypropylene fibre, Sisal Fibre, Hybrid concrete

INTRODUCTION

Now a day all over the world, fiber reinforcement concrete used. Fibers are act as secondary reinforcement. The composite materials applications are used for strengthening of reinforced concrete structures .The Polypropylene fiber and sisal fiber are easily mixed with in a concrete. Polypropylene fiber is artificial fiber and it having good tensile strength, sisal fiber is natural fiber and it having tensile strength.

MATERIALS USED:

FLYASH

Fly ash having commentaries property. Class C fly ash was used in this experiment due to low content of CaO. It having fineness of 7.8%, Initial setting time around 127 mins and specific gravity is 3.15.

FINEAGGREGATE

It consist of natural sand as per IS: 383-1970 and the Fineness Modulus of 3.02, Zone-II. Bulking modulus of sand is 21%.

COURSEAGGREGATE

Size of 20 mm and 12.5 mm Coarse aggregate size were used and it satisfied requirements of IS: 383-1970. It having SpecificGravity of 2.7, WaterAbsorption of 0.53%, FinenessModulus of 6.6, CrushingStrength of 2.5 Mpa & Impact Value of 7.2%.

ALKALINEACTIVATOR

In this study used sodium hydroxide and sodium silicate. Silicate modulus of 2.0 and bulk density of 1390 kg/m³ and an analytical grade sodium hydroxide in pellet from.

POLYPROPYLENEFIBRES

It is act as a secondary reinforcement for arrest cracks. It is verified ASTM C-1116, Shape is Monofilament, Length of 12mm, Specific Gravity is 0.92, Melting point is 164°C & Tensile Strength is 3400-7600kg/m³.

SISALFIBERS:

It is an organic fiber. It is resistance to deterioration in sea water and high durability compare with coir fiber. Sisal fiber are widely available in India.

LITERATURE REVIEW

Report by Wallah et al. (2006) discussed the long-term properties of low-calcium fly ash-based geopolymer concrete. An investigational has done by Prabir Sarker (2008) this showed the suitability of using the modified model for geopolymer concrete. Thermal activation of Indian flyash with sodium hydroxide and sodium silicate solution by Ravindra N Thakur et al. (2009). Satpute Manesh et al. (2012) geopolymer concrete was manufactured by replacing cement with calcium flyash and alkaline solutions. Madheswaran et al. (2013) in this study different molarities like NaOH and Na₂SiO₃. SomNath Sachdeva et al. (2014) In this study, the effect of varying proportions of flyash, 20% to 40%, on compressive strength and flexural strength of concrete was evaluated. Gabor Mucsi et al. (2014) in this study, the main process engineering properties of the raw materials, such as particle size distribution, moisture content, density and specific surface area are shown. Djwantoro Hardjito et al. (2014) discussed geopolymer concrete, a byproduct material rich in silicon and aluminium, such as low-calcium flyash was chemically activated by a high-alkaline solution to form a paste that bounds the loose coarse and fine aggregates, and other materials in the mixture. Kewal et al. (2015), investigated the partial replacement of fine aggregate in different percentages like 0%, 20%, 40%, 60%, 80% and 100% and the test results showed that 60% replacement gave better compressive strength. Gayathri et al. (2016) studied the change in mechanical properties of geopolymer concrete with E-Waste in concrete The investigation was made with replacement of sand by using e- waste of 0%,10%,20%,30%,40%, 50%. Manimaran et al. (2017) studied the particle size distribution by the uniaxial compressive strength. From literature review summary of geo polymer concrete with fiber improving mechanical properties of compression, split tensile, flexural strength.

Mix Design:

The different percentage of polypropylene fibers and sisal fibers are used such as 0.5%,1.0%,1.5%,and 2%.The optimum mix in this research is 2%. -M30Grade of concrete was used with mix ratio of 1(Fly ash):1.05 (Fine aggregate):1.786 (Coarse aggregate).

RESULTS AND DISCUSSION:

Compressive strength:

The compressive strength test was carried out using the cube mould size of 15 x15x15 cm.



Fig. 1 Cube compression test

Comparing with conventional concrete, Mix 1 is 4.2 % compressive strength is increased; Mix 2 is 10.5% compressive strength is increased; Mix 3 is 7.0 % compressive strength is increased; Mix 4 is 5.2 % compressive strength is increased & Mix 5 is 6.1 % compressive strength is increased. Mix 2 is performed well comparing with other mixes.

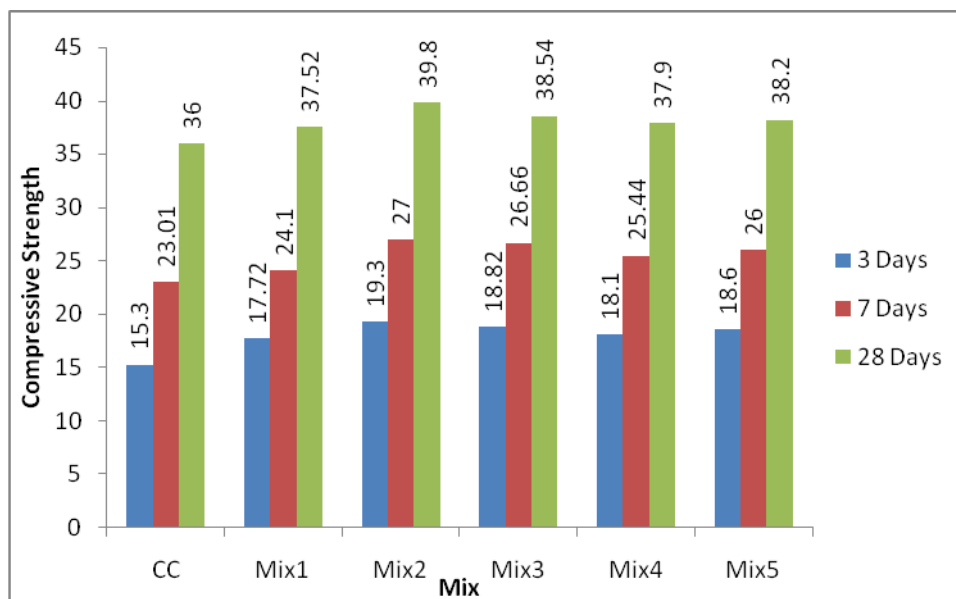


Fig. 2 Compressive strength test results

Split Tensile Strength:



Fig. 3. Cylinder split tensile strength test

The split tensile strength test was carried out using the size of 300mm x 150mm. Comparing with conventional concrete, Mix 1 is 0.6 % split tensile strength is increased; Mix 2 is 2 % split tensile strength is increased; Mix 3 is 1 % split tensile strength is increased; Mix 4 is 1 % split tensile strength is increased & Mix 5 is 1.3 % split tensile strength is increased. Mix 2 is performed well comparing with other mixes.

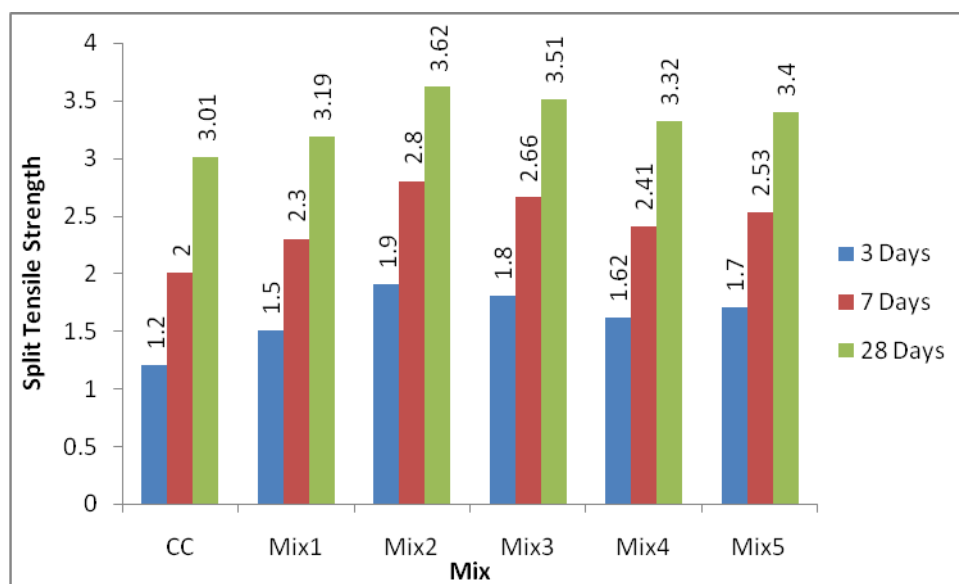


Fig. 4. Cylinder split tensile strength test

Flexural Strength:



Fig.5.Flexural strength test

The flexural strength test was carried out using the size of 100mm x100mm x 500mm. Comparing with conventional concrete Mix 1 is 2.5 % flexural strength is increased; Mix 2 is 4 % flexural strength is increased; Mix 3 is 3.5 % flexural strength is increased; Mix 4 is 2.9 % flexural strength is increased & Mix 5 is 3.2 % flexural strength is increased. Mix 2 is performed well comparing with other mixes.

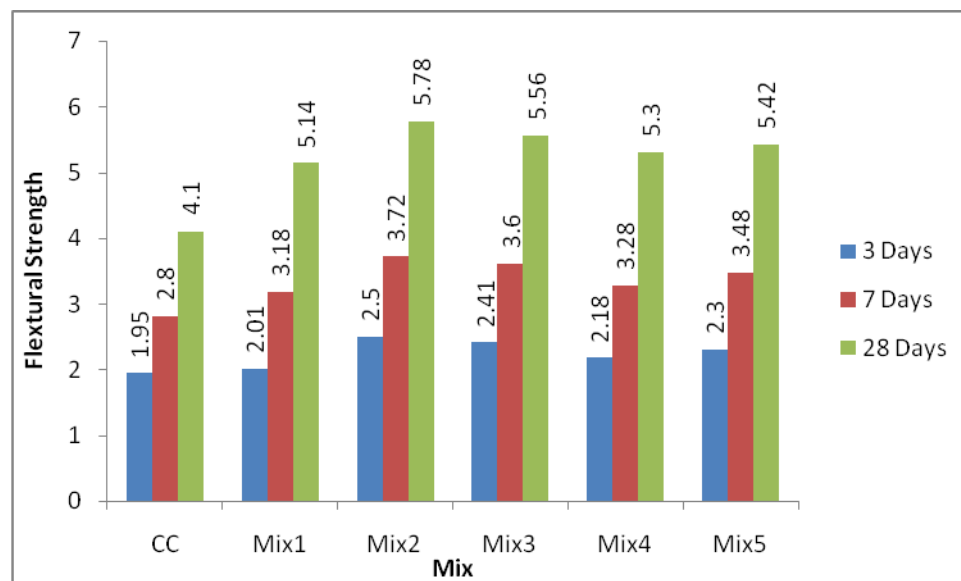


Fig.6.Flexural strength test

CONCLUSIONS

In this research work,

The mix designs of CC, Mix-1, Mix -2, Mix -3, Mix -4, and Mix -5 with two different fibers have been compared. In compressive strength, the conventional concrete value is 36N/mm² and Mix-2 hybrid geopolymer concrete value is 39.2 N/mm². The percentage of compressive strength is increased by 10.5% compared with conventional concrete.



In Split tensile strength test, the conventional concrete value is 3.01N/mm^2 and Mix-2 hybrid geopolymer concrete value is 3.62N/mm^2 . The percentage of Split tensile strength is increased by 2% compared with conventional concrete.

In Flexural strength test, the conventional concrete value is 4.1N/mm^2 and Mix-2 hybrid geopolymer concrete value is 5.78N/mm^2 . The percentage of Flexural strength test strength is increased by 4% compared with conventional concrete.

We concluded that, Geopolymer with fibers increased the compressive strength, split tensile strength and flexural strength compared with conventional concrete.

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