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International Journal for Modern Trends in Science and Technology, 7(12): 403-409, 2021

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0712074
Available online at: http://www.ijmtst.com/vol7issue12.html

Comprarision of Compressive Strength of Geopolymer Concrete with Fibers

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To Cite this Article
Allu Rajya Lakshmi, Y Priyanka. Comprarision of Compressive Strength of Geopolymer Concrete with Fibers. *International Journal for Modern Trends in Science and Technology* 2021, *7* pp. 403-409. https://doi.org/10.46501/IJMTST0712074

Article Info
Received: 15 November 2021; Accepted: 12 December 2021; Published: 28 December 2021

ABSTRACT

Concrete is the most normally utilized shape cloth on the planet. The measure of water assumes a full-size job in the association of cement. What's more, the pastime for concrete is increasing step with the aid of step and concrete is utilized to fulfill the requirement for framework improvement, 1 ton of concrete introduction produces 1 ton of CO2, which contrarily influences the earth. So as to reduce the utilization of OPC and the age of CO2, some other age cement, for example, geopolymer concrete (GPC) has been created.

Geopolymers are inorganic polymers and their concoction introduction is like attribute materials. Geopolymer covers are the alternatives in the development of corrosive protected cement for instance solidness of cement. Geopolymer concrete is produced using Fly ash at 100% replacement to cement and binders like NaOH, Na_2SiO_3 to ignite the geopolymerisation. Many studies were carried out on properties of geopolymer concrete. This study focuses on enhancing the strength of geopolymer concrete by using fibers. 60% polyester and 40% polypropylene fibers are added to geopolymer concrete addition with Fly ash content. The trail mixes were casted with addition of fibers at different percentages like (0.20, 0.25, 0.30, 0.35, 0.40, 0.45 and 0.50 %). Then samples were air-cured for 28 days at ambient temperature. Compressive strength test is conducted on the samples after 3, 7 and 28 days. The optimum value is obtained at 0.40% addition of fibers when compared to nominal mix (GPC).

Keywords: Geopolymer concrete, Fly ash, NaOH, Na_2SiO_3, Fibers, Compressive strength.

INTRODUCTION

The geopolymer was once the title given with the aid of Daidovits in 1978 to substances described through chains or organizes or inorganic particles. Geopolymer concrete strong contains of the utilization of squanders, for example, fly particles and squashed granulated have an effect on heater slag (GGBS). Fly particles is the waste produced by means of the thermoelectric force plant and the slag from the squashed granulated influence heater is created as waste in the steelworks. Fly particles and GGBS are treated with the becoming innovation and utilized for working cement as a stable geopolymer. Utilizing this strong diminishes the load of waste and furthermore lessens carbon outflows with the aid of reducing the hobby for Portland concrete. Soluble Activator Solution is a combine of antacid silicate and hydroxide arrangements, in addition to subtle water. The job of the soluble actuation association is to provoke substances of worldwide beginning factor containing Si and Al, for example, fly particles and GGBS.

Geopolymers are a piece of the inorganic polymer family. The concoction enterprise of the geopolymer cloth is like that of ordinary zeolitic materials, but the microstructure is formless. The polymerization process consists of a generously speedy artificial response below fundamental prerequisites on Si-Al minerals, this consequences in a third-dimensional polymer chain and ring shape comprising of Si-O-Al-O bonds. Studies exhibit that water is discharged all through the compound response that takes place in the course of geopolymer arrangement. This water, eliminated from the geopolymer framework for the duration of the solidifying and ensuing drying periods, leaves spasmodic nanopores in the grid, enhancing the exhibition of the geopolymers.

REVIEW OF LITERATURE

Prakash R et al.,[1] Studied about the compressive strength of geopolymer concrete. They considered fly ash based geopolymer concrete using alkaline solution. They conducted experimental work by considering 20 geopolymer concrete mixes by evaluating the effect of various parameters affecting compressive strength. Various parameters considered in their study are ratio of alkaline liquid to fly ash, concentration of s odium hydroxide, ratio of sodium silicate to so dium hydroxide, curing time, curing temperature , dosage of super plasticizer, rest period and additional water content. After curing, the tests on specimens for compressive strength at the age of 3 days by different conditions were considered. They observed that as the water cement ratio varies from 0.35 and 0.40, there is no significant change in compressive strength for 3days. They reported t hat compressive strength increases in the increa se in the curing time, curing temperature, rest period, concentration of alkaline solution and d ecrease with increase in the ratio of water to geopolymer solids by mass and admixture dosa ge. The addition of naphthalene based supper plasticizer improves the workability of fresh ge opolymer concrete. They concluded that ratio of alkaline liquid to fly ash mass does not affe ct the compressive strength of the geopolymer concrete compressive strength of the geopolymer concrete decreases with increase in the ratio of water to geopolymer solid mass. With incre ase in the curing temperature in the range 60^0 C to 90^0 C the compressive strength of the geopolymer concrete also increases.

Vignesh . p et al.,[2] studied experimental investigation on strength parameters of fly ash based geopolymer concrete with GGBS. In their work they considered fly ash, GGBS and alkaline solutions. They studied strength properties of geopolymer concrete using low calcium fly ash replacing with slag in 5 different percentages, sodium hydroxide of 8 molarity solution was used. After curing they conducted the tests on specimens for compressive strength, split tensile strength and flexural strength test at the ages of 7 days and 28 days. They observed maximum strength was obtained for the replacement of fly ash at 70% and GGBS at 30%. They reported that in compressive strength, split tensile strength and flexural strength were decreased beyond the replacement of 30% of GGBS and 70% of fly ash. They concluded that the water absorption property of geopolymer concrete achieves 70% of the compressive strength in first 4 hours of setting.

Madheswaran C.K. et,al.,[3] In this paper they were investigated about the effect of molarity in geopolymer concrete. Mainly alkaline liquids used for geopolymerisation, i.e. sodium hydroxide and sodium silicate with different (3, 5, 7) molarities. In this study the influence of ground granulate d blast furnace slag on geopolymer concrete. T he types of geopolymer concrete mixes are 10 % GGBS and 90% fly ash, 15%GGBS and 85% FA, 20% GGBS and 80% FA, 50% GGBS and 50% of FA. And that mixes were immersed in different concentrations of alkaline activator s olutions. The compressive quality of the GPC is expanded with the expanding of grouping of NaOH. Higher grouping of sodium hydroxide arrangement yielded higher compressive quality. The rates of GGBS changed from half, 75%, 100%. It was seen that as level of GGBS builds the compressive quality additionally increments. What's more, the impact of GGBS on quality of geopolymer concrete blends were contemplated, it has been seen that the expanding the amount of GGBS and compressive quality of geopolymer increments. The deliberate compressive quality of GPC blend is in the range from 45 MPa and limit of 60MPa for 100% GGBS. The amount of GGBS increments and split rigidity of GPC increments.

Karthik A et,al.,[4] The intention of this examination was once to recognize the positiveimpact of bio-added substances, for example, terminalia chebula and ordinary sugars on the sturdiness residences of coal fly particles influence heater slag primarily based GPC underneath distinct artificial assaults. Different assessments had been directed by means of inundating examples in 5% sulfuric corrosive, 5% sodium sulfate and 5% sodium chloride reply for more than a few time period of 7, 14, 28, fifty six and ninety days to determine the obstruction of bio-added components protected geopolymer concrete in opposition to concoction assaults. Following ninety days of submersion, check consequences affirmed that bio-added resources incorporation in coal fly particles influence heater slag primarily based GPC had skilled weight discount and compressive first-class misfortune in the scope of 2.82-3.91%, 9.67-12.05% below sulfuric corrosive assault, 0.38-0.68%, 2.15-2.95% beneath sodium sulfate assault and 0.28-0.51%, 0.83-1.33% underneath sodium chloride assault was once 13.97%, 33.57% beneath sulfuric corrosive assault, 1.64%, 6.45%, underneath sodium sulfate assault and 0.86%, 2.05% beneath sodium chloride assault was once watched.

Yeonho Park et,al.,[5] This examination affords the plausibility of GPC to which morsel elastic from reused tires has been included. In this examination, fly debris, a fundamental fluid mixture of sodium hydroxide and sodium silicate, and piece elastic had been utilized a the imperative elements of GPC. Different variables that have an impact on the compressive fantastic have been contemplated, for example, molarity of sodium hydroxide, measurement of totals, measure of elastic, and varieties of fly debris. The investigation of fluctuation demonstrates that great whole can be supplanted with an equal extent of piece elastic, up to 5% in three types of fly particles primarily based GPC at the 95% walk in the park level.

EXPERIMENTAL WORK

TESTS ON FINE AGGREGATE

Fine aggregate should pass through I.S. sieve 4.75 mm. Standard coarse sand is to be from river origin. According to IS 383-1970, fine aggregate used in this present study confirms to zone – II classification.

S. No	Property	Test Results	Standard Limits	IS Standard Testing Code
1	S Specific gravity (Fine aggregate) Zone II Sand	2.5019	> 2.5	IS 2386-1963] Part III
2	Fineness modulus of Fine aggregates	2.58	2.6-3.2 (Coarse Sand)	IS 2386-1963 Part III
3	Bulk Densityin fineaggregates	1.49	1.5 ~ 1.7	IS 2386-1963 Part III
4	Water absorption	0.47	(0.5- 1) %	IS 2386-1963 Part III
Type ofFineaggregates - Natural riversand Result – The properties of the fine aggregates tested lie within the Indian standard limits and are considered to be suitable for production of concrete since the properties come under ZONE II category				

a) NATURAL COARSE AGGREGATES

Aggregate which retained on 4.75 mm sieve and the broken stone is generally used as a Coarse aggregates. The nature of work decides the maximum size of the coarse aggregates. Locally available coarse aggregates having the maximum size 20 mm and minimum size 10 mm was used in the present work.

Several laboratory testing will be carried out and compared to the standard requirements as per IS: 2386-1963 has grouped the test methods for aggregates into different parts

S.No	Property	Test Results	Permissible Limit	IS Standard Testing Code
1	Specific gravity	For 20mm-2.80 For 10mm-2.68	2.5 to 3.0	IS 2383-1986
2	Water Absorption	For 20 mm-0.3 For 10 mm-0.60	Not more than 0.6 %	IS 2383-1986
3	Bulk density **(kg/m ^{3})**	1738	1520 to 1680 kg/m^3	IS 2383-1986
4	Flakiness Index %	11.3%	Not more than 15 %	IS 2383-1963 Part 1
5	El Elongation Index	18.9%	Not more than 15 %	IS 2383-1963 Part 1
6	Aggregate Impact Value	28.6%	Not more than 30%	IS 2383-1963 Part 1
7	Aggregate Crushing Value	26.459%	Not more than 30%	IS 2383-1963 Part 1
8	Fineness modulus	6.27	-	IS 2383-1963 Part 1

Properties of fly ash as per IS codes

S.No	Description of test	IS code
1	Specific gravity	IS 3812-2003 (part-1)
2	Fineness	IS 3812-2003 (part-1)

Chemical properties of fly ash

S.No	Chemical compositions (%)	Fly ash
1	Silicon Dioxide (SiO_2) + Aluminum Oxide (Al_2O_3) + Ferric Oxide (Fe_2O_3)	70%
2	Silicon Dioxide	35%
3	Reactive silica	20%
4	Magnesium Oxide (MgO)	5.00%
5	Sulphur trioxide (SO_3)	3.00%
6	Sodium oxide (Na_2O_3)	1.50%
7	Total chlorides	0.05%
8	Loss on ignition	5%

RESULTS AND DISCUSSIONS

Average Compressive Strength In MPa of Fly ash Based GPC With Addition Of Reliance Fibers.

S.No	Mix designation	Compressive strength (MPa)		
		3 days	7 days	28 days
1	GPC	39.00	46.00	58.00
2	GPC RF 0.20	38.33	42.67	54.00
3	GPC RF 0.25	36.00	43.33	55.00
4	GPC RF 0.30	35.67	45.33	56.00
5	GPC RF 0.35	34.00	46.67	58.00
6	**GPC RF 0.40**	**41.33**	**48.33**	**61.00**
7	GPC RF 0.45	38.67	44.83	55.33
8	GPC RF 0.50	36.00	42.33	53.00

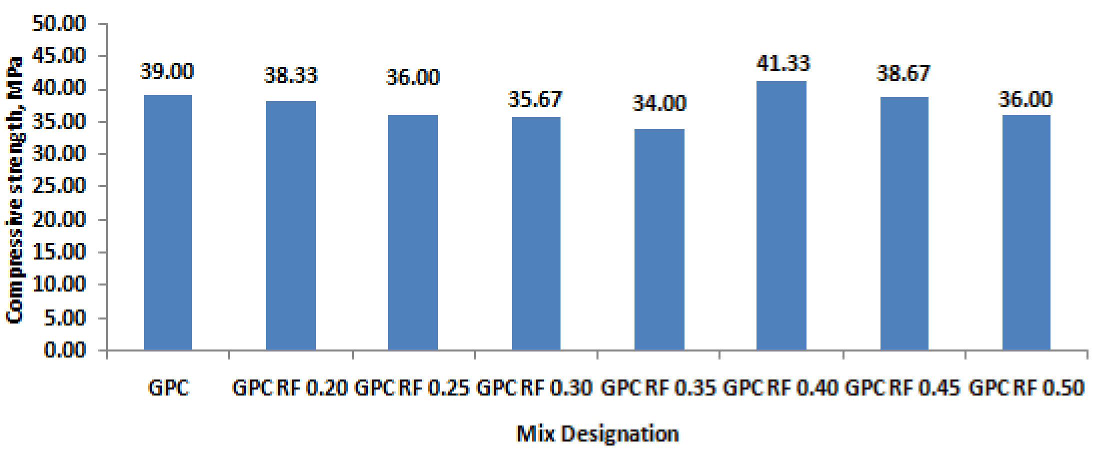


Figure 5.1 compressive strength of cubes with addition of fibers for 3 days

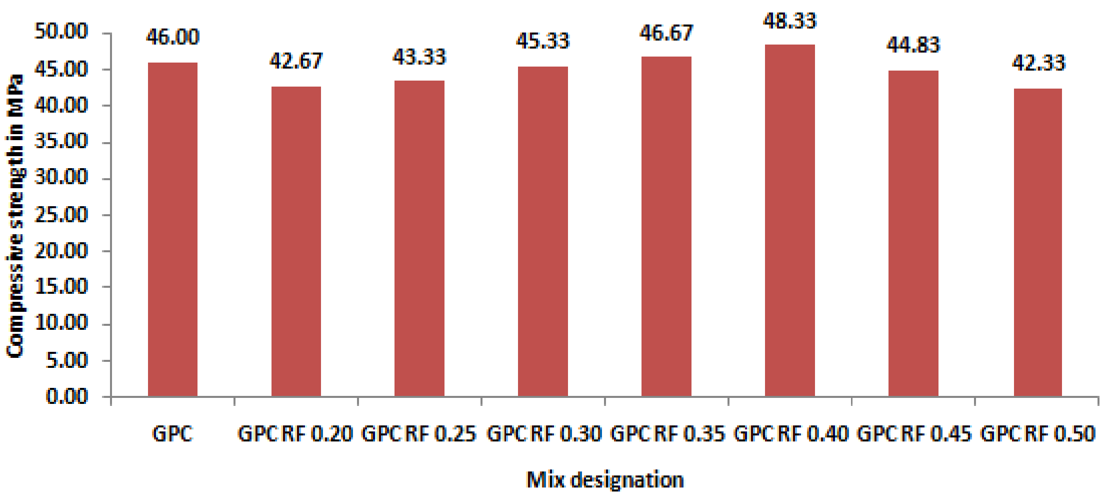


Figure 5.2 compressive strength of cubes with addition of fibers for 7 days

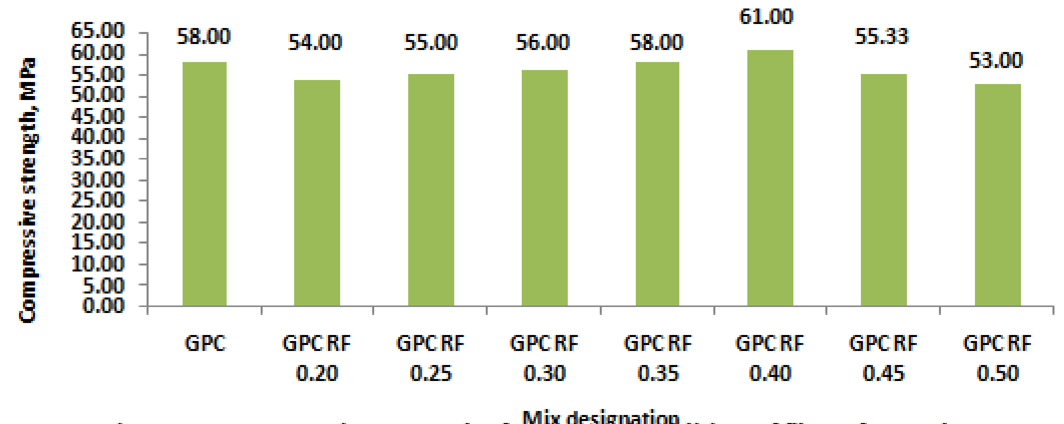
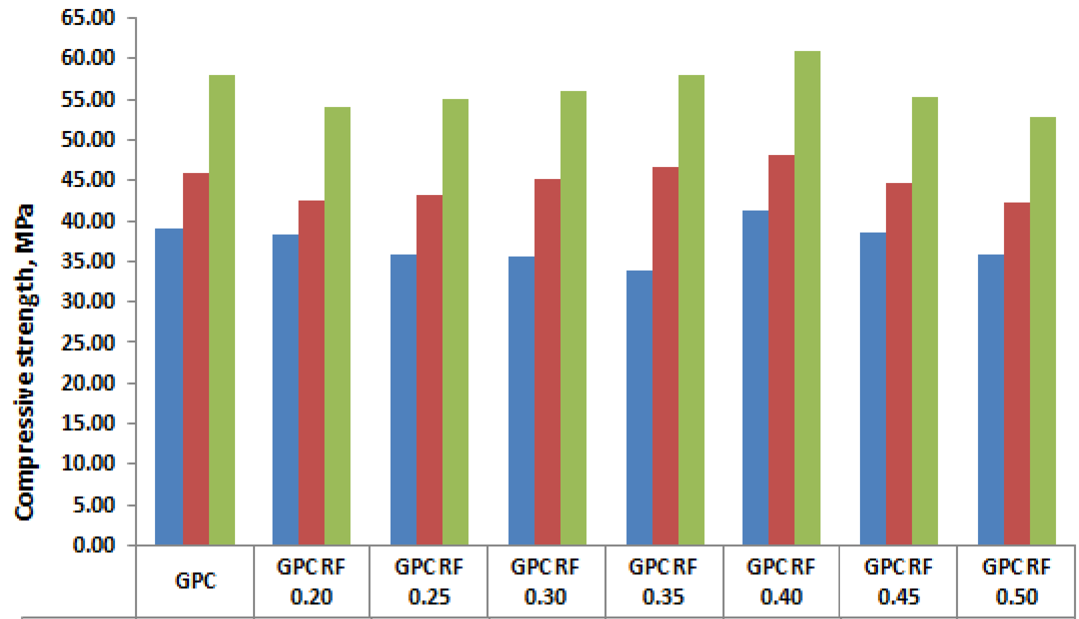


Figure 5.3 compressive strength of cubes with addition of fibers for 28 days



	GPC	GPC RF 0.20	GPC RF 0.25	GPC RF 0.30	GPC RF 0.35	GPC RF 0.40	GPC RF 0.45	GPC RF 0.50
3 DAYS	39.00	38.33	36.00	35.67	34.00	41.33	38.67	36.00
7 DAYS	46.00	42.67	43.33	45.33	46.67	48.33	44.83	42.33
28 DAYS	58.00	54.00	55.00	56.00	58.00	61.00	55.33	53.00

Mix designation

Figure 5.4 comparison of compressive strength of cubes with addition of fibers for 3, 7 and 28 days

The compressive strength decreases with increase of reliance fibers percentage. But at 0.40% addition of fibers the strength has increase than the nominal mix. Compressive strength of geopolymer paste improved from 39.00 to 41.33 MPa and 46.00 to 48.33MPa and 58.00 to 61 MPa after the addition of 0.40% reliance fibers for 3, 7 and 28 days respectively.

CONCLUSIONS

- Geopolymer concrete exhibited higher compressive strength when compared to ordinary Portland concrete.
- Compressive strength decreases with increase of fibers percentage. But at 0.40% addition of fibers the strength has increase than the nominal mix.

- As only limited information is available on Geopolymer concrete with fly ash and reliance fibers lots of trial and error have been made before finalizing the appropriate parameters of study.
- One of the objectives of this study is to produce sustainable concrete by using the industrial wastes like Fly ash.
- The source material and its constituents play a crucial role in gaining the strength of GPC.
- Sodium hydroxide (NaOH) and Sodium silicate (Na2SiO3) are, however, manufactured in industries under controlled conditions and hence sufficient quality control already exists. The outcome of the study is summarized as below.

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