Experimental Study on Polypropylene Fiber Reinforced GEO Polymer Concrete

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***Abstract*— The increasing demand of environment friendly construction has been the driving force for developing sustainable and economical building materials.**

The critical aspects influencing the development are performance of the materials under different and special user conditions, economic aspects as well as environmental impact aspects. Cement is an energy consuming and high greenhouse gas emitting product.

Geopolymers are gaining increased interest as binders with low CO2-emission in comparison to Portland cement. In the present investigation, the mechanical properties of flyash based geopolymer concrete (GPC) were studied.

Experimentally measured values of the compressive strength and split tensile strength of GPC specimens made from low, medium and higher grades compared with reference to the control mixes (OPC).

The regression model analysis was carried out to study the relationship between the Compressive strength and Split tensile strength and It was found that the mechanical behaviour of GPC is similar to that of ordinary Portland cement(OPC) concrete.

INTRODUCTION

The term 'geopolymer' was first introduced by Davidovits in 1978 to describe a family of mineral binders with chemical composition similar to zeolites but with an amorphous microstructure.

Unlike ordinary Portland/pozzolanic cements, geopolymers do not form calcium- silicate-hydrates (CSHs) for matrix formation and strength, but utilise the polycondensation of silica and alumina precursors to attain structural strength.

Two main constituents of geopolymers are: source materials and alkaline liquids. The source materials on alumino-silicate should be rich in silicon (Si) and aluminium (Al).

They could be by-product materials such as fly ash, silica fume, slag, rice-husk ash, red mud, etc. Geopolymers are also unique in comparison to other aluminosilicate.

The geo-polymeric concretes are commonly formed by alkali activation of industrial aluminosilicate waste materials such as fly ash (FA) and ground granulated blast furnace slag (GGBS), and have very small footprints of greenhouse gases when compared to traditional concretes.

EXPERIMENTAL INVESTIGATION

The concrete mixture was prepared by adding polypropylene fibers from 0% to 0.6% to the binders weight as per Table 6.

The experimental program was conducted to determine the strength parameters of geopolymer concrete of the experimental work.

COMPRESSIVE STRENGTH:

(varying proportion of flyash and GGBS with optimum % polypropylene fiber)

Mix design	Compressive strength (N/mm²)	
	7 days	28 days
M1	7.5	11.8
M2	20.5	26.9
M3	37.3	43.8
M4	45.7	52.8
M5	48.5	58.1
M6	69.2	70.6

SPLIT TENSILE STRENGTH:

(varying proportion of flyash and ggbs with optimum % polypropylene fiber)

Mix design	Split tensile strength (N/mm²)	
	7 days	28 days
M1	0.79	1.13
M2	0.94	2.12
M3	2.18	3.32
M4	3.28	3.6
M5	3.43	3.65
M6	3.59	4.02

FLEXURAL STRENGTH:

(varying proportion of flyash and ggbs with optimum % polypropylene fiber)

Mix design	Flexural strength (N/mm²)	
	7 days	28 days
M1	8.85	9.9
M2	10.11	12.94
M3	11.84	15.2
M4	13.08	16.1
M5	14.4	17.1
M6	15.08	18.25

CONCLUSION

Based upon the above discussions, the following conclusions could be drawn,

The geopolymer has low workability and it further decreases with the increase in the addition of polypropylene fibers.

The incorporation of fibers increases the compressive strength and split tensile strength in small proportions till 0.5% and then it decreases. This fall in the characteristic strength could be due to the more complex matrix due to the presence of fibers.The presence of fibers add more air voids inside the matrix that results in the decrease of the mechanical properties after optimum percent of utilization.

There is a significant increase in the flexural strength of the polypropylene fiber reinforced geopolymer concrete with the increase in the addition of polypropylene fibers till 0.5%.

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