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An Eco-Friendly Geopolymer Concrete By Using Ggbs As Partial Replcement Of Cement And Nylon Crystal As Reinforcement

Vamsikrishna Daka1, Dr.Victor Babu.N[2]

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ABSTRACT: Concrete has occupied an important place in construction industry in the past few decades and it is used widely in all types of constructions ranging from small buildings to large infrastructural dams or reservoirs. Cement is major component of concrete. The cost of cement is increasing day by day due to its limited availability and large demand. At the same time the global warming is increasing day by day. Manufacturing of cement also releases carbon dioxide. In the present study an attempt had been made on concrete and also an experimental investigation on the concrete using by partially replacing cement with GGBS to avoid the usage of cement as well as emission of green house gases In the present study an attempt been made on geopolymer concrete with nylon crystals. And also an comparative study of this gpc with M30 concrete

Experimental studies were performed on plain geopolymer concrete and partial replacement of cement with GGBS and Nylon crystal as reinforcement is done. In this study the concrete mix were prepared by using GGBS, sodium silicate, sodium hydroxide and Nylon crystal from 5% to 20% by weight of GGBS were added partially to the mixes. A comparative analysis has been carried out for M30 concrete to that of the Nylon crystal reinforced geopolymer concrete in relation to their compressive strength, split tension strength and flexural strength properties. The geopolymer concrete made with Nylon crystal performed well in terms of compressive strength, split tension strength and flexural strength showed higher performance at the age of 7, 14 and 28 days than conventional concrete. And also two different types of acid attack is done to determine the Bond Strength and compressive strength both on conventional concrete and Nylon crystal reinforced geopolymer concrete

Key words: Compressive strength, Flexural strength, Split tensile strength

I. INTRODUCTION

Construction industry is one of the major consumers of natural resources and produces quantities of the waste materials. Infrastructure development in the developing countries increased the utilization of aggregate from the quarries leading to depletion of the natural resources. The Coarse aggregate occupies 60-70% of the concrete volume. The rheological and mechanical properties of the aggregate play a vital role in concrete structures. Mineral properties of the aggregate determine the strength and durability properties of the concrete mix. Development of composite concretes using various admixtures increased the strength properties.

II. MATERILS USED

2.1 CEMENT: Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. The most common use for Portland cement is in the production of concrete.

Physical Properties of Cement (OPC 53 GRADE) (IS 8112-1989)

1. Specific Gravity – 3.12
2. Fineness of cement – 2.5
3. Standard Consistency – 31%
4. Initial and Final Setting time of cement – 140min and 260 min
5. Compressive Strength – 3 days -27 Mpa, 7days – 37 Mpa, 28days – 53 Mpa

2.2 AGGREGATES: Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates.

2.2.1. COARSE AGGREGATE: The material which is retained on IS sieve 4.75mm is termed as coarse aggregate. The broken stone is generally used as a stone aggregate.

2.3.2. FINE AGGREGATE: The material which passes through IS sieve 4.75mm is termed as fine

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aggregate usually natural sand is used as a fine aggregate The sand used for the experimental works was locally procured and confirmed to grading zone II, sieve analysis of the fine aggregate was carried out in the laboratory as per IS 383-1970 and results are provided.

2.3.1.Physical Properties of Aggregates:

S.No	Type of Aggregates	Specific Gravity	Fineness modulus
1	Coarse aggregate	2.85	6.65
2	Coarse aggregate	2.59	2.24
3	Crusher Dust	2.57	2.75

2.4 CONCRETE: Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water.M30 and M40 grades are used.

2.5Geo polymer Concrete

Geopolymer was the name given by Daidovits in 1978 to materials which are characterized by chains or networks or inorganic molecules. It is an innovative and eco-friendly construction material and an alternative to Portland cement concrete. Generally Geopolymer cement concrete is made from utilization of waste materials such as fly ash and ground granulated blast furnace slag(GGBS). Fly ash is the waste product generated from thermal power plant and ground granulate blast furnace slag is generated as waste material in steel plant. Use of geopolymer reduces the demand of Portland cement which is responsible for high CO2 emission

III. STRENGTH STUDIES ON CONCRETE

3.1. Compressive Strength test according to IS 516-1959

The test setup for conducting cube compressive strength test is depicted in Plate No. Compression test on the cubes is conducted on the 300T compression testing machine. The cube was placed in the compressiontestingmachineandtheloadonthecubeisappliedataconstantrateup tothefailureofthespecimenandthe ultimateloadisnoted. The cubecompressivestrengthoftheconcretemixisthencomputed..Thistesthas been carried out on cubespecimensat 7, 14,and 28 daysage.Thevaluesarepresentedin below.

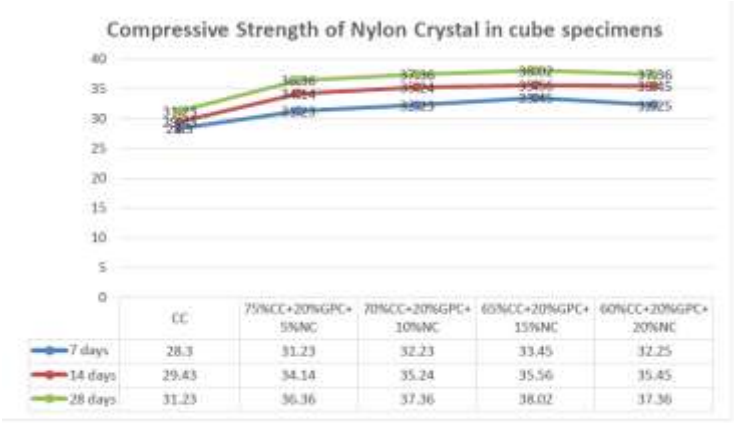

Figure 5.1: Compressive Strength for (7,14,28 days of curing (N/mm^2))

3.2 Split Tensile Strengthaccording to IS 5816-1999

This test is conducted on 300T compression testing machine. The cylinders prepared for testing are 150mm in diameter and 300mm height. In the present work, this test has been conducted on cylinder specimens after 7,14, and 28 days of curing. The values are tabulated in above tables

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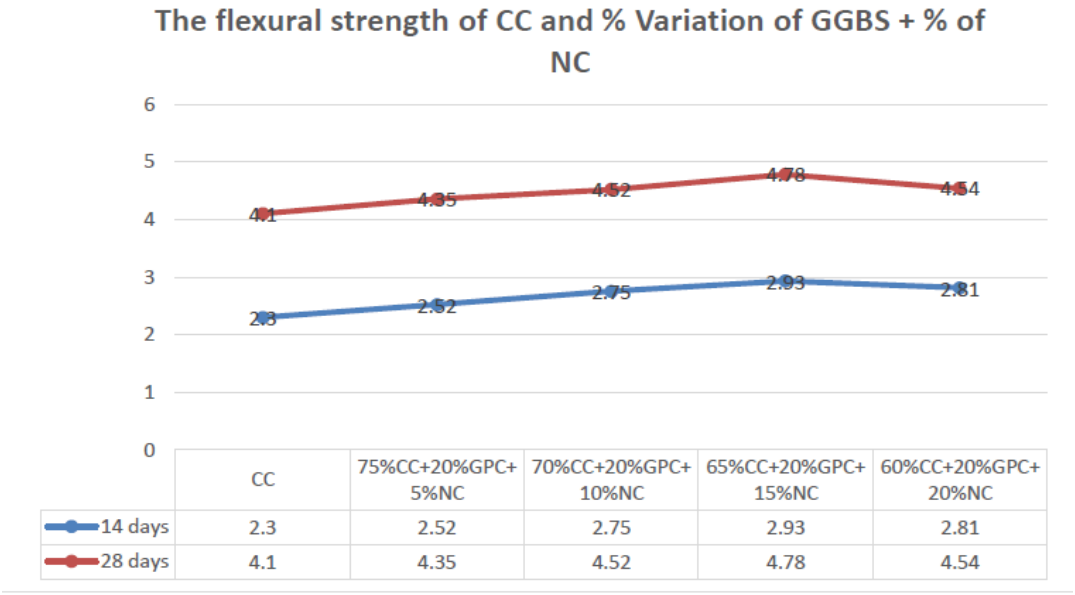
	CC	75%CC+20%GPC+ 5%NC	70%CC+20%GPC+ 10%NC	65%CC+20%GPC+ 15%NC	60%CC+20%GPC+ 20%NC
7 days	2.19	2.28	2.56	2.62	2.43
14 days	3.03	3.13	3.31	3.39	3.29
28 days	3.15	3.28	3.46	3.7	3.51

Figure 5.2: Split Tensile Strength Test for (7,14,28 days of curing (N/mm²))

3.3 Flexural Strengthtestaccording to IS 516-1959

The prism specimens of size 500x 100x 100 mm were used for the determination of the flexural strength. The average flexural strength of concrete



	CC	75%CC+20%GPC+ 5%NC	70%CC+20%GPC+ 10%NC	65%CC+20%GPC+ 15%NC	60%CC+20%GPC+ 20%NC
14 days	2.3	2.52	2.75	2.93	2.81
28 days	4.1	4.35	4.52	4.78	4.54

Figure 5.3: Flexural Strength Test for (14, 28 days of curing (N/mm²))

3.4 ACIDS RESISTANCE TEST

3.4.1EffectofAcidonGeoPolymerConcretewithNylon CrystalCubewithHCL

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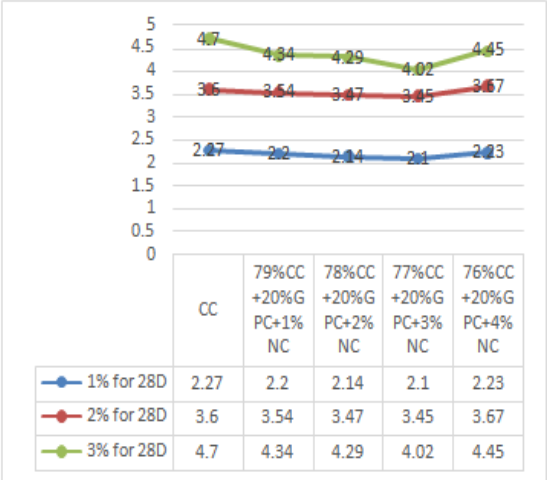
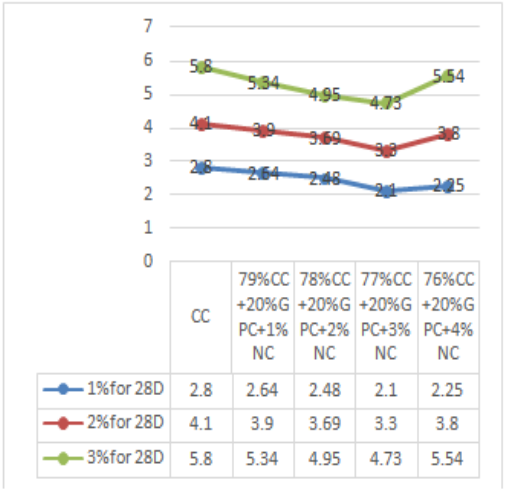


Effect of Acidon Geo Polymer Concrete with Nylon CrystalCubewithHCL



Effect of Acid on Geo Polymer Concrete Nylon Crystal Cube with H_2SO_4

IV. CONCLUSIONS

- It is observed that the concrete slump values are decreasing with the increasing Nylon Crystalpercentage. The reduction in slump with the increase in the Crystal will be attributed to presenceofCrystalwhich causesobstruction to thefreeflowofconcrete.
- ItisobservedthattheoptimumdosageofNylonCrystal is15% of GGBS (or) 3% of CC.
- It is observed that the compressive strength of the GPC is high and the strength is increases.
- ItisobservedthatthecompressivestrengthoftheGPCishighasthevalues36.36,37.36,38.02,37.36 N/mm^2 when % ofNylon crystal increases from 5%,10%,15%,20% for GPC (or) 1%,2%,3%,4% of CC respectively,whenitiscomparedwith conventionalconcreteat28days.
- It is observed that split tensile strength of the GPC is high as the values are 3.28, 3.46, 3.70,3.51 N/mm^2% of Nylon crystal increases from 5%,10%,15%,20% for GPC (or) 1%,2%,3%,4% of CC respectively, when it iscomparedwith conventional concreteat 28days.

It is observed that in the acid resistance tests of the GPC is losing less weight when % of Nylon crystal increases from 5%,10%,15%,20% for GPC (or) 1%,2%,3%,4% of CC respectively, when it is compared with conventional concrete at 28days

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