An Ecofriendly Geopolymer Concrete By Using Fly Ash And GGBS As A Replacement of Cement And Nylon Crystal As Reinforcement

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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 been made on concrete and also an experimental investigation on the concrete using by replacing cement with FLYASH and 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 ordinary M20 concrete*

Experimental studies were performed on plain geopolymer concrete and replacement of cement with Nylon crystal is done. In this study the concrete mix were prepared by using flyash, sodium silicate, sodium hydroxide and Nylon crystal from 5% to 20 by weight of flyash were added partially to the mixes. A comparative analysis has been carried out for M20 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, 28, 60 and 90 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

Keywords- Acid Attack, Bond Strength, Compressive strength, Flexural strength, Nylon crystal, Split Tensile strength. Geopolymer

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. The utilization of the waste materials reduces the density of the concrete. Scientific methods should be developed for the utilization the various alternate aggregates.

According to Indian scenario, India is expected to grow with a huge population, which crosses china by the middle of this century. These population growth leads to two effects in which India is going to have unique advantage of having the biggest work force in the coming years and which it leads to large scale developments over the coming years. India has focused on 12th Five Year plan on the growth of infrastructural facility such as roads and highways, railways, ports, power, communication, etc., and also investment of the order US 1 trillion is envisaged for this sector during the 12th plan. As we all know that concrete is the single most material that is used in this endeavor.

Concrete is defined as any solid mass made by the use of a cementing medium; the ingredients generally comprise sand, gravel, cement and water. That the mixing together of such disparate and discrete materials can result in a solid mass with well-defined properties, is a wonder in itself. Concrete has been in use as a building material for more than hundred and fifty years. Its success and popularity may be largely attributed to

1. Durability under hostile environments

2. Ease with which it can be cast into a variety of shapes and sizes.
3. Its relative economy and easy availability.

The main objective of this paper is to examine the physical properties of coarse aggregate, fine aggregate and cement. Investigate the mechanical properties of concrete by adding Nylon Crystal in concrete mix then find the optimum percentage of Nylon Crystal to be added in concrete in relation to their mechanical properties and determine the special mechanical properties using acid attack and bond strength on conventional concrete and Nylon reinforced crystal.

Dr. SujiD[1] determines Bituminous mixes are most commonly used all over the world in flexible pavement construction. These industrial wastes occupies large amount of space around plants throughout the country. Various percentages (0, 25, 35, 40, 50 and 75%) of Foundry sand were used, and the proposed mix designs for bituminous concrete mix were conducted in accordance with Marshall Mix design. The experimental results revealed that the addition of Foundry sand has a significant improvement on the properties of bituminous concrete mix.

Deepak R[2] observes Steel Slag is a co-product of the steel industry and can be used potentially as a sustainable construction material in bituminous mix with proper mix design. Based on Intensive laboratory testing program, the characteristic properties of steel slag were assessed to determine its suitability to be used in the bituminous mix. Four different percentages (0, 25, 50,75 and 100%) of steel slag aggregate were used and experiment results revealed that the addition of steel slag has a significant improvement on the properties of bituminous concrete mix.

II. EXPERIMENTAL STUDY

Material Used

1. Flyash
2. Ggbs
3. Cement For Manufacturing Of M20 Cement Concrete
4. Fine Aggregates
5. Coarse Aggregates
6. Alkaline Liquids
7. Super Plastisizer
8. Nylon Crystals

1) Fly ash

- It was a waste product hich was formed by industries and from other sources
- The specific gravity of fly ash is 2.133

2) GGBS

- Ground granulated blast furnace slag is used as main replacement for cement in this geopolymer concrete Specific gravity test should be conducted before mixing

The specific gravity of GGBS was 2.92

3) Cement

- Specific gravity of cement used is 3.16.
- Fineness of cement is 92.3%.
- The initial setting time of the cement used is 51minutes. > 30 minutes
- The final setting time of cement is 5hours 20 minutes.< 10 hours

4) Fine Aggregate

This material which passes through BIS test sieve number 4 (4.75mm) is called as fine aggregate usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone is used as fine aggregates.

- Specific gravity of fine aggregate is 2.74
- Sieve Analysis was conducted to the fine aggregate which shows the sand belong to zone III as per IS: 383-1917.

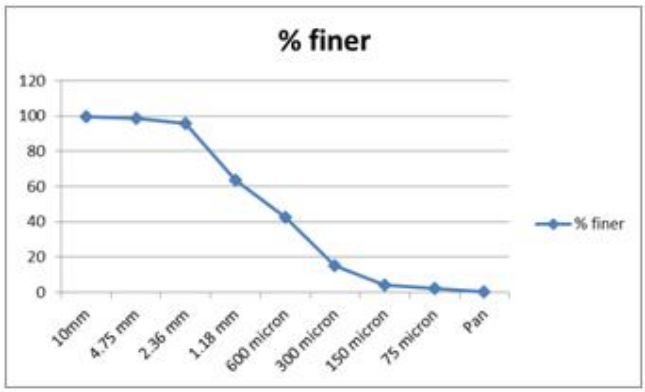


Fig 1. Sieve analysis graph for fine aggregate

3) Coarse Aggregate

The material which is retained on BIS test sieve number greater than 4.75mm size of aggregate is termed as coarse aggregate. The broken stone is generally used as a stone aggregate. The nature of work decides the maximum

size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20mm was used.

TABLE 1SPECIFIC GRAVITY OF AGGREGATES

Size	Specific gravity
20mm	2.64
10mm	2.57

- Average impact value of aggregate sample = 21.43%
- Average abrasion value of aggregate sample =15.82%
- Average crushing value of aggregate sample = 19.81%.

4) Nylon Crystal

Properties of Nylon Crystal:

- Strength – Good tenacity, strongest textile fiber, excellent abrasion resistance.
- Elasticity – Good elasticity, high elongation and excellent recovery.
- Resilience – Retains smooth appearance and wrinkles from daily activities.
- Drapability – Excellent draping qualities. Light weight sheer nylon has high draping quality. Medium weight can drape very nicely.
- Structure – Normal cross section is circular.
- Density – 1.14 g/cc (light weight)
- Effect of sunlight - Fair resistance to sunlight

Mix Design

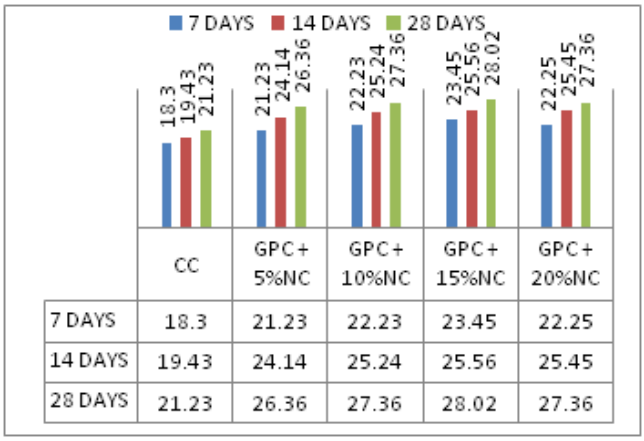
Extensive study on the development and the manufacture of low-calcium fly ash based geopolymer concrete research was already been reported in several publications many of them are from Indian region also.so we are considering the mix design which is available in a Research Report by Hardjito and Rangan (2005). Based on that study we made a geopolymer concrete specimens. The mixture proportions per m3 for GPC are

Material	Weight in kg/m^3
20mm coarse aggregate	756
10mm coarse aggregate	504
Fine aggregate	540
flyash	133.50
GGBS	311.50
Sodium silicate	110
Sodium hydroxide	45
Super plastisizer	20
water	55
Nylon crystals	Starting from 5% of GGBS

III. TEST AND RESULTS

Mechanical Characteristics of Nylon Crystal in Concrete

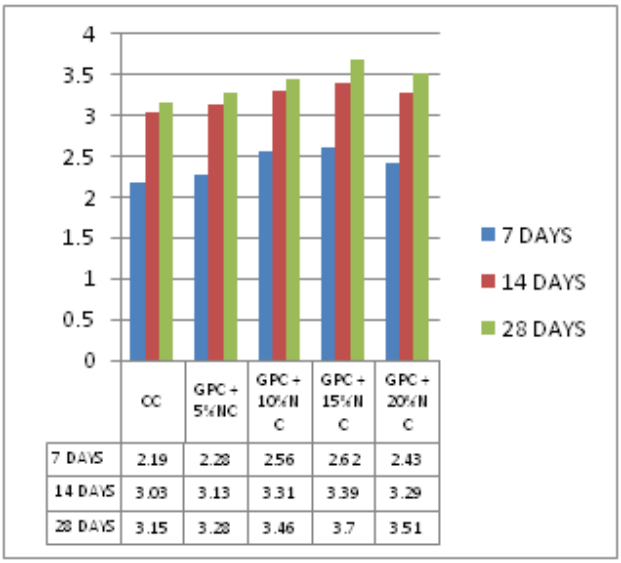
Compressive Strength of Nylon Crystal in Cube Specimens



	CC	GPC+ 5%NC	GPC+ 10%NC	GPC+ 15%NC	GPC+ 20%NC
7 DAYS	18.3	21.23	22.23	23.45	22.25
14 DAYS	19.43	24.14	25.24	25.56	25.45
28 DAYS	21.23	26.36	27.36	28.02	27.36

Compressive strength values of G.P.C with Nylon Crystal at 7, 14, 28 Days

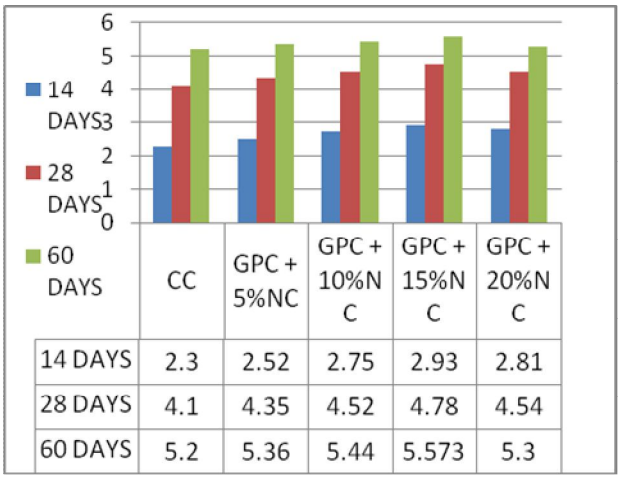
Split Tensile Strength of Nylon Crystal in Cylinder Specimens:



	CC	GPC + 5%NC	GPC + 10%NC	GPC + 15%NC	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

Split tensile strength values of G.P.C with Nylon Crystal At 7, 14, 28 Days

Flexural Strength of Nylon Crystal in Prism Specimens:

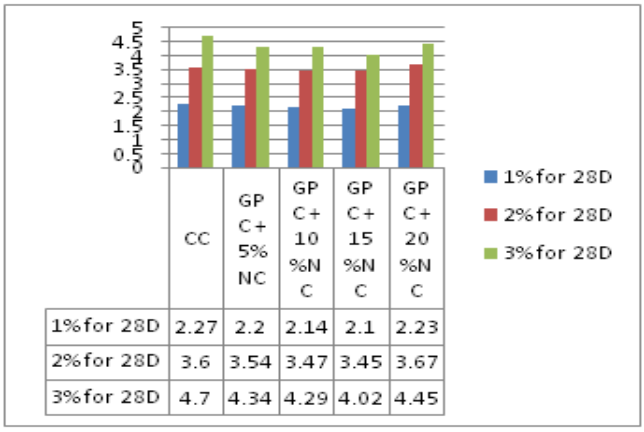


	CC	GPC + 5%NC	GPC + 10%NC	GPC + 15%NC	GPC + 20%NC
14 DAYS	2.3	2.52	2.75	2.93	2.81
28 DAYS	4.1	4.35	4.52	4.78	4.54
60 DAYS	5.2	5.36	5.44	5.573	5.3

Flexural strength values of G.P.C with Nylon Crystal at 14, 28, 60 Days

Acid Attack on Concrete

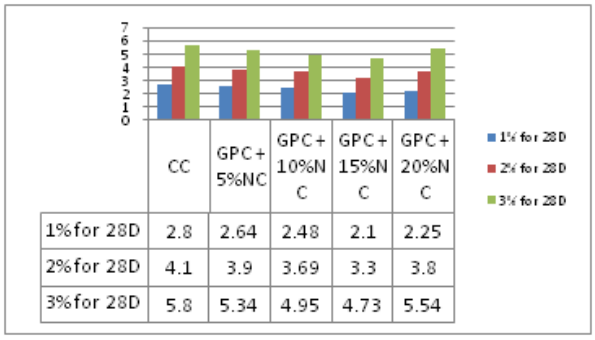
Weight loss percentage of G.P.C with Nylon Crystal cube with HCL



	CC	GPC + 5% NC	GPC + 10 %NC	GPC + 15 %NC	GPC + 20 %NC
1%for 28D	2.27	2.2	2.14	2.1	2.23
2%for 28D	3.6	3.54	3.47	3.45	3.67
3%for 28D	4.7	4.34	4.29	4.02	4.45

Weight loss percentage of G.P.C with Nylon Crystal cube with HCL

3.3.2. Weight loss percentage of G.P.C with Nylon Crystal cube with H2SO4



	CC	GPC + 5%NC	GPC + 10%NC	GPC + 15%NC	GPC + 20%NC
1%for 28D	2.8	2.64	2.48	2.1	2.25
2%for 28D	4.1	3.9	3.69	3.3	3.8
3%for 28D	5.8	5.34	4.95	4.73	5.54

Compressive strengths of Nylon Crystal cube specimens with H2SO4

IV. CONCLUSION

1. It is observed that the concrete slump values are decreasing with the increasing Nylon Crystal percentage. The reduction in slump with the increase in the Crystal will be attributed to presence of Crystal which causes obstruction to the free flow of concrete.
2. It is observed that the optimum dosage of Nylon Crystal is 4%.
3. It is observed that the compressive strength of the GPC is high as the values are21.23, 29.36, 30.36, 31.02 when % of Nylon crystal increases from 1%,2%,3%,4% for GPC when it is compared with conventional concrete at 28 days.
4. It is observed that split tensile strength of the GPC is high as the values are…when % of Nylon crystal Increases from 1%, 2%, 3%, 4% for GPC when it is compared with conventional concrete at 28 days.
5. It is observed that flexural strength of the GPC is high as the values are when % of Nylon crystal increases

from 1%, 2%, 3%, 4% for GPC when it is compared with conventional concrete at 28days.

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