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An Eco Friendly Geopolymer Concrete with Nylon Crystal Replacement

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Abstract: ***Concrete has occupied a crucial place in housing industry within the past few decades and it's used wide altogether kinds of constructions starting from little buildings to massive infrastructural dams or reservoirs. Cement is major element of concrete. the value of cement is increasing day by day because of its restricted availableness and huge demand. At a similar time the world warming is increasing day by day. producing of cement additionally releases greenhouse gas. within the gift study an endeavor been created on concrete ANd additionally an experimental investigation on the concrete mistreatment by commutation cement with FLYASH and GGBS to avoid the usage of cement also as emission of inexperienced house gases within the gift study an endeavor been created on geopolymer concrete with nylon crystals.And additionally AN comparative study of this gpc with standard M20 concrete Experimental studies were performed on plain geopolymer concrete and replacement of cement with Nylon crystal is completed. during this study the concrete combine were ready by mistreatment flyash, glass, hydroxide and Nylon crystal from 100% to four-hundredth by weight of flyash were superimposed part to the mixes. A comparative analysis has been meted out for M20concrete to it of the Nylon crystal bolstered geopolymer concrete in regard to their compressive strength, split tension strength and flexural strength properties. The geopolymer concrete created with Nylon crystal performed well in terms of compressive strength, split tension strength and flexural strength showed higher performance at the age of seven, 28, sixty and ninety days than typical concrete. And additionally 2 differing types of acid attack is completed to see the Bond Strength and compressive strength each on typical concrete and Nylon crystal bolstered geopolymer concrete.***

I. INTRODUCTION

Construction industry is one amongst the most important customers of natural resources and produces quantities of the waste materials. Infrastructure development within the developing countries raised the employment of mixture from the quarries resulting in depletion of the natural resources. The Coarse mixture occupies 60-70% of the concrete volume. The physical science and mechanical properties of the combination play a significant role in concrete structures. Mineral properties of the {mixture|the combination} verify the strength and sturdiness properties of the concrete mix. Development of composite concretes victimization varied admixtures raised the strength properties. the employment of the waste materials reduces the density of the concrete. Scientific ways ought to be developed for the employment the varied alternate aggregates. in step with Indian state of affairs, Asian nation is predicted to grow with an enormous population, that crosses china by the center of this century. These growth results in 2 effects {in that|during which|within which} Asian nation goes to own distinctive advantage of getting the most important} hands within the returning years and which it results in large scale developments over the approaching years. Asian nation has targeted on twelfth 5 Year arrange on the expansion of infrastructural facility like roads and highways, railways, ports, power, communication, etc., and additionally investment of the order North American country one trillion is envisaged for this sector throughout the twelfth arrange. As we tend to all understand that concrete is that the single most material that's employed in this endeavor. Concrete is outlined as any solid mass created by the utilization of a cementing medium; the ingredients typically comprise sand, gravel, cement and water. That the blending along of such disparate and separate materials may end up in a very solid mass with well-defined properties, could be a marvel in itself. Concrete has been in use as an artefact for over hundred and fifty years. Its success and recognition could also be mostly attributed to (1) sturdiness underneath hostile environments (2) Ease with that it are often solid into a spread of shapes and sizes. (3) Its relative economy and simple handiness. the physical properties of coarse mixture, fine mixture and cement. Investigate the mechanical properties of concrete by adding Nylon Crystal in concrete combine then notice the optimum share of Nylon Crystal to be side in concrete in relevancy their mechanical properties and verify the special mechanical properties victimization acid attack and bond strength on typical concrete and Nylon strengthened crystal. Dr. SujiD[1] determines hydrocarbon mixes ar most ordinarily used everywhere the globe in versatile pavement construction. These industrial wastes occupies great amount of house around plants throughout the country. varied percentages (0, 25, 35, 40, fifty and 75%) of factory sand were used, and also the projected combine styles for hydrocarbon concrete combine were conducted in accordance with Marshall combine style.

The experimental results discovered that the addition of factory sand features a important improvement on the properties of hydrocarbon concrete combine. Deepak R[2] observes Steel scum could be a co-product of the industry and may be used probably as a property construction material in hydrocarbon combine with correct combine style. supported Intensive laboratory testing program, the characteristic properties of steel scum were assessed to see its quality to be employed in the hydrocarbon combine. Four completely different percentages (0, 25, 50, seventy five and 100%) of steel scum mixture were used and experiment results discovered that the addition of steel scum features a important improvement on the properties of hydrocarbon concrete mix.

II. CEMENT

Cement, as a binding material, could be a important artefact. nearly each construction work needs cement. Cements ar materials that exhibit characteristic properties of setting and hardening once mixed to a paste with water. This makes them be a part of rigid lots into coherent structures. it's powdery bonding material having adhesive and cohesive properties. Chemically it's a finely ground mixture of metallic element silicates and aluminates that set to a tough mass once treated with water. These ar referred to as as Hydraulic Cements (Portland Cement) and people setting in air ar Non-Hydraulic Cements (Ordinary Lime)

A. Objectives

The objectives of this research is to study the following long-term characteristics of fly ash-based Geopolymer concrete with the addition of nylon crystals

1) Strength; which involves compressive, flexural and splittensile
2) Water absorption tests for both cylindrical as well as cubicalspecimen
3) And resistance for both HCL and H_2SO_4

III. DATA AND SOURCES OF DATA

DjwantoroHardjito, Steenie E , Dody M.J. Sumajouw, and B.V. Rangan (1992) gave an in depth description on the the results of many factors on the properties of ash primarily based Geo compound concrete, primarily the compressive strength. The check variables enclosed were the age of concrete, hardening temperature,curing time, amount geo-polymer of super-plasticizer, the remainder amount before hardening, and also the water content of the combination. They had all over that compressive strength of concrete doesn't vary with age, and hardening the concrete specimens at higher temperature and longer hardening amount can lead to higher compressive strength. They conjointly all over Naphthalene-based super-plasticizer improves the workability of contemporary geo-polymer concrete.

Van Jaarsveld et. al., (1997; 1999)3 known the many use of waste materials like ash, GGBS, contaminated soil, mine tailings and building waste to toxic metals. Palomo et. al., (1999) according the study of ash primarily based geopolymer concrete. They used mixtures of four chemicals hydrated oxide with salt|soluble glass|water glass|glass} and hydroxide with K silicate as alkalescent liquids. then it had been found that the alkalescent liquids plays a major issue poignant the mechanical strength, and also the combination of two alkalescent liquids, water glass and hydrated oxide gave the best compressive and different strengths.

XiaoluGuo ,Huisheng Shi , Warren A. Dick(2009)[5] in this the compressive strength and micro structural characteristics of a class C fly ash geopolymer (CFAG) were studied. They conclusion of this study was that a high compressive strength was obtained when the class C fly ash (CFA) was activated by the mixed alkali activator (sodium hydroxide and sodium silicate solution) with the optimum modulus viz., molar ratio of SiO_2/Na_2O of 1.5. When Class fly ash is alkali activated and the sphere seems to be attacked and broken due to the dissolution of alumino-silicate in the high pH alkali solution. Usage of this fly ash in geo-polymer materials is a resource and energy saving process and it also indirectly reduces the emission of green house gas CO2 released from cement manufacturing. This is beneficial for resource conservation and environmental protection.

Ganapathi Naidu, A.S.S.N et al., (2012)[9] had made an attempt in studying the strength properties of geopolymer concrete using low calcium flyash replacing with slag in 5 different percentages. Sodium silicate (103 kg/m3) and sodium hydroxide of 8 molarity (41kg/m3) solutions were used as alkalis in all 5 different mixes. With maximum (28.57%) replacement of flyash with slag, achieved a maximum compressive strength of 57MPa for 28 days. The same mix is shown 43.56 MPa after exposure of 500°C for 2 hours. Aminul Islam Laskar and RajanBhattacharjee (2012) has made an attempt to study the variation of workability of fly ash based geopolymer concrete with the variation of lignin based plasticizer and poly-carboxylic ether based superplasticizer. It has been observed that there exists a critical value of molar strength of sodium hydroxide beyond which superplasticizer and plasticizer have adverse effect on workability of fly ash based geopolymer concrete. Below the critical molar strength of sodium hydroxide, there is an increase in slump. It was also observed that there is a good correlation between the rheological parameters and slump for fly ash based geopolymer concrete incorporating plasticizer and superplasticizer.

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IV. RESEARCH METHODOLOGY

To investigate the strength behaviour of Geo polymer concrete which is made by replacement of cement with flyash and ggbs and with the addition of nylon crystals . The results obtained by this mix are compared with the regular mix or conventional mixof M20 grade. The experimental programme consists of casting and testing of totally 40 cubes of size 150mm × 150mm × 150mm, . The specimens were tested after curing of 7,14, 28 and 90 days. The compressive test was conducted on the specimens.

A. Description of Materials

1) FLYASH

It was a waste product Which IS formed by industries and from other sources likes burning of different elements The specific gravity of fly ash is 2.123

2) GGBS

Ground granulated blast furnace slag is used as the primary replacement for cement in this geopolymer concrete
Specific gravity test should be conducted before mixing The specific gravity of GGBS was 2.86

3) CEMENT

Ordinary Portland cement is used for general constructions. Cement can be used must meet the following requirements.
It must develop the appropriatestrength.
It must represent the appropriate theological behavior.

Generally same types of cements have quite different geological and strength characteristics. Increase in the fineness of the Portland cement increases the early strength of concrete, since the higher surface area in contact with water will lead to a more rapid hydration. In this experimental study Nagarjuna 53 grade ordinary Portland cement is used

B. Fineness Of Cement Test

Procedure

1) Take the dry cement sample
2) Weigh correctly 100gm of cement and take it on to the IS sieve no9.
3) To break down the air set lumps in the sample withfingers.
4) Before taking the sieve, clean the sieve.
5) Shake continuously the sample giving circular and vertical motion fora period of 15 minutes.
6) Weigh the residue left on thesieve.
7) The weight shall not exceed 10% for ordinary cement sieve that is rarely to be used.

V. EXPERIMENTAL TESTS

A. Slump Cone Test

This test is used extensively in site all over the world. The slump test does not measure the workability of concrete, but the test is very useful in detecting variations in the uniformity of a mix of given nominal proportions.

B. Compressive Strength Test

Compression test was conducted on 150mm×150mm×150mm cubes. Concrete specimens were removed from curing tank and cleaned

C. Split Tensile Strength

The resistance of a material to a force tending to tear it apart, measured as the maximum tension the material can withstand without tearing. Tested by keeping the cylindrical specimen in the compressive testing machine and is continued until failure of the specimen occurs.

D. Flexural Strength

The flexural strength may be expressed as the modulus of rupture fb, which, if "a" equals the distance between the line of fracture and the nearer support, measured on the centre line of tensile side of the specimen, shall be calculated to the nearest 0.5kg/sq.cm

E. Durability Tests

AcidExposure

Hydrochloric acid (HCL) of 1% concentration was considered to be representative of aggressive sewer environments and 1% Hydrochloric acid (HCL) solution has been used in many laboratory tests to investigate the acid resistance of concretes for sewer structures.

$$\frac{\text{Load}}{\text{Area of cross section}}$$

Sulphate Exposure

In this study, Sodium sulphate,H2SO4 1% by mass of water solution is prepared .The compressive strength of cube specimens with dimensions of 15 × 15 × 15 cm which were prepared by the substitution of quartzite by coarse aggregate by weight.

F. Water Absorption Tests

Water absorption test was done for measuring the amount of water absorbed by a cube or a cylindrical specimen. And the percentage of water absorbed Concrete samples were prepared and cured in the laboratory, and are tested,

VI. RESULTS AND DISCUSSION

In this following chapter we are going to discuss about the experimental results of Geo polymer concrete and the conventional concrete specimens. We are going to compare the test results of both GPC and CC. Here we conducted compressive strength, split tensile, flexural strength, water absorption and acid resistance tests to both the GPC and CC and compared all those test results.

A. Compressive Strength Test

The compressive strength of CC and GPC was calculated for 7days, 14 days and 28 days. After the Heat curing the GPC specimen were tested at 7, 14,28 days with 3 cubes each for the better and accurate result and the average was taken as the compressive strength at that specific time period. As usually the water cured CC also tested in the same period with three specimens each for accuracy

For 7 days of curing (N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	18	18.6	18.3	18.3
GPC + 1%NC	11.09	11	11.60	11.23
GPC + 2%NC	12.40	12.06	12.23	12.23
GPC + 3%NC	13.40	13.60	13.40	13.45
GPC + 4%NC	12.50	12.05	12.20	12.25

Compressive Strength for 7 days of curing (N/mm2)

For 14 days ofcuring(N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	19.29	20	19	19.43
GPC + 1%NC	14	14.40	14.02	14.14
GPC + 2%NC	15.50	15.04	15.20	15.24
GPC + 3%NC	15.90	15.18	15.60	15.56
GPC + 4%NC	15.50	15.40	15.46	15.45

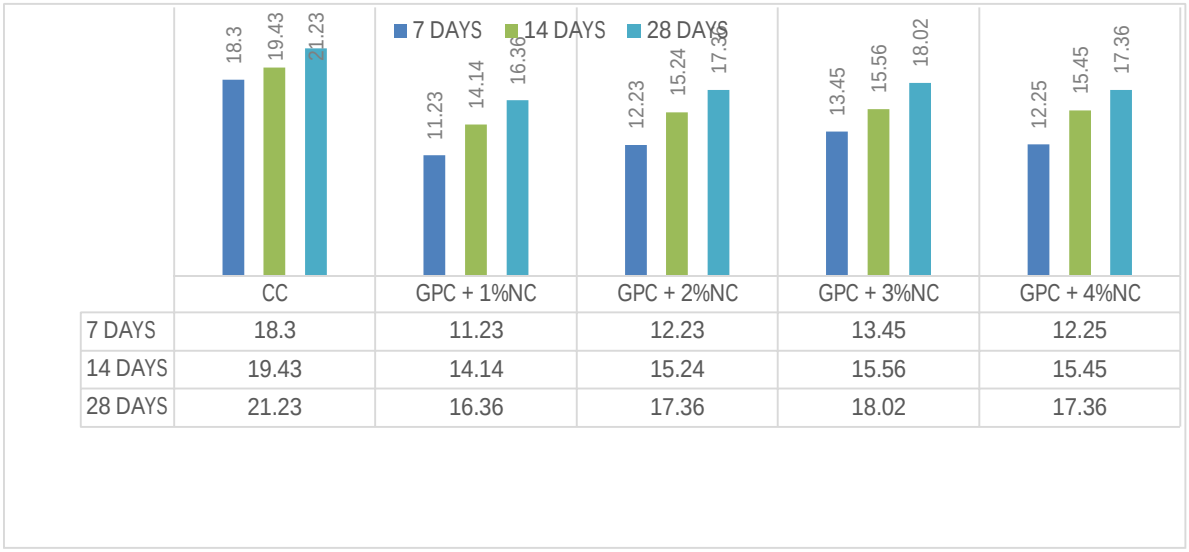
Compressive Strength for 14 days of curing (N/mm2)

For 28 days ofcuring(N/mm2)

Specimen	Sample 1	Sample 2	Sample 3	Average
CC	21.20	21.16	21.30	21.23
GPC + 1%NC	16.50	16.56	16.02	16.36
GPC + 2%NC	17.08	17.60	17.40	17.36
GPC + 3%NC	18.90	18.10	18.06	18.02
GPC + 4%NC	17	17.50	17.58	17.36

Compressive Strength for 28 days of curing (N/mm2)

Compressive Strength of Nylon Crystal in Cube Specimens



	CC	GPC + 1%NC	GPC + 2%NC	GPC + 3%NC	GPC + 4%NC
7 DAYS	18.3	11.23	12.23	13.45	12.25
14 DAYS	19.43	14.14	15.24	15.56	15.45
28 DAYS	21.23	16.36	17.36	18.02	17.36

Compressive Strength for (7,14,28 days of curing (N/mm2))

B. Split Tensile Test

The tensile strength of CC and GPC was calculated for 7days, 14 days and 28 days. After the Heat curing the GPC specimen were tested at 7, 14,28 days with 3 cubes each for the better and accurate result and the average was taken as the split tensile strength at that specific time period. As usually the water cured CC also tested in the same period with three specimens each for accuracy.
A table containing the test values was prepared for comparison of both types of concrete

For 7 days of curing (N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	2.30	2.27	2.00	2.19
GPC + 1%NC	1.24	1.30	1.30	1.28
GPC + 2%NC	1.40	1.58	1.70	1.56
GPC + 3%NC	1.5	1.65	1.69	1.62
GPC + 4%NC	1.4	1.5	1.4	1.43

Split Tensile Strength test for 7 days of curing (N/mm2)

For 14 days ofcuring(N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	3.00	3.06	3.03	3.03
GPC + 1%NC	2.16	2.10	2.15	2.13
GPC + 2%NC	2.24	2.30	2.40	2.31
GPC + 3%NC	2.35	2.40	2.42	2.39
GPC + 4%NC	2.30	2.30	2.28	2.29

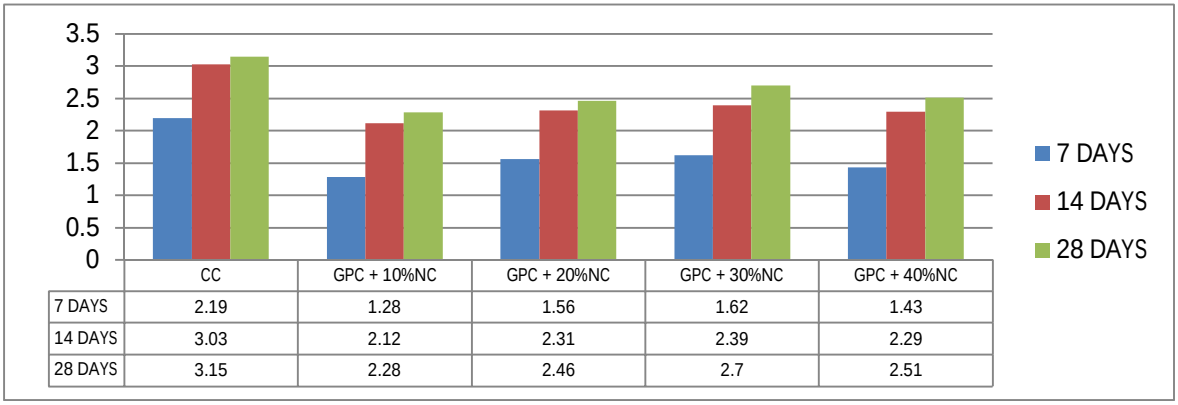
Split Tensile Strength test for 14 days of curing (N/mm2)

For 28 days ofcuring(N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	3.10	3.20	3.15	3.15
GPC + 1%NC	2.20	2.30	2.34	2.28
GPC + 2%NC	2.50	2.40	2.48	2.46
GPC + 3%NC	2.60	2.70	2.80	2.70
GPC + 4%NC	2.54	2.45	2.55	2.51

Split Tensile Strength test for 28 days of curing (N/mm2)

Split Tensile Strength of Nylon Crystal in Cylinder Specimens



	CC	GPC + 10%NC	GPC + 20%NC	GPC + 30%NC	GPC + 40%NC
7 DAYS	2.19	1.28	1.56	1.62	1.43
14 DAYS	3.03	2.12	2.31	2.39	2.29
28 DAYS	3.15	2.28	2.46	2.7	2.51

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

C. Flexural Strength

The flexural strength of CC and GPC was calculated for 14 days 28 days and 60 days. After the Heat curing the GPC specimen were tested at 14,28, 60 days with 3 cubes each for the better and accurate result and the average was taken as the flexural strength at that specific time period. As usually the water cured CC also tested in the same period with three specimens each for accuracy

14 days of curing (N/mm2)

Specimen	Sample 1	Sample 2	Sample 3	Average
CC	2.4	2.2	2.3	2.3
GPC + 1%NC	1.40	1.60	1.56	1.52
GPC + 2%NC	1.80	1.70	1.74	1.75
GPC + 3%NC	2.01	1.90	1.98	1.93
GPC + 4%NC	1.80	1.83	1.78	1.81

Flexural strength test for 14 days of curing (N/mm2)

For 28 days ofcuring(N/mm2)

Specimen	Sample 1	Sample 2	Sample 3	Average
CC	4.00	4.15	4.15	4.1
GPC + 1%NC	3.35	3.40	3.30	3.35
GPC + 2%NC	3.60	3.50	3.46	3.52
GPC + 3%NC	3.84	3.74	3.96	3.78
GPC + 4%NC	3.62	3.56	3.44	3.54

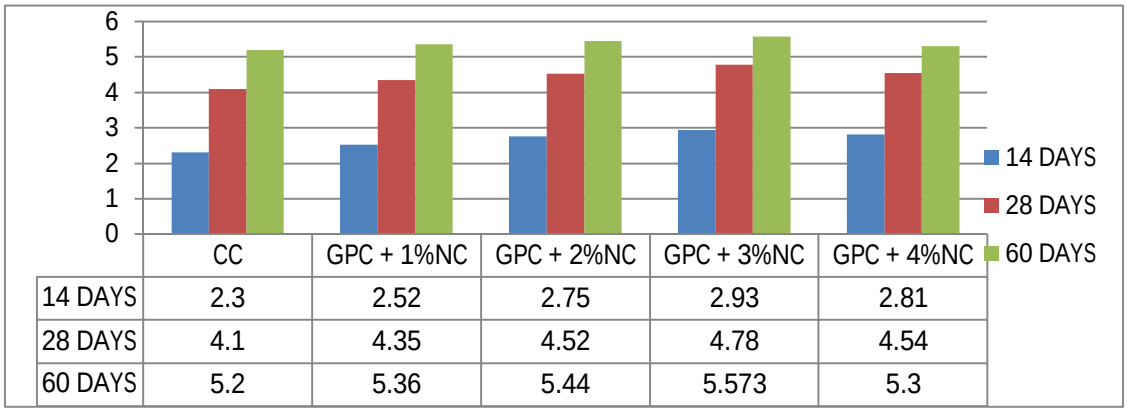
Flexural strength test for 28 days of curing (N/mm2)

For 60 days ofcuring(N/mm2)

specimen	Sample 1	Sample 2	Sample 3	Average
CC	5.3	5.2	5.1	5.2
GPC + 1%NC	4.36	4.30	4.42	4.36
GPC + 2%NC	4.44	4.40	4.48	4.44
GPC + 3%NC	4.61	4.58	4.50	4.473
GPC + 4%NC	4.1	4.4	4.39	4.3

Flexural strength test for 60 days of curing (N/mm2)

The flexural strength of CC and GPC



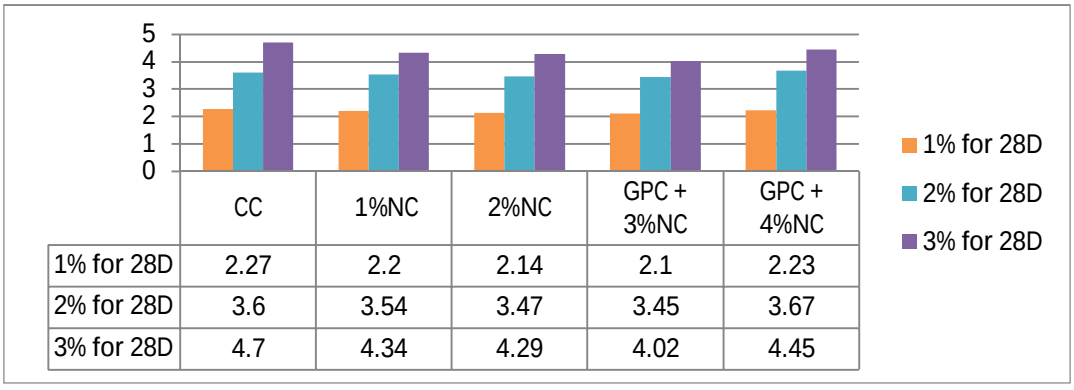
	CC	GPC + 1%NC	GPC + 2%NC	GPC + 3%NC	GPC + 4%NC
14 DAYS	2.3	2.52	2.75	2.93	2.81
28 DAYS	4.1	4.35	4.52	4.78	4.54
60 DAYS	5.2	5.36	5.44	5.573	5.3

Flexural Strength Test for (14, 28, 60 days of curing (N/mm2))

D. Acid Resistance Tests

The acid resistance tests were conducted on GPC and CC with HCL as well as with H2SO4. The tests were conducted with a specific time period of 28 days. But the percentage of acid in water was changed from 1% to 3%. simply the test was conducted by increasing acid percentage. For HCL, three specimens of each type of concrete was exposed and the loss in weight was calculated

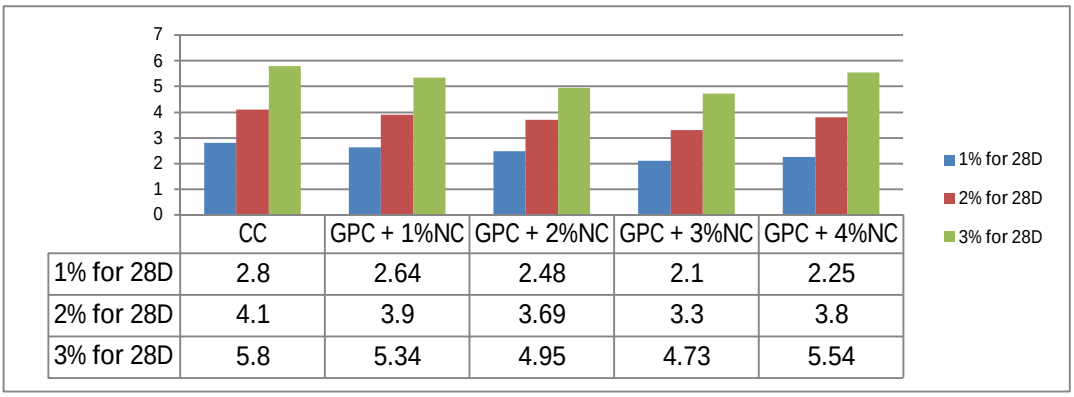
The average loss was considered and compared Effect of Acid on Geo Polymer Concrete with Nylon Crystal Cube with HCL



	CC	1%NC	2%NC	GPC + 3%NC	GPC + 4%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

Effect of Acid on Geo Polymer Concrete with Nylon Crystal Cube with H2SO4



	CC	GPC + 1%NC	GPC + 2%NC	GPC + 3%NC	GPC + 4%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

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

VII. CONCLUSIONS

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 15%.

3) It is observed that the compressive strength of the GPC is high as the values are 21.09, 22.40,23.40,22.50when % of Nylon crystal increases from 5%,10%,15%,,20% for GPC when it is compared with conventional concrete at 7 days.

4) It is observed that the compressive strength of the GPC is high as the values 24.14,25.24,25.56,25.45when % of Nylon crystal increases from 5%,10%,15%,,20% for GPC when it is compared with conventional concrete at 14 days.

5) It is observed that the compressive strength of the GPC is high as the values 26.36,27.36,28.02,27.36when % of Nylon crystal increases from 5%,10%,15%,,20% for GPC when it is compared with conventional concrete at 28days.

6) It is observed that split tensile strength of the GPC is high as the values are 3.28,3.46,3.70,3.51when % of Nylon crystal increases from 5%, 10%, 15%, 20% for GPC when it is compared with conventional concrete at 28 days.

7) It is observed that flexural strength of the GPC is high as the values are 5.36,5.44,5.573,5.3 when % of Nylon crystal increases from 5%, 10%, 15%, 20% for GPC when it is compared with conventional concrete at 60 days.

8) 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 when it is compared with conventional concrete at 28days

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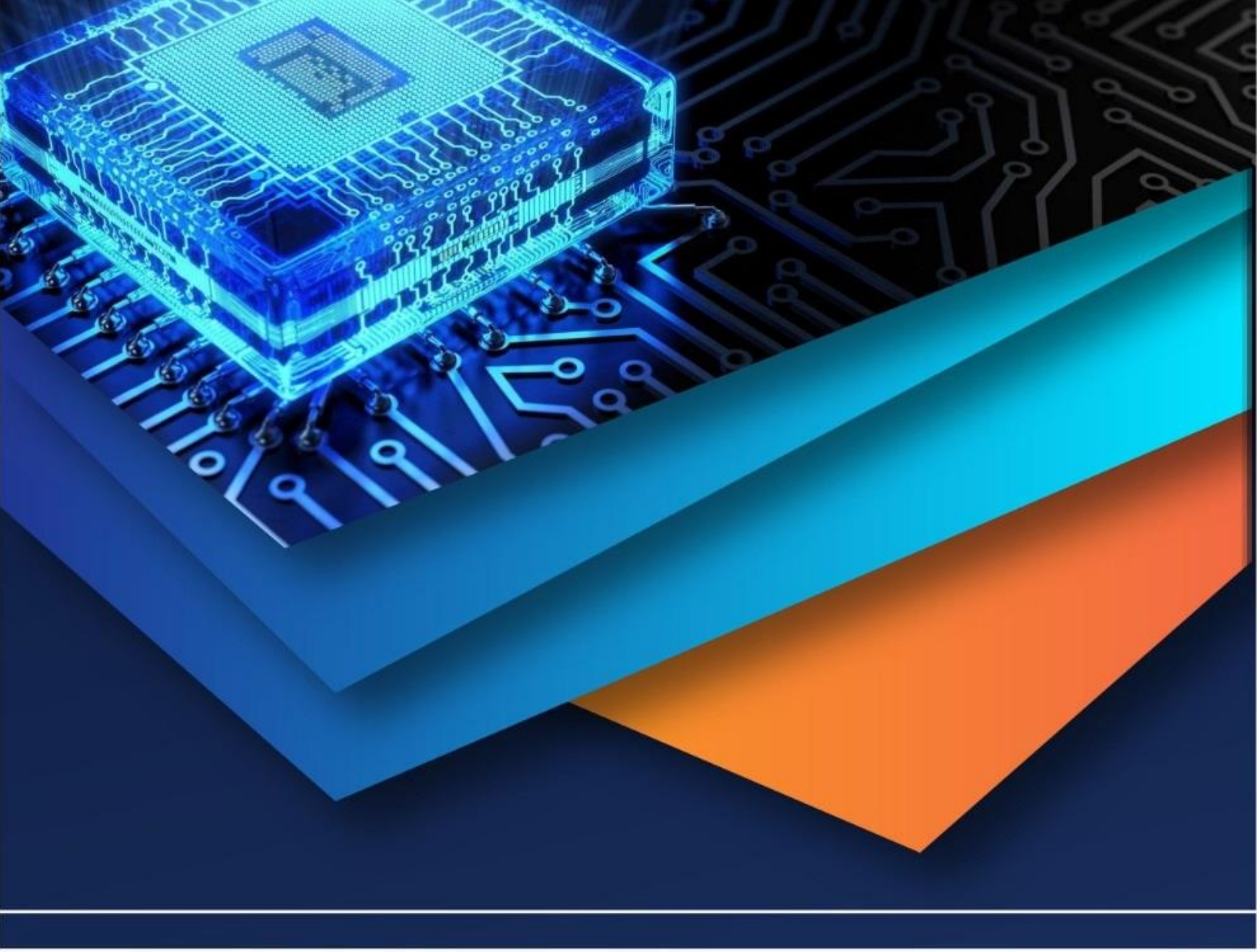

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