International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 03 | March - 2022 ISSN: 2582-3930

AN INVENTIVE CONCRETE PAVEMENT BY USING NYLON CRYSTAL AS A PARTIAL REPLACEMENT OF CEMENT

Chelliboyina Hemavathi[1], Mr. Karri Ramu[2]

M.Tech Scholar[1], Assistant Professor[2], Department of Civil Engineering, A.M. REDDY MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY, Narasaraopet, Guntur, Andhra Pradesh, India.

***

ABSTRACT: Transportation is a major developing sector in India, and required for good quality of roads, railways and airways is high. 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 ingredient of concrete. The cost of cement is increasing day by day due to its limited availability and large demand. In the present study an attempt been made on concrete and also an experimental investigation on the concrete using Nylon Crystal.

Experimental studies were performed on plain cement concrete and replacement of cement with Nylon crystal is done. In this study the concrete mix were prepared by using Nylon crystal from 1% to soon by weight of cement were added partially to the mixes. A comparative analysis has been carried out for concrete to that of the Nylon crystal reinforced concrete in relation to their compressive strength, split tension strength and flexural strength properties. The 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 Bond Strength by using cylinders and two different types of acid attack is done to determine the Bond Strength and compressive strength both on conventional concrete and Nylon crystal reinforced concrete.

Key Words: Acid Attack, Bond Strength, Compressive Strength, Flexural Strength, Nylon Crystal, Split Tensile Strength.

1. INTRODUCTION

1.1 General:

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. Large quantities of waste from various process industries are dumped into the landfill sites without any pre-processing. These enter into the ecosystems and create lot havoc. Utilization of the waste material as replacement of aggregate would reduce stress on 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.

Physical, Mechanical Workability, Strength and durability properties of the concrete were investigated under various curing and elevated temperatures.

1.2 Indain Scenario:

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.

Annually, the production of concrete is more than 10 billion tons and it is considered to be the most important building material. It has been predicted that the world's population will increase from the present-day 6–9 billion by the year 2050 and to 11 billion by the end of the century, which will result in a considerable increase in the demand for water, energy, food, river sources, common goods and services and also, the demand for concrete is expected to grow to approximately 18 billion tons a year by 2050. Consequently, the concrete industry is going to use a considerable amount of natural resources to produce cement and concrete.

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 US1 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 endeavour. In this situation to achieve the above goal there are several aspects of concrete, be it the production of constituent materials like cement, aggregate, fly ash, construction chemicals, concrete production and use, construction technologies, quality and durability, maintenance, sustainability, standardization, skill development, research and development, etc.

1.3 Importance of Concrete In Construction Industry:

Concrete is a common structural material and is well known. Concrete is extensively used in the construction of various kinds of buildings, stadiums, auditoria, pavements, bridges, piers, breakwaters, dams, waterways, pipes, water tanks, swimming pools, cooling towers, bunkers and silos, chimneys, communication towers, tunnels, etc. It is the most commonly used construction material, consumed at a rate of one ton for every living human being.

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 strength of concrete lies in its compression-bearing ability, which surpasses that of traditional materials like brick and stone masonry. Advances in concrete technology, during the past four decades have now made it possible to produce a wide range of concrete grades, varying in mass density (1200-2500 kg/m^3) and compressive strength (10-100 Mpa).

2. LITERATURE REVIEW

2.1 Effect of using fibres on the strength properties of concrete:

Dr. Suji D (2019) Bituminous mixes are most commonly used all over the world in flexible pavement construction. Here the author looking for alternative materials for pavement construction, and industrial waste materials such as foundry sand are one such category. If these materials can be suitably utilized in pavement construction, the disposal and pollution problems may be reduced. These industrial wastes occupy 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 (2019) 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. This study evaluates the use of steel slag as a substitute for fine aggregate in the production of bituminous mix for road construction. 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 the proposed mix designs for bituminous concrete mix were conducted in accordance with Marshall Mix design. The experiment results revealed that the addition of steel slag has a significant improvement on the properties of bituminous concrete mix.

Krishna Kumar S (2019) Concrete is the most important component which used in the construction industry throughout the world, where the fine aggregate is generally natural sand. The demand for natural sand in the construction industry has consecutively increased which affects the results in the reduction of sources and an increase in price. In such a situation the quarry dust can be economical alternative to the river sand. Concrete with the use of waste marble powder as an alternate for cement disposal of the marble powder material from the marble industry is one of the environmental problems worldwide today. In this the author determined about marble powder and quarry dust as partial replacement of cement and fine aggregate in concrete and comparing it with conventional concrete.

S.A Kanalli (2018) investigated comparative study of Nylon fiber reinforced concrete with conventional concrete. He conducted a preliminary study on compressive strength, tensile strength and flexural using different proportions of Nylon fibers resulted in a varying ratio of fiber dosage of 0.25 percent by volume of M_{20} grade concrete. Experimental studies shows that maximum values of compressive, split tensile and flexural strength of concrete are obtained at 0.75% fiber dosage.

S.A Kanalli et al. (2018) investigated comparative study of polymer fiber reinforced concrete with conventional concrete. He conducted a preliminary study on compressive strength, tensile strength and flexural strength determined about different proportions of polypropylene fibers resulted in a varying ratio of fiber dosage of 0.25 percent by volume of M20 grade concrete. Experimental studies shows that maximum values of compressive, split tensile and flexural strength of concrete are obtained at 0.75% fiber dosage.

Rajarajeshwari B Vibhuti et al. (2013) studied the effect of addition of mono fibers and hybrid fibers on the mechanical properties of concrete for pavements. Steel fibers of 1% and polypropylene fibers 0.03% were added to the concrete mixture as mono fibers and then it is added together to form a hybrid fiber reinforced concrete. Mechanical properties such as compressive test result, split tensile test result and flexural test result were determined. The results show about hybrid fibers improve the compressive strength marginally as compared to mono fibers. Whereas, hybridization improves split tensile strength and flexural strengths noticeably.

Kavita S kene et al. (2012) studied the laboratory experiment on fiber reinforced concrete (FRC), cube and cylinders specimens have been designed with the steel fiber reinforced concrete (SFRC) containing fibers of 0% and 0.5% volume fraction of hook end Steel fibers of 53.85, 50 aspect ratio and alkali resistant glass fibers is taken from 0% and 0.25% by weight of cement of 12mm cut length were used without admixture. Comparing the result of FRC with plain M20 grade concrete, author gave a positive effect of different fibers with percentage increase in compression and splitting improvement of specimen at 7 and 28 days, analyzed the sensitivity of addition of fibers to concrete with different strength.

A.M Shende et al. (2012) studied the strength properties of steel fiber reinforced concrete for M40 Grade. Critical investigation for M-40 grade of concrete having mix proportion, and water cement ratio 0.35 to study the compressive strength, flexural strength, Split tensile strength of steel fiber reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook stain steel fibers of 50, 60 and 67 aspect ratio the author were used. A result data obtained has been analyzed and compared with a control specimen. The relationship between aspect ratio vs. compressive strength, aspect ratio vs. flexural strength, aspect ratio vs. Split tensile strength represented graphically. Result data clearly shows percentage increase of strength in 28 days compressive strength, flexural strength and split Tensile strength for M-40 Grade of Concrete.

Indrajit patel et al. (2011) Investigated effect of polyester fibers on engineering properties of high volume fly ash concrete**.** His work includes mix design for M25, 30, 35 and M40 grade HVFA concrete with different percentage of class F fly ash is taken as 50,55 and 60%. To improve the engineering properties such as compressive, flexural, impact strength and abrasion resistance, 12mm triangular shaped polyester fiber is used at rates of 0.25% by the mass of cementious material. The test results for compressive strength at 3,7,28 and 56 days for plain HVFA concrete for all grades with and without meets codal requirement. The use of polyester fibers has increased the compressive strength to order of 12 to 15 %. Flexural strength using center point loading also meets the required parameters and fiber reinforced HVFA shows 16 to 23% increase compared to plain HVFA concrete at 28 and 56 days.

Majid Ali (2010) Investigated to Coconut fiber is one of the natural fiber abundantly available in some regions which is extracted from the husk of coconut fruit. Not only the physical, chemical and mechanical properties of coconut fibers are shown; but also properties of composites (cement pastes, mortar and/or concrete mixture etc.,), in which coconut fibers are used as reinforcement. The research carried out and the conclusions drawn by different researchers in last few decades are also briefly presented. In paper the author showing the relationship between different properties are also shown in this paper. Coconut fibers reinforced composites have been used as cheap and durable non-structural elements.

2.2 Current Research in Concrete:

In the **previous literature** the authors have studied the physical properties of the different types of materials and the admixtures which are used as replacement in the concrete. The previous authors have also experimented on artificial material like fibers as a partial replacement of cement. Some of the authors have also determined the properties of concrete by using different natural fibers.

In the **present study** both physical and mechanical properties of reinforced concrete with a partial replacement of cement with Nylon Crystal is determined. Concrete has a great advantage in which there is a possibility to choose its constituents and then it is up to the user to exploit and optimize the properties of each of the components to develop a high quality, durable construction material of high impermeability. By using this Nylon crystal there was a decrease in cement content in concrete. And also the strength of the concrete is increased by partially replacement of cement with nylon crystal. The result obtained has shown the influences of Nylon crystal on strength parameter of cement concrete.

3. METHODOLOGY AND EXPERIMENTAL STUDY

In this chapter the methodology adopted and experimental study carried out is presented in the form of flowchart and parameters studied. Also the sequential activities involved in this study are presented in graphical form. Methodology is broadly of two phases. In this phase tests are carried on the reinforced concrete by varying the Nylon crystal.

3.1 Methodology:

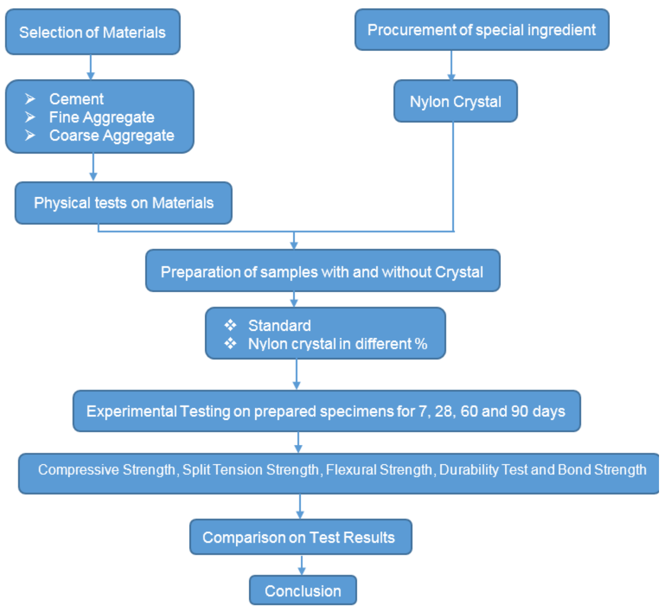

Figure3.1: Outline of Methodology

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 03 | March - 2022 ISSN: 2582-3930

3.2 Material Characterization:

Cement:

Cement is a binder material. The cement sets and hardens independently, and can bind other materials together. In 2010, the world production of cement was 3,300million tons. The top three producers were China with 1,800, India with 220 and U.S.A with 63.5million tons respectively. C e m e n t is used as an ingredient in the production of mortar in masonry and of concrete, a combination of cement and an aggregate to form a strong building material. Cement is manufactured by the heating limestone (calcium carbonate) with small quantities of other materials (such as clay) to 1450°C in a kiln this process is called as calcination, whereby a molecule of CO_2 is liberated from the calcium carbonate to form calcium oxide, or quicklime, which is then blended with the other materials that have been included in the mix. The resulting hard substance such as clinker, is then ground with a small amount of gypsum into a powder to make "Ordinary Portland Cement" (OPC), this is the most commonly used type of cement. The Portland cement is a basic ingredient of concrete mortar and most non specialty grout. For the production of concrete Portland cement is used. Concrete is a composite material consisting of fine aggregate (such as sand), cement and water. As a construction material, concrete can be casted in almost any shape desired, and once hardened, can become a structural (load bearing) element. The Portland cement may be grey or white. Cement sets or cures when mixed with water which causes a series of hydration chemical reactions. The constituents slowly hydrate and crystallize; the interlocking of the crystals gives concrete strength. Maintaining high moisture content in cement during curing increases both the speed of curing, and its final strength. Here Gypsum is often added to Portland cement to prevent early hardening or "flash setting", allowing a longer working time. The time it takes for cement to cure varies depending on the mixture with respect to the environmental conditions; initial hardening can occur in as little as twenty minutes, while full cure can take over a month. Cement typically cures to the extent that it can be put into service within 24 hours to a week. Cements used in construction can be characterized as being either hydraulic or non-hydraulic. Hydraulic cements (e.g. Portland cement) because harder for hydration, a chemical reaction between the anhydrous cement powder and water. Thus, they can harden underwater or when constantly exposed to wet weather. The chemical reaction results the hydrates that are not very water-soluble and so are quite durable in water. Non-hydraulic cements do not harden underwater; for example, slaked limes harden by reaction with atmospheric carbon dioxide. The cement used in this experimental work is 53 grade ordinary Portland cement.

Figure Cement

3.2.1 Aggregates

Aggregates are the very important constituents in concrete. Aggregates gives body to the concrete, and it reduces the shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading is that a sample fractions of aggregates in required proportion such that the sample contains the minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste will mean less quantity of cement and less water, which will further mean increased economy, lower shrinkage, greater durability and higher strength.

Requirements of aggregates

- Aggregates must be hard, strong and durable.
- It should be free from inorganic materials, oils etc.
- Reduce Porosity.
- The shape of aggregate should be angular
- Low thermal conductivity
- Should not react with cement or steel
- Aggregates Should be well graded
- Should be free from deleterious materials

3.3 Fine aggregate:

The 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. 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. The sand was first sieved through 4.75mm sieve to remove any particle greater than 4.75 mm and then was washed to remove the dust. The results of testing carried out for fine aggregate is provided.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 03 | March - 2022 ISSN: 2582-3930

Fine aggregates are available from:

- ❖ River sand
- ❖ Pit sand
- ❖ Sea sand

Locally available sand passed through 4.75mm IS sieve is used.

Figure. 3.3 Fine aggregates

3.3.1 Tests on Fine Aggregate:

Specific Gravity IS : 238 1963 Part I Specific gravity of fine aggregate is 2.74. It ranges between 2.6 – 2.9

Sieve Analysis Sieve analysis was conducted to the fine aggregate which shows the sand belong to zone III as per IS: 383-1917

Figure. 3.3.1 Sieve Shaker

Table 3.3.1 Grain size analysis of sand

Sl. No	IS Sieve No	Particle size	Wt. Retained	% retained	Cumulative % Retained	% finer	Zone3
1	10mm	10mm	2	0.2	0.2	99.8	90-100
2	4.75 mm	4.75 mm	12	1.2	1.4	98.6	85-100
3	2.36 mm	2.36 mm	30	3.0	4.4	95.6	75-100
4	1.18 mm	1.18 mm	322	32.2	36.6	63.4	60-79
5	600 micron	600 micron	208	20.8	57.4	42.6	12 – 40
6	300 micron	300 micron	276	27.6	85.0	15.0	0-10
7	150 micron	150 micron	107	10.7	95.7	4.3	-
8	75 micron	75 micron	21	2.1	97.8	2.2	-
9	Pan	0	22	2.2	100	Zero	-

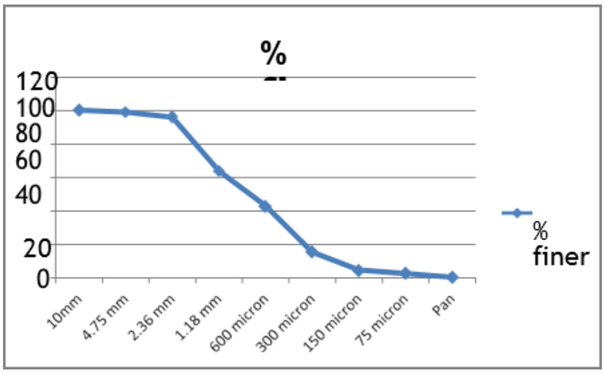

Figure. 3.3.1 Sieve analysis graph for fine aggregate

3.4 Nylon crystal:

As per my investigation, Nylon is a strongest crystal fibre and it have good abrasion resistance. Generally, Nylon crystals are in Octagonal shape which is made by Polymer and Wax on melt spinning machine.

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.
- ❖ Drap-ability – 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
- ❖ Hard and tough thermoplastic.
- ❖ Low coefficient of friction and high tensile strength
- ❖ Good dimensional stability
- ❖ Low tendency to work and smooth appearance.

Figure.3.4 Nylon crystal

4. Preparation of Samples and Experimental setup

It deals with preparation of Mix design to cast the samples and experimental methodology for carrying out Compressive, Split tensile and Flexural strength of concrete samples.

4.1 Mix Design:

All the concrete mixes in the project are prepared as per IS: 10262-2009.This standard was first prepared in the year 1982 and later revised in the year 2009.This Indian standard was adopted by the Bureau of Indian standards, after the draft finalized by the cement and the concrete sectional committee has been approved by the civil engineering division council.

The following prerequisites are to be taken into consideration before designing a concrete

a) **mix:** Degree of workability desired

b) Characteristic compressive strength of concrete at 28 days (f_{ck})

c) Limitations on the water cement ratio and the minimum cement content to ensure adequate durability

d) Type and maximum size of aggregate to be used

e) Standard deviation(s) of compressive strength of concrete.

Grade Designation: M 50

1. Characteristic Comp. Strength required in the field at 28 days = 50 Mpa
2. Max.size of aggregate= 20 mm
3. Type of exposure= Mild
4. Minimum cement content= 400 kg/m^3
5. Maximum water cement ratio = 0.32

Test data for materials:

a) Cement Used= OPC 53Grade

b) Specific Gravity of

1) Fine Aggregate= 2.57

2) Coarse Aggregate –20mm=2.64

c) Specific Gravity of Cement = 3.16

d) Sand corresponds of Zone = Zone II

Mix Calculation: –

1. Target Mean Strength = 0 + (5 X 1.65) = 58.25 Mpa
2. Selection of water cement ratio: Assume water cement ratio =0.35
3. **Calculation of water:**

Approximate water content for 20mm max. Size of aggregate = 180 kg /m^3 (As per Table No. 5, IS: 10262). As plasticizer (Conplast SP 430) is proposed we can reduce water content by 20%.

Now water content = 180 X 0.8 = 144 kg /m3

Calculation of cement content:

Water cement ratio = 0.35

Water content per cum of concrete=144 kg Cement content= 144/0.35 = 411.4 kg/m3

Say cement content = 412 kg / m3

Hence, O.K.

4. Calculation for C.A & F.A:

Volume of concrete = 1 m^3

Volume of cement= 412/ (3.16 X 1000) = 0.1303 m3

Volume of water = 144/ (1 X 1000) =0.1440 m^3

Total weight of other materials except coarse aggregate = 0.1303 + 0.1440 = 0.2743 m^3

Volume of coarse and fine aggregate = 1-0.2743 = 0.7257 m^3

Volume of F.A = 0.7257 X 0.33 = 0.2394 m^3

(Assuming 33% by volume of total aggregate)

Volume of C.A	**= 0.7257 - 0.2394**	**= 0.4863 m^3**
Therefore weight of F.A	= 0.2394 X 2.57 X 1000	**= 615.258kg/m^3**
Say weight of F.A	= 615 kg/m^3	
Therefore weight of C.A	**= 0.4863 X 2.64 X 1000**	**= 1283.832 kg/ m^3**

Say weight of C.A. = 1284 kg/ m^3

Mix-proportions:

Cement	**= 412 kg / m^3**
Water	**= 144 liters**
Fine aggregate	**= 615 kg/m^3**
Coarse aggregate	**= 1284 kg/m^3**
Water-cement ratio	**= 0.35**
Water : Cement : F.A : C.A	**= 0.35: 1: 1.492 : 3.116**

4. Preparation of samples:

4.1 Experimental setup:

4.1.1 Compressive strength:

The compressive strength of a material is that value of uni-axial compressive stress reached when the material fails completely. The cubes are then tested between the loading surfaces of the compressive testing machine of capacity 2000KN in such a way that the smooth surface directly receives the load and it is applied until the failure of the load. The compressive strength is determined by the ratio of failure load to the cross sectional area of the specimen.

Figure. 4.1.1 Testing of Cube Specimens

4.1.2 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.

Splitting Tensile Strength shall be calculated by using the formula:

$$f_{ct} = \frac{2P}{\pi \, l d}$$

P = maximum load in Newtons applied to the specimen,

L = length of the specimen in mm,

D = cross sectional dimension of the specimen in mm.

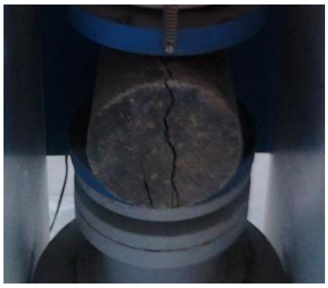

Figure. 4.1.2 Testing of Cylindrical Specimens

5. RESULTS AND DISCUSSION

Mechanical Characteristics of Nylon Crystal in Concrete:

5.1 Compressive Strength of Nylon Crystal in Cube Specimens:

Table 5.1 Compressive strengths of Nylon Crystal cube specimens

MIX	7 DAYS	28 DAYS	60 DAYS	90 DAYS
CC	19.43	41.82	57.72	86.14
CC+1% NC	21.37	44.66	60.45	86.94
CC+2% NC	23.22	47.34	62.14	87.55
CC+3% NC	25.76	50.07	62.89	88.13
CC+4% NC	26.94	52.76	63.67	88.9
CC+5% NC	27.76	55.72	64.49	89.54
CC+6% NC	27.14	54.11	64.21	89.18

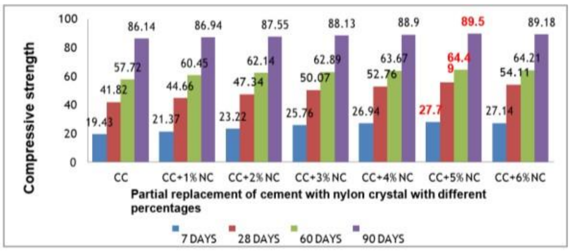

Figure. 5.1 Compressive strength values of C.C and Nylon Crystal at 7, 28, 60 and 90 Days

Description of Result:

1. From fig: 5.1, It is observed that the compressive strength of the concrete increases to 9.98%, 19.50%, 32.57%, 38.65% and 42.87% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 7 days.
2. It is observed that the compressive strength of the concrete increases to 6.79%, 13.19%, 19.72%, 26.15% and 33.23% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 28 days.
3. It is observed that the compressive strength of the concrete increases to 4.72%, 7.65%, 8.95%, 1030%

and 11.72% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 60 days.

4. It is observed that the compressive strength of the concrete increases to 0.92%, 1.63%, 2.31%, 3.20% and 3.94% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 90 days.
5. It is observed that compressive strength values decreased as the percentage of Nylon crystal increases beyond 5%.

5.1.2 Split Tensile Strength of Nylon Crystal in Cylinder Specimens:

5.1.2 Split Tensile Strength of Nylon Crystal in Cylinder Specimens:

Table 5.2 Split Tensile strengths of Nylon Crystal Cylinder Specimens

MIX	7 DAYS	28 DAYS	60 DAYS	90 DAYS
CC	2.841	3.521	4.222	5.366
CC+1% NC	2.914	3.594	4.281	5.42
CC+2% NC	2.983	3.637	4.367	5.497
CC+3% NC	3.176	3.708	4.439	5.558
CC+4% NC	3.258	3.781	4.498	5.612
CC+5% NC	3.349	3.869	4.572	5.684
CC+6% NC	3.341	3.858	4.564	5.677

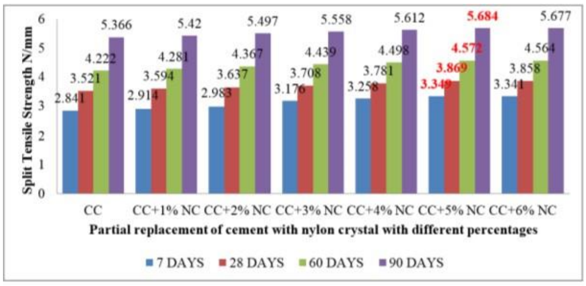

Figure. 5.2 Split tensile strength values of C.C and Nylon Crystal at 7, 28, 60 and 90 Days

Description of Result:

1. From fig: 5.2, It is observed that split tensile strength of the concrete increases to 2.56%,4.99%,11.79%,14.67% and 17.88% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 7 days.
2. It is observed that split tensile strength of the concrete increases to 2.07%, 3.29%, 5.31%, 7.38% and 9.88% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 28 days.
3. It is observed that split tensile strength of the concrete increases to 1.39%, 3.43%, 5.13%, 6.53% and 8.28% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 60 days.
4. It is observed that the Split tensile strength of the concrete increases to 1.11%, 2.42%, 3.54%, 4.58% and 5.97% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 90 days.
5. It is observed that Split tensile strength values decreased as the percentage of Nylon crystal increases beyond 5%.

6. 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 5%.
3. It is observed that the compressive strength of the concrete increases to 6.79%, 13.19%, 19.72%, 26.15% and 33.23% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 28 days.
4. It is observed that the compressive strength of the concrete increases to 0.92%, 1.63%, 2.31%, 3.20% and 3.94% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 90 days.
5. It is observed that split tensile strength of the concrete increases to 2.07%, 3.29%, 5.31%, 7.38% and 9.88% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 28 days.
6. It is observed that the Split tensile strength of the concrete increases to 1.11%, 2.42%, 3.54%, 4.58% and 5.97% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 90 days.
7. It is observed that flexural strength of the concrete increases to 1.43%, 2.63%, 4.54%, 5.74% and 7.65% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 28days.
8. It is observed that the flexural strength of the concrete increases to 0.79%, 1.75%, 2.87%, 3.50% and 4.62% when % of Nylon crystal increases from 1%,2%,3%,4% and 5% for NCRC when it is compared with conventional concrete at 90 days.
9. It is observed that the Bond Strength of Split Tensile strength of Nylon Crystal in Cylinder Specimens of the concrete increases to 3.58%, 3.81%, 4.12%, 4.79%, 4.91%, 5.6%, 5.02% when % of Nylon crystal increases from 1%, 2%, 3%, 4%, 5% for NCRC when compared with conventional concrete at 28 days.
10. It is observed that bond strength of the concrete increases to 0.06%, 0.15%, 0.33%, 0.37% and 0.44% when % of Nylon crystal increases from 1%, 2%, 3%, 4% and 5% for NCRC when it is compared with conventional concrete at 28 days.

6.1 Scope of future improvement:

The present data indicates that using Nylon Crystal there is significant improvement in the strength properties of concrete. For further study can be extended to know the mechanical properties of Nylon Crystal reinforced concrete by adding combination of Nylon Crystal with other materials (Hybridization). Here we are studied addition of Nylon Crystal in cement to increase the properties of concrete like strength and durability, for future investigations we can also add admixtures not only in the cement, we can add in aggregates also. We can also study different parameters like permeability, porosity, drying shrinkage, abrasion resistance etc, of the concrete with or without Nylon Crystal.

REFERENCES

1. Dr.Suji D, Poovendran S, Prabhakar P " Experimental Study on Partial Replacement of Waste Foundry Sand in Flexible Pavements" in IJCSER, 2019.

2. Deepak R " Experimental study on Mechanical properties of the Bituminous paving mixes using steel slag" in IJCSER, 2019.

3. Krishna Kumar S "Experimental Study on Concrete using Waste Marble Power and Quarry Dust as Partial Replacement of Cement and Fine Aggregate" in IJCSER,2019.

4. S.A Kanalli, Ramu palankar, Bharat kumar, Praveen kumar, Prakash S.K "Comparitive Study On Nylon Fiber Reinforced Concrete With Conventional Concrete Pavement" in the IJRET, 2018.

5. Rajarajeshwari B Vibhuti, Radhakrishna and Aravind N. "Mechanical Properties Of Hybrid Fiber Reinforced Concrete For Pavements" in IJRET NOV2013

6. Kavita S kene, Vikrant S Vairagade and Satish Sathawane "Experimental Study On Behaviour Of a Steel and Glass Fiber Reinforced Concrete Composites" in Bonfring International Journal of Industrial Engineering and Management Science, Vol. 2, No. 4, December 2012A.M Shende, A.M Pande, M. Gulfam pathan , " Experimental Study On Steel Fiber Reinforced Concrete For M40 Grade" in the International refereed Journal of engineering and science.

7. A.M Shende, A.M Pande, M. Gulfam pathan , " Experimental Study On Steel Fiber Reinforced Concrete For M40 Grade" in the International refereed Journal of engineering and science.

8. Indrajt Patel and C D Modherav " Study Effect a Polyester Fibers On Engineering Properties Of High Volume Fly Ash Concrete" in the Journal of engineering research and studies,2011.

IS Codes:

1. IS: 2386 -1963, "Methods of testing for aggregate for concrete".

2. IS:10262-2009, "Recommended guidelines for concrete mix design and Bureau of Indian standards", New Delhi, India.

3. IS:516-1959, Indian standard methods of tests for strength of concrete, Bureau of Indian Standards, New Delhi, India.

4. IRC: 58-2002, Guide lines for the design of plain jointed Rigid Pavements for the Highways, India.

5. IS 456 – 2000: Indian Standard "Plain and reinforced concrete" – code of practice

6. IS 383 – 1970: Indian Standard "Specification for coarse and fine aggregates from naturals sources for concrete"