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EFFICIENT USE OF CENTRILIT NC IN HIGH STRENGTH CONCRETE AND REPLACEMENT OF FINE AGGREGATE BY QUARRY DUST

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Abstract

Concrete is an important building material but is weak tensile strength and this normal concrete possess Limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro-cracks. An mineral admixture Centrilit NC (nano- crystallizers) when added in certain percentage in the concrete improve the strain properties as well as crack resistance, corrosion resistance, ductility, flexure strength and toughness. Sand is completely replaced by Quarry dust and is a fine particle when boulders are broken into small pieces quarry dust is formed. Mainly this study and research in concrete to improve the strength and crack resistance of concrete. This project outlines the experimental investigation conducts on the use of Centrilit NC and complete replace of sand by Quarry dust with strength and of concrete.

Keywords : Tensile strength:microcracks; flexural strength; durability; strain properties; crack resistance; corrosion resistance; toughness.

1. INTRODUCTION

Concrete is mixture of cement (or lime), sand, brick or stone ballast and water which when placed in forms and allowed to cure, becomes hard like stone. The hardening is caused by the chemical reaction between the cement and water. The cement and water form paste which, upon hardening, binds the aggregates to a permanent mass. Cement is called the “binding material”. The stone or brick ballast is called the “coarse aggregate” as distinguished from the “fine aggregate” which is sand. The mortar used in concrete is called “matrix”. Cement concrete when used by itself is known as “mass concrete”. An admixtures is a materials other than water, aggregate and cement and is added to batch immediately before or during its mixing. These are used to improve or give special properties to concrete. The use of admixture should offer an improvement not economically attainable by adjusting the proportions of cement, finely divided materials which improve the workability, durability and increases the strength and also decrease the permeability. Admixture is generally in two types they are chemical and mineral admixtures. Centrilit NC is a admixtures which used in this experimental study.

Adding as a admixture of Centrilit NC (nano-crystallizers) of 0%, 2.5%, 5%, 7.5%, as per Indian Standard(IS), American Concrete Institute (ACI) and British (DOE method) Department Of Environment. To compare the result which gives optimum level of strength, durability, flexurability and tensile strength.The

particle size of Centrilit NC is significantly smaller than the particle size of cement. The particles more or less completely fill the fine cavities in the hardened cement paste, depending on the grade of dispersion. Not only the concrete-strength but also the concrete-density is increased by the pozzolana. The chloride migration is reduced, the resistance against detrimental substances is improved and the durability of the concrete is generally increased. Centrilit NC makes the manufacture of very homogeneous concrete possible. Thus the surface quality can be optimized. A bright-toned, aesthetic concrete surface can be achieved. Apart from a high uniformity, a long-term availability is also ensured.Quarry dust is complete replacement for fine aggregate that is sand. It is cheap material and by product when rock is turn to small particles.In this project presents the additiveCentrilit NC is used as a versatile material and Quarry dust as a fine aggregate which overcomes all types of problems in the concrete materials.

A . CENTRILIT NC

Centrilit NC (nano-crystallizer) is a pozzolanic concrete additive based on amorphous alumo-silicate. It concerns a synthetically manufactured material, not an industrial by-product. Apart from a high uniformity a long term availability is also ensured. New generation materials like Centrilit NC based on special nano-crystallizershave been recently developed. These new materials improve the properties that are crucialfor the durability ofhigh-performance concrete. In addition to reducing chloride migration, an exceptional chemical and acid resistance of the high-performance concrete can be achieved with Centrilit NC. The concrete structure is simultaneously reinforced right down to Nano scale, density is improved and compressive and flexural strength as well as abrasion resistance of the high-performance concrete is increased.

B. MIXING REACTION PROCESS

The particle size is significantly smaller than the particle size of cement. The particles more or less completely fill the fine cavities in the hardened cement paste, depending on the grade of dispersion. Not only the concrete-strength but also the concrete-density is increased by the pozzolan. The chloride migration is reduced, the resistance against detrimental substances is improved and the durability of the concrete is generally increased. Centrilit NC makes the manufacture of very homogeneous concrete possible. Thus the surface quality can be optimized. A bright-toned, aesthetic concrete surface can be achieved. Apart from a high uniformity, a long-term availability is also ensured. Centrilit NC is available as a 50% suspension (slurry) or as fine powder. It can be mixed fast into the concrete.

C. ADVANTAGES OF THE PROJECT

In brief, Centrilit NC provides the following benefits when used in concrete

- Provides excellent water-tightness
- Reduces chloride ingress and carbonation
- Increases sulphate-resistant of concrete
- Enhanced workability and finishing of concrete
- Reduced shrinkage, due to ‘particle packing’ making concrete denser
- Improved colour by lightening the colour of concrete making it possible to tint concrete integrally
- Endless quantities
- Factory made homogeneous product
- Reduced dosage of super-plasticizer

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- Better workability
- Better pumpability

TYPE OF MATERIALS USED AND THEIR SPECIFICATIONS

S.No	Table column head		
	Materials	**Type**	**Specification**
1	CEMENT	OPC 53 Grade	IS 12269- 2013 Ordinary Portland Cement
2	COARSE AGGREGATE	Crushed Angular Aggregate (size = 20 mm)	IS 2386 (Part I & III)-1963
3	FINE AGGREGATE	Natural Sand (size ≤ 4.75 mm)	IS 2386(Part I & III)-1963
4	WATER	Clean potable water (pH value=7.0)	IS 456 – 2000
5	CENTRILIT NC	Adding as a Chemical admixtures in concrete.	Trial & error approach
6	SUPERPLASTICIZERS	Poly Carboxylate Ether (PCE) (Dosage=0.2% of total cementitious materials)	IS 9103

D. OBJECTIVES OF THE PROJECT

- Centrilit NC provides extreme density to the cement matrix.
- It helps increases durability of the concrete tremendously.
- Construction chemicals encompass a wide range of products, based on the theme of concrete.
- The industry is focused on the improvement, protection and restoration of concrete and concrete-based construction.
- The focus of construction is back to improved construction time, better durability, reduced maintenance and higher quality.

2. TESTING OF MATERIAL USED

Table 2.1 Testing Of Cement

Sl.No	Type Of Test	Value Obtained
1	Fineness Test By Sieving	5%

2	Standard Consistency Test	26%
3	Initial Setting Time	30 minutes
4	Final Setting Time	8 hours
5	Specific Gravity Test	3.6

Table 2.2 Testing Of Centrilit NC

Sl.No	Type Of Test	Value Obtained
1	Fineness Test By Sieving	4 %
2	Consistency Test	30 %
3	Initial Setting Time	45 Minutes
4	Final Setting Time	8.5 Hours
5	Specific Gravity Test	2.85

Table 2.3 Testing of fine Aggregate

Sl.No	Type Of Test	Value Obtained
1	Fineness Modulus Test	5.46%
2	Bulkiness Of Sand	11.11%
3	Specific Gravity Test	2.77
4	Water Absorption Test	1 %

Table 2.4 Testing of coarse Aggregate

Sl.No	Type Of Test	Value Obtained
1	Specific Gravity Test	2.47
2	Water Absorption Test	1%
3	Aggregate Crushing Value	3.5%
4	Aggregate Impact Value	22.5%

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5	Aggregate Abrasion Value	54%
6	Flakiness Index	36.30%
7	Elongation Index	45.25%

3. MIX DESIGN

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. Mix design for each set having different combinations are carried out by using **ACI.211.4r method**. The mix proportion obtained for normal M60 grade concrete is **1: 0.81: 1.83** with a water-cement ratio of **0.31.** Polycarboxylate ether of dosage 0.2% is used.

4.CASTING AND TESTINGOF SPECIMENS

4.1 COMPRESSIVE STRENGTH TEST

Cubes moulds of size 150 X 150 X 150 mm, to be used are cleaned properly with dry cloth and oil was applied before casting. The amount of cement, fine aggregate, coarse aggregate were measured based on their weight and then they were mixed on water tight platform under standard condition. Water was added gradually till all the materials has been adequately mixed together to form a uniform mix. Concrete was then filled in moulds and compacted using standard tamping rod. After curing for required period the specimen were tested using compressive testing machine. The curing periods were was 7days, 14days and 28days. Compressive strength test was found by the following formula:

$$\textbf{Compressive strength} = \frac{\text{max load(N)}}{\text{crosssectionalarea(mm}^2\text{)}}$$

Table 4.1.Comparison of compressive strength between standard, 0%, 2.5%, 5% and 7.5% CNC concrete cubes

% of CNC (Addition to concrete)	7days (N/mm^2)	14days (N/mm^2)	28 days (N/mm^2)
0%	27.07	49.22	61.26
0% (Quarry Dust)	27.86	53.00	65.76
2.5%	28.46	54.44	66.71
5%	29.18	56.11	70.43

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7.5%	27.86	53.28	64.10

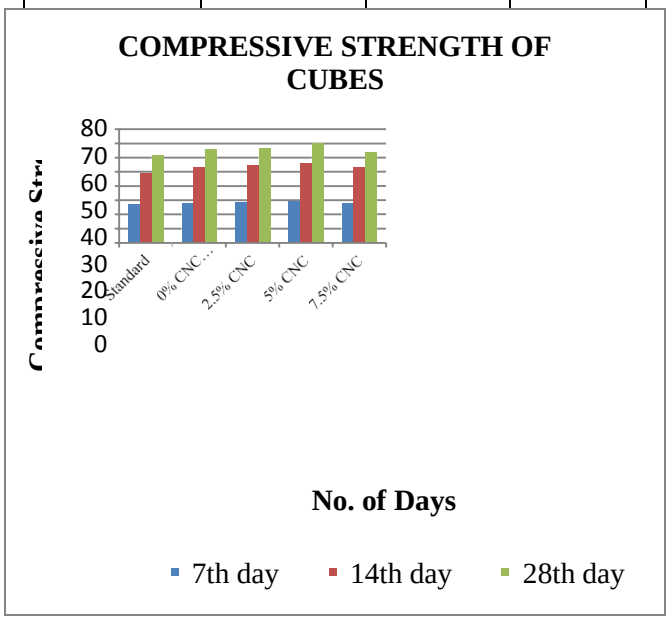

Fig.4.1. Comparison of compressive strength between standard, 0% CNC (Quarry dust), 2.5%, 5% and 7.5% CNC concrete cubes

4.2. SPLIT TENSILE TEST

Cylinder specimen of size 300mm height and 150mm diameter are to be cast for the mix proportion. After curing for required period the specimen were tested using compressive testing machine. The curing periods are 7days, 14days and 28days and tested to find the split tensile of concrete and the result obtained is being tabulated below.

Table 4.2. Split Tensile Test of Cylinder

% of CNC	7 DAYS (N/mm^2)	14 DAYS (N/mm^2)	28 DAYS (N/mm^2)
0%	6.57	11.00	15.12
0% (Quarry Dust)	8.10	13.68	17.59
2.5%	10.78	14.34	18.15
5%	**12.50**	**16.50**	**25.20**

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7.5%	10.21	12.89	16.98

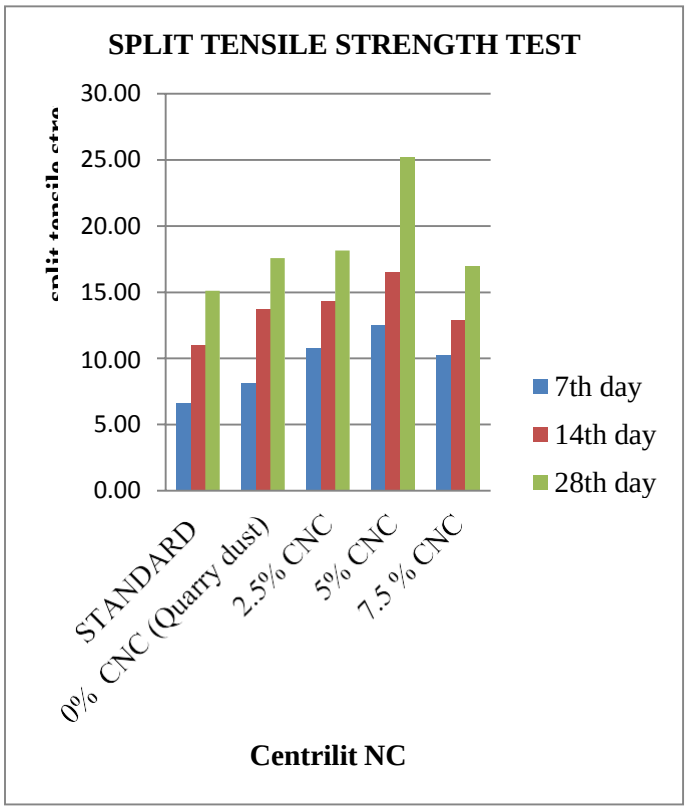

Fig.4.2. Comparison of Split tensile strength between standard, 0% CNC (Quarry dust), 2.5%, 5% and 7.5% CNC concrete cylinder

4.3. FLEXURAL STRENGTH TEST:

The flexural strength of concrete beam, using CNC as additive for Cement was determined at the age of 7 days 14 days and 28 days were reported in Table 4.3 and Fig.3 The flexural strength of concrete with CNC is considerably higher than that of the conventional concrete.

Table 4.3 Flexural Strength for Prisms in N/mm^2

% of CNC	7 DAYS (N/mm^2)	14 DAYS (N/mm^2)	28 DAYS (N/mm^2)
0%	8.00	9.87	13.50
0% (Quarry Dust)	8.87	10.72	14.33
2.5%	9.65	11.75	15.90

5%	**11.10**	**14.38**	**19.66**
7.5%	7.95	10.89	14.66

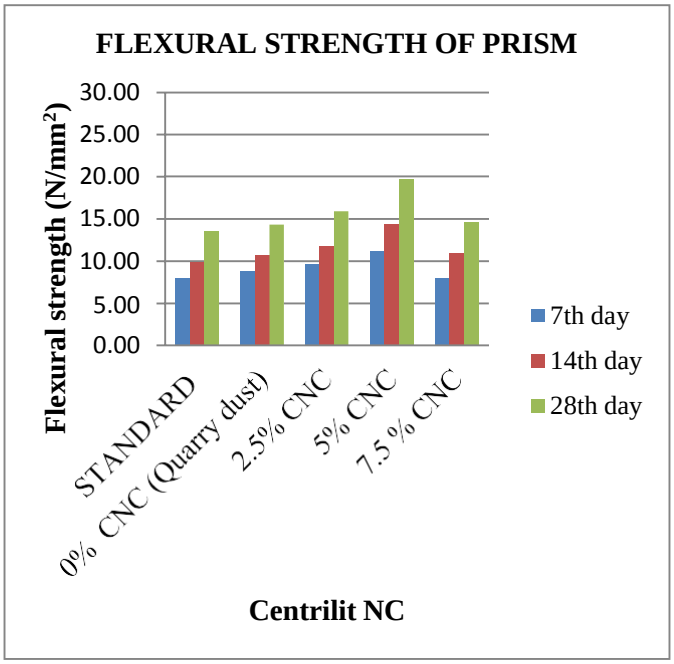

Fig.4.3. Comparison of flexural strength between standard, 0% CNC (Quarry dust), 2.5%, 5% and 7.5% CNC concrete prisms

CONCLUSION

Centrilit NC is also very convincing in visual aspects. Thus, the concrete additive achieving a bright-tone surface equally combines durability and esthetics. This leads to maximum architectural freedom when manufacturing fair-faced concrete with the aid of the product.This project work is based on the usage of the Centrilit NC concerns a synthetically manufactured material, not an industrial by-product. Apart from a high uniformity a long-term availability is also ensured. New generation materials like Centrilit NC based on special nano-crystallizers have been recently developed. These new materials improve the properties that are crucial for the durability of high-performance concrete. In addition to reducing chloride migration, an exceptional chemical and acid resistance of the high performance concrete can be achieved with Centrilit NC.

The experimental investigation will be based on the results obtained from various material tests conducted in due course. The strength and durability characteristics of M60 grade concrete in which Centrilit NC added with 0%, 2.5%, 5% ,7.5%(adding as a admixture) is found out and from the result the optimum amount of Centrilit NC use in concrete 5% above this level concrete loses it strength. The concrete structure is simultaneously reinforced right down to nano scale, density is improved and compressive and flexural strength as well as abrasion resistance of the high-performance concrete is increased. The unique properties of Centrilit NC can be utilized in all areas of ready-made and precast concrete production that need high durability.

In this project the mix design prepared for M60 grade concrete based on IS specifications and mix design was verified by casting and testing of sample cubes. The results are found confirming to the standards and in future researches internal structural properties and chemical action of Centrilit NC in the concrete is to be tested. The product is based on an especially designed nano crystallizer setting new standards concerning the resistance to chemicals, acid resistance and strength of high-performance concretes. Therefore, it especially qualifies for projects with special demands on the durability and resistance to wear.As a consequence to the European technical approval (ETA) granted, Centrilit NC now also bears the CE mark. The CE marking confirms that the product is neither harmful to health nor to the environment both as a finished product and in all stages of manufacturing. Furthermore, the CE marking allows free movement of the product in EU countries. Centrilit NC ensures resistance to wear and durability without the need of any elaborate, cost-intensive coatings. In contrast to conventional concrete additives, the product is homogeneous, compact and less adhesive. Using Centrilit NC it is even possible to manufacture pumpable high-performance concrete in a quick and easy way.
Centrilit NC is also very convincing in visual aspects. Thus, the concrete additive achieving a bright-tone surface equally combines durability and aesthetics. This leads to maximum architectural freedom when manufacturing fair-faced concrete with the aid of the product. Quarry dust has lots of finer dust particle than sand which reduce the workability of concrete. To compensate this problem super plasticizer was used. When quarry dust was used with super plasticizer it will show better workability and flow ability. Combination of quarry dust and centrilit NC exhibiting good performance due to efficient micro filling ability and pozzolanic action of centrilit NC. From this we can conclude that 100% replacement of sand with quarry dust shows good strength and durability. From this study it was conclude quarry dust is the better alternative for natural sand.

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