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Effect of Centrilit NC on Strength & Durability of Concrete

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Abstract

Portland cement possesses very low tensile strength, 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. Centrilit NC (nano-crystallizers) when added in certain percentage in the concrete improves the strain properties as well as crack resistance, corrosion resistance, ductility, flexure strength and toughness. Mainly this studies and research in concrete is to improve the durability of concrete. This project outlines the experimental investigation conducts on the use of Centrilit NC with strength and durability ofconcrete.

Keywords:*Micro cracks, Flexure Strength, Durability, Strain Properties, Crack Resistance and Toughness.*

1. Introduction

Concrete is a composite material consisting of aggregate (gravel & sand), cement and water. As a construction material, concrete can be cast in almost any shape desired, and once hardened, can become a structural (load- bearing) element. Portland cement may be grey orwhite.

Nowadays the concrete strength can be improved by various process such as partial replacement of cement such as fly-ash, rice-husk, marble powder, etc., partial replacement of sand such as M-sand, pond-ash, egg-shell etc., and partial replacement of coarse aggregate by natural rubber, tyres, coconut shell or adding super-plasticizers to reduce the water content and it improves the workability and durability of the concrete.

Adding as a admixture of Centrilit NC (Nano-Crystallizers) of 0%, 5%, 10%, 15%, 20% as per Indian Standard(IS), American Concrete Institute (ACI) and British (DOE method) Department of Environment. To compare the result this gives optimum level of strength, durability, flexibility 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 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.

In this project presents the chemical additive Centrilit NC is used as a versatile material which overcomes all types of problems in the concretematerials.

1.1 CentrilitNC

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 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 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.

1.2 Mixing ReactionProcess

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 theconcrete.

2. Type of Materials used and their Specifications

Table 2.1 Type of materials and their specifications

Sl. No.	*Material*	*Type*	*IS Specification*
1	Cement	OPC 53 grade	IS 12269-2013
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	Admixtures in Concrete	Trial & Error Approach

3. Test results of the Materials

The following were the test results of the materials which are used.

Table 3.1 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	40 Minutes
4	Final Setting Time	8 Hours
5	Specific Gravity Test	3.15

Table 3.2 Testing of Centrilit NC

Sl. No.	*Type of Test*	*Value Obtained*
1	Fineness Test By Sieving	10 %
2	Standard Consistency Test	30 %
3	Initial Setting Time	55 Minutes
4	Final Setting Time	10 Hours
5	Specific Gravity Test	2.90

Table 3.3 Testing of Fine Aggregate

Sl.. No.	*Type of Test*	*Value Obtained*
1	Fineness Modulus Test	2.564
2	Bulkiness of Sand	11.11 %
3	Specific Gravity Test	2.61
4	Water Absorption Test	0.94 %

Table 3.4 Testing of Coarse Aggregate

Sl.. No.	*Type of Test*	*Value Obtained*
1	Fineness Modulus Test	2.30
2	Specific Gravity Test	2.64
3	Water Absorption Test	0.50 %
4	Aggregate Crushing	12.70 %
5	Aggregate Impact Value	12.40 %
6	Aggregate Abrasion	14.10 %
7	Flakiness Index	36.30 %
8	Elongation Index	45.25 %

4.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 **IS: 10262 - 2009** method. The mix proportion obtained for normal M20 grade concrete is **1: 1.9: 2.8** with a water-cement ratio of**0.50.**

5. Casting and Testing ofSpecimens

5.1 Compressive StrengthTest

Cubemoulds 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 7days, 14days and 28days. Compressive strength test was found by the followingformula:

$$\textbf{Compressivestrength} = \frac{\text{max load}(N)}{\text{cross sectional area } (mm^2)}$$

Table 5.1 Compressive strength of Cubes in (N/mm^2)

% of CNC (Replacement of Cement)	7days (N/mm^2)	14days (N/mm^2)	28 days (N/mm^2)
0	12.87	19.79	29.63
5	11.83	15.50	18.50
10	12.70	18.50	26.40
15	**22.00**	**26.66**	**32.63**
20	24.33	25.66	27.66

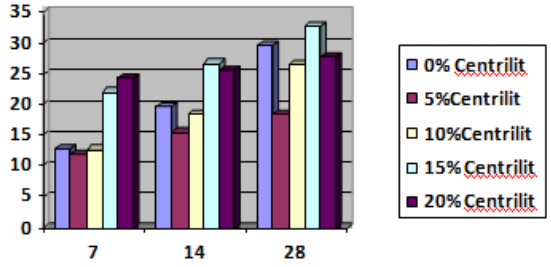

Fig. 5.1 Compressive strength of cubes

5.2 Split TensileTest

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 were 7days, 14days and 28days and tested to find the split tensile of concrete and the result obtained is being tabulated below.

Table 5.2Split Tensile strength of Cylinders in (N/mm^2)

% of CNC (Replacement of Cement)	7days (N/mm^2)	14days (N/mm^2)	28 days (N/mm^2)
0	10.41	15.00	21.12
5	9.83	11.46	19.50
10	9.77	12.33	17.33
15	**13.50**	**19.66**	**27.00**
20	9.33	14.33	18

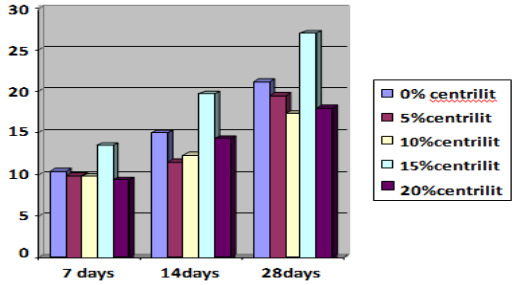

Fig.5.2 Split Tensile strength of Cylinders

5.3 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. The flexural strength of concrete with CNC is considerably higher than that of the conventionalconcrete.

Table 5.3 Flexural Strength of concrete beams in (N/mm^2)

% of CNC (Replacement for Cement)	7days (N/mm^2)	14days (N/mm^2)	28days (N/mm^2)
0	7	8.76	13.50
5	9.20	10.00	12.93
10	10.00	10.86	14.00
15	**11.00**	**13.16**	**17.66**
20	6.33	9.00	11.66

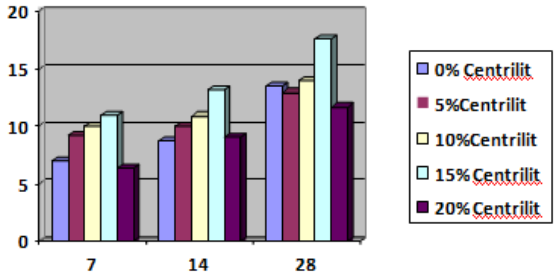

Fig. 5.3 Flexural Strength of Concrete beams

6. DurabilityTest

6.1 Acid AttackTest

Test carried out to obtain weight loss of different type of concrete. From the result it will be observed that weight loss for conventional concrete is greater than CNC concrete and CNC has good void filling ability. So that acid test on CNC concrete will show the good result. From the result we can found that acid attack in CNC concrete will be very less after long duration.

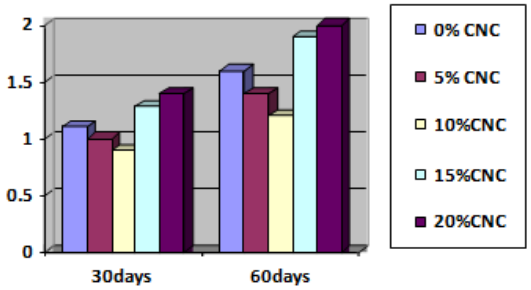

Fig. 6.1 Percentage loss of weight due to acid test

Table.6.1 Compressive Strength after Acid Test

% of CNC (Replacement for Cement)	Compressive strength in (N/mm^2)	
	30	**60**
0	27	25
5	28	26
10	26	20
15	**30**	**29**
20	23	19

6.2 Sulphate AttackTest

Test carried out to obtain weight loss of different type of concrete. From the result it will be observed that weight for conventional concrete is greater than CNC concrete and CNC has good void filling ability. So that chloride test on CNC concrete will show the good result. From the result we can found that chloride attack in CNC concrete will be very less after long duration.

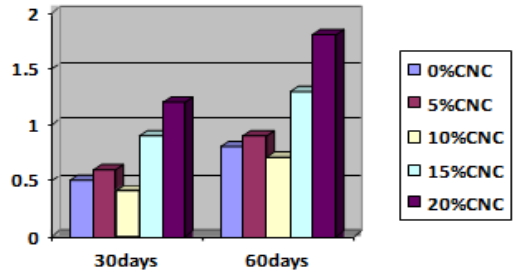

Fig. 6.2 Percentage loss of weight due to Sulphate Attack test

Table.6.2Compressive Strength after Sulphate Attack Test

% of CNC (Replacement for Cement)	Compressive strength in (N/mm^2)	
	30	**60**
0	28	26
5	29	25
10	25	20
15	**30**	**28**
20	23	19

6.3 Alkaline AttackTest

Test carried out to obtain weight loss of different type of concrete. From the result it will be observed that weight loss is for conventional concrete is greater than CNC concrete and CNC has good void filling ability. So that alkaline test on CNC concrete will show the good result. From the result we can found that alkaline attack in CNC concrete will be very less after longduration.

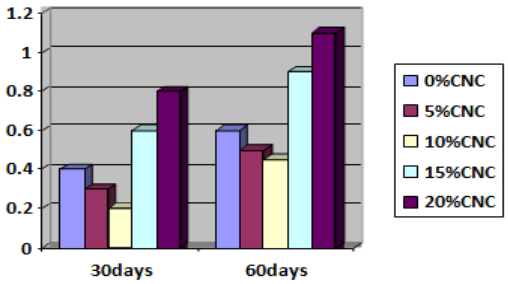

Fig. 6.3 Percentage loss of weight due to Alkaline Attack test

Table.6.3 Compressive Strength after Alkaline AttackTest

% of CNC (Replacement for Cement)	Compressive strength in	
	30	**60**
0	26	23
5	27	24
10	29	26
15	**24**	**22**
20	20	18

7. Conclusions

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 M20 grade concrete in which Centrilit NC added with 5%,10%, 15%,and 20% (adding as a admixture) is found out and from the result the optimum amount of Centrilit NC use in concrete is 10% above this level concrete it will loss is strength.

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 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 esthetics. This leads to maximum architectural freedom when manufacturing fair- faced concrete with the aid of the product.

References

[1] Popat D. Kumbhar, Pranesh B. Murnal, "Assessment of Suitability of Existing Mix Design Methods of Normal Concrete for Designing High Performance ConcreteMixes".

[2] M.C. Nataraja and Lelin Das "Concrete Mix Proportioning As Per IS 10262:2009 – Comparison with IS 10262:1982 and ACI211.1-91".

[3] Janis Justs, GenadijShakhmenko, Diana Bajare, NikolajsToropovs, "Comparison ofPozzolanic Additives for Normal and High StrengthConcrete."

[4] Nataraja, M.C and PatilGopal Reddy, "Proportioning Of High Strength Concrete Mixes, Proceedings of The International Symposium On Innovative World Of Concrete", ICI-IWC-93, August 1993, India, Vol. 2, pp. 3-223 to3-232.

[5] Nataraja, M.C and Anil Kumar T.V., "Computerized Fly Ash Concrete Mix Design as per IS 10262:1982 using Provisions of IS 456:2000, IN CONTEST-2003. *CD-ROM* Proceedings of the international seminar on industrial structures", Association of Consulting Civil Engineers (India), Coimbatore, India. September 2003, pp39-40.

[6] Nataraja, M.C and Ramalinga Reddy, B.M, Bavanishankar, S. and BarathrajEtigi., "Mix Design And Some Properties Of Concrete Containing Ground Granulated Blast Furnace Slag", II CANMET-ACI International Conference On Concrete Technology For Sustainable Development, Hyderabad, March 2005,pp.491-500.

[7] Nataraja, M.C, Lelin Das and N. Richard Sandeep "Comparison Of Indian Standard Draft Method And ACI Method Of Concrete Mix Proportioning", second national seminar on advances in materials and structure, IIT,Chennai,India.

[8] Copernicus Research Project. "Recycling of waste clay brick and tile material for the partial replacement of cement in concrete". Research contract no. CIPA-CT94-0211, First annual report, 1996, Second annual report, 1997 and Third annual report,1998.

[9] Gopalkrishnan S., Rajmane N.P., Neelamegam M., Peter J.A., and Dattatreya J. K., (2001), "Effect of partial replacement of cement with fly ash on the strength and durability of HPC", The Indian Concrete Journal, 75(5), pp335-341.

[10] 11. Ramarao G.N., and SeshagiriRao M.N., (2005), "HighPerformanceConcrete Mix Proportioning with Rice Husk Ash as Mineral Admixture, NewBuildingMaterials & Construction World", vol-10(7), pp100-108.