

Experimental Study on the Effect of Concure WB Curing on Nano Concrete

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Abstract - Concrete is characterized by quasi-brittle failure, nearly complete loss of loading capacity, once failure is initiated. This characteristic, which limits the application of the material, can be overcome by the inclusion of optimum percentage of Nano silica and silica fume. In the present paper an attempt is made to study the effect of concure WB curing on compressive test of Nano concrete. The Nano concrete (NC) used contains 2% Nano silica and 10% silica fume replaced by cement which were casted and cured subjecting to both water curing and self-curing with the use of concure WB curing compound for various curing period such as 3, 7, 14, 21 & 28 days and compared with conventional concrete. The results showed that compressive strength of Nano concrete was found to be greater than conventional concrete, also water cured specimen showed higher compressive strength than concure WB cured specimens.

Key Words: Nano silica, Silica fume, Concure WB, curing, Compressive strength.

1. INTRODUCTION

Concrete is world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world. The recent developments in the study and manipulation of materials and process at the Nano scale offer the great prospect of producing new macro materials, properties and products. But till date, Nano technology applications and advances in the construction and building materials fields have been uneven. Nano technology applied to concrete includes the use of Nano materials like Nano silica, Nano fibers etc. By adding the Nano materials, concrete composites with superior properties. Addition of Nano silica in concrete and mortars results in more efficient hydration of cement. Due to pozzolanic activity, additional calcium silicate hydrates are formed to generate more strength and to reduce free calcium hydroxide. This also helps in reducing the cement requirement. Nano silica improves the micro structure and reduces the water permeability of concrete thus making it more durable.

1.1 Nano silica (NS)

Nano silica is typically a highly effective pozzolanic material. It normally consists of very fine vitreous particles approximately 1000 times smaller than the average cement particles. It has proven to be an excellent admixture for cement to improve strength and durability and decrease permeability, Nano silica reduces the setting time and increases the strength (compressive, tensile) of resulting cement.

1.2 Silica fume (SF)

Silica fume is an extremely fine material with the particle size ranging from 1µm in diameter. Silica fume have high silica content and also it is an efficient pozzolanic material. Silica fume is supplemented to the concrete to enhance its properties, such as compressive strength, bond strength, and abrasion resistance.

1.3 Concure-WB (water based)

Concure WB is a membrane forming, ready to use, white color emulsion of specially blended synthetic waxes. Common method of curing such as, continuous spraying of water on concrete surface and ponding etc., are inconvenient and is also expensive. Evaporation of water from concrete will deprive it of its much-needed water for hydration resulting in capillary pores, lower compressive strength, chipping off on the surface and development of surface cracks.

2. LITERATURE REVIEW

Many research works were carried on this topic, some of them are shown below:

Satya (2018): In his experiment, investigations were made to study fresh concrete tests (slump flow test, V-funnel, L-box test and U-box test) and compressive strength of cubes at 28 days curing (using Concure WB as curing agent) for different percentages of silica fume (2%,4%,6%). Thus 4% of silica fume addition in concrete yield better strength compared to other percentages of silica fume and workability tests fresh concrete was found better for scc containing silica fume up to 4% replacement.

Krishna Rao et.al (2010): They studied the parameters like curing period (1,3,7,14 and 28 days), curing method (conventional wet curing, membrane forming compound curing and accelerated curing) and the type of cement (OPC

43 grade, PPC 43 grade and OPC 43 grade + 10% silica fume replacement of cement). Test results indicate a drop-in strength at all ages for concrete with PPC and the one which 10% OPC is replaced by silica fume in comparison with the concrete with OPC. Curing by membrane forming curing compound yielded nearly the same results as that of conventional wet curing for concrete with OPC and there was a marginal decrement in concrete with PPC. Predicted 28-day strength of concrete from accelerated curing test was found to be on a conservative side compared to control concrete.

Jakkam snehavi et.al (2018): His experiment was based on self-curing concrete of M30 grade using Forsoc Concure wb white as self-curing agent, which were cast by replacing fine aggregate with 50% quarry dust and by varying quantity of fly ash and silica fume by 5%, 10%, 15%, 20%,25%. In this study compressive strength of cubes, split tensile strength of cylinders of self-curing concrete with optimum % of silica fume (5%) and fly ash (10%) showed high strength results.

2.1 Objectives

Based on the above literature review an attempt is made to study:

1. The effect of Concure WB curing on compressive strength of Nano concrete containing 2% Nano silica and 10% silica fume and compared with conventional concrete.

3. EXPERIMENTAL PROGRAM

Experimental program includes collection of material, preliminary tests on materials and experimental procedure.

3.1 MATERIALS USED

1. **Cement:** Ordinary Portland cement (OPC) of 53 grade was used conforming to IS: 8112-1989, Birla super cement was procured from local sources. Tests are conducted in laboratory to determine its basic properties. Specific gravity was found to be 3.10.
2. **Fine aggregate (FA):** Well graded manufactured sand passing through 4.75 mm, conforming to zone-2 of IS :383-1970 was used as fine aggregate. The specific gravity of M-sand is 2.7
3. **Coarse aggregate (CA):** Coarse aggregates of maximum size 20 mm which is in saturated surface dry condition were used as per IS: 383-1970. Specific gravity of coarse aggregate obtained is 2.64
4. **Nano silica:** Nano silica is procured from Nuchems, Rajajinagar, Bangalore. The properties of nano silica are listed in table-1.

Table- 1 Properties of Nano silica

Properties	Range
Particle size	5-30 nm
Specific gravity	2.2-2.4
Sieve residue	Less than 0.04%
SiO2 content	Greater than 99.8%
pH value	3.7 - 4.5
Carbon content	Less than 0.15%
Chloride content	Less than 0.0202%

5. **Silica fume:** silica fume is procured from Nuchems, Rajajinagar, Bangalore. The properties of nano silica are listed in table-2.

Table- 2 Properties of silica fume

Properties	Range
Particle size	Less than 1µm
Specific gravity	2.61
Retained on 45µ sieve	Maximum 2.5%
Density	450-720kg/m3
SiO2	Maximum 78-85%
pH	6.5-8.3

6. **Concure WB:** It is the curing compound which is sprayed on the surface of concrete A curing compound is used on the principle that concrete gets water for uninterrupted hydration after placement. It is procured from La Greens india pvt. Ltd, Bangalore. The properties are listed in table -3

Table-3 Properties of Concure wb

Properties	
Color	White
Form	Liquid
Specific Gravity	1.01 ± 0.03
Thinning	Not required
Drying time	Approximate 90min
Viscosity	5.10cps
Curing Efficiency	>80%

7. **Water:** Water which is clean, fit for drinking is used for making concrete and shall conform to the requirements of IS: 456-2000.

3.2 METHODOLOGY

Concrete were casted for M₂₅ grade as per code IS 10262-2009, for water-cement ratio of 0.45

Experimental procedure: Materials are weighed batched using electronic weighing machine, mixing was done in lab concrete mixer, moulds were casted with cube size of 150mm×150mm×150mm by proper compaction. After 24 hours casted specimens were demoulded, certain sets of concrete are subjected to water curing and other sets were subjected to concure wb curing by spraying the liquid on the surface of concrete for a curing period of 3, 7, 14, 21 and 28 days. Specimen were tested after curing period to determine compressive strength of concrete, three numbers of specimen in each sample were tested and average value is calculated.

4. RESULTS

4.1 EFFECT OF CONCURE WB CURING ON COMPRESSIVE STRENGTH:

The compressive strength results of conventional concrete (CC) and Nano concrete (NC) at 3, 7, 14, 21 & 28 days for both water curing and concure WB curing are tabulated in table-4.

Table- 4 Compressive strength results

Water curing					
Type of concrete	Compressive strength (N/mm ²)				
	3 days	7 days	14 days	21 days	28 days
CC	12.52	20.43	28.30	29.65	32.13
NC	13.64	27.55	38.14	39.55	41.96
Concure WB curing					
CC	12.26	18.16	25.24	26.86	29.04
NC	12.59	24.87	34.29	35.96	37.87

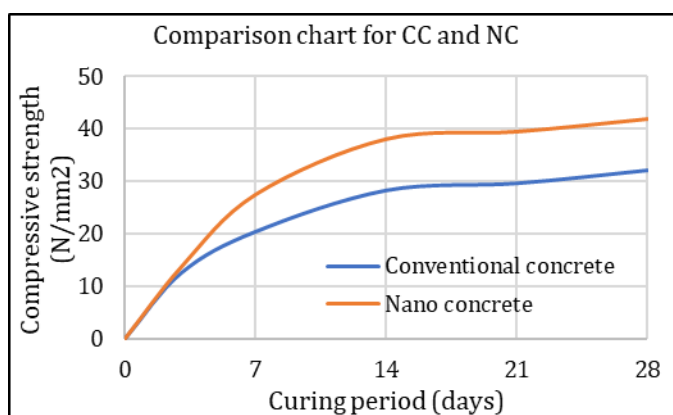


Chart -1: Effect of water curing on conventional concrete and Nano concrete

From chart-1, It is noticed that the compressive strength increases as the curing period increases for both conventional concrete and Nano concrete. It can also be

seen that strength of Nano concrete is greater than conventional concrete for all curing period, that is for 28 days of water curing strength of Nano concrete is 41.96N/mm² whereas for conventional concrete it is 32.13N/mm². This increase in strength of Nano concrete is because of high surface area, filling ability and high pozzolanic nature of Nano silica and silica fume.

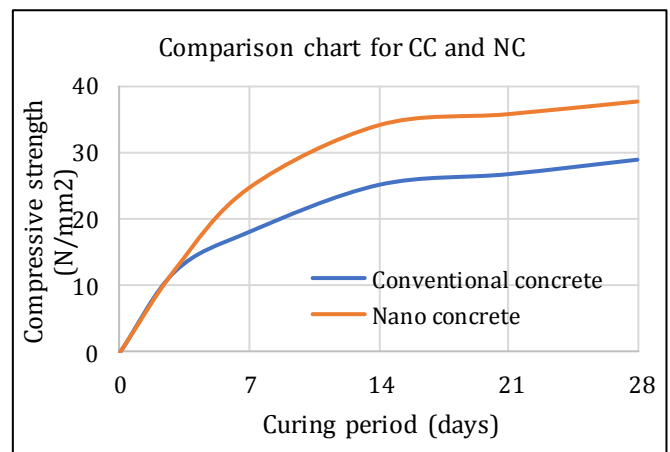


Chart-2 Effect of Concure WB curing on conventional concrete and Nano concrete

From chart-2, it is observed that compressive strength increases as the curing period increases for both conventional concrete and Nano concrete. It can also be seen that strength of Nano concrete is greater than conventional concrete for all curing period, that is for 28 days of concure WB curing strength of Nano concrete is 37.87N/mm² whereas for conventional concrete it is 29.04N/mm². This increase in strength of Nano concrete is because of high surface area, filling ability and high pozzolanic nature of Nano silica and silica fume.

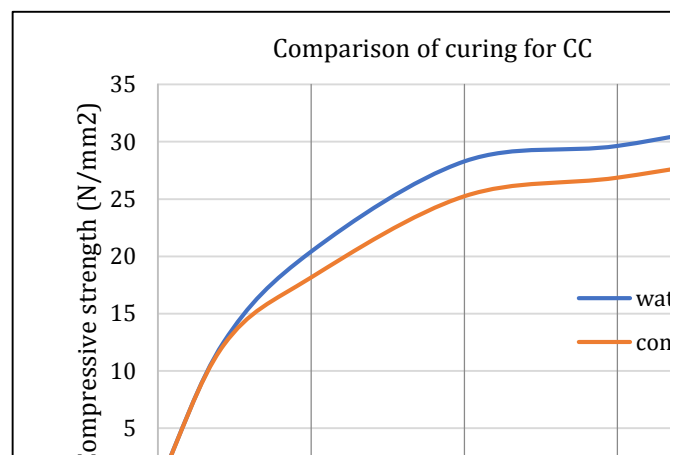


Chart-3 Effect of water curing and Concure WB curing on compressive strength of conventional concrete

From chart-3, it is observed that compressive strength increases as the curing period increases for conventional concrete. It can also be seen that strength of water cured specimens is greater than concure WB cured specimens,

that is for 28 days of curing, strength of water cured specimen is 32.13N/mm² whereas for concure WB cured specimen it is 29.04N/mm². This increase in strength for water curing is because sufficient amount of water is available for concrete water absorption.

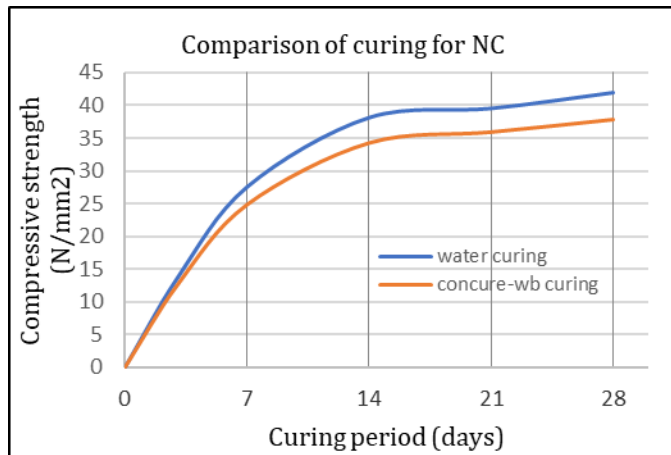


Chart-4 Effect of water curing and Concure WB curing on compressive strength of Nano concrete

From chart-4, it is observed that compressive strength increases as the curing period increases for Nano concrete. It can also be seen that strength of water cured specimens is greater than concure WB cured specimens, that is for 28 days of curing, strength of water cured specimen is 41.96N/mm² whereas for concure WB cured specimen it is 37.87N/mm². This increase in strength for water curing is because sufficient amount of water is available for concrete water absorption.

5. CONCLUSIONS

Based on the experimental results the following conclusions can be drawn:

- [1] As the curing period increases compressive strength of concrete increases irrespective of method of curing.
- [2] Compressive strength of Nano concrete increases by 30.4% than conventional concrete at 28days for concure WB curing.
- [3] Concure WB cured specimens gains about 90% of compressive strength of normal water cured specimens, hence it can be adopted in areas with shortage of water.

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