International Journal of Civil Engineering and Technology (IJCIET)
Volume 7, Issue 2, March-April 2016, pp. 315–320, Article ID: IJCIET_07_02_027
Available online at
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=7&IType=2
Journal Impact Factor (2016): 9.7820 (Calculated by GISI) www.jifactor.com
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

EXPERIMENTAL INVESTIGATION ON BEHAVIOUR OF NANO CONCRETE

R. Sakthivel
Research Scholar Karpagam University, Coimbatore, India

Dr. N. Balasundaram
Head of Department, Civil Engineering,
Karpagam University, Coimbatore, India

ABSTRACT

The influence of Nano-Silica on various properties of concrete is obtained by replacing the cement with various percentages of Nano-Silica. Nano-Silica is used as a partial replacement for cement in the range of 2.5%, 3%, and 3.5% for M_{25} mix. Specimens are casted using Nano-Silica concrete. Laboratory tests were conducted to determine the compressive strength, split tensile and flexural strength of Nano-Silica concrete at the age of 7 and 28 days. Results indicate that the concrete, by using Nano-Silica powder, was able to increase its compressive strength. However, the density is reduced compared to standard mix of concrete. The replacement of cement with 3% Nano-Silica results in higher strength and reduction in the permeability than the controlled concrete. The replacement of cement with Nano-Silica more than 3% results in the reduction of various properties of Nano-Silica concrete.

Key words: Nano-Silica Powder, Strength, Concrete, Plasticizers.

Cite this Article: Dr. B.Vidivelli and A. Jayaranjini. Prediction of Compressive Strength of High Performance Concrete Containing Industrial by products Using Artificial Neural Networks, *International Journal of Civil Engineering and Technology*, 7(2), 2016, pp. 315–320.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=7&IType=2

1. INTRODUCTION

Concrete is the most common material used in the construction. It is a highly homogeneous material produced by mixture of finely powdered cement, aggregates of various sizes and water with inherent physical, chemical and mechanical properties. A reaction between the cement and water yields calcium silicate hydrate, which gives concrete strength and other mechanical properties of concrete as well as some by-products including calcium hydroxide [CH],'gel pores' etc.

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as expanded slag or vermiculite. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregates, and for economy no more cement paste is used than is necessary to coat all the aggregate surfaces and fill all the voids.

Super plasticizers

A super plasticizer is used to improve the workability of fresh Nano concrete. The dosage of super plasticizer also has an effect on the compressive strength of concrete. It also gives good surface finish and reduces setting time. It is generally acknowledged that the slump loss of fresh concrete at the construction site is one of the principal reasons associated with problems related to the strength and durability of concrete.

To produce high workability concrete without loss of strength. To promote high early and ultimate strengths by taking advantage of water reduction whilst maintaining workability.

To produce high quality concrete of improved durability and permeability. At higher dosages, advantages can be taken of the retardation of initial setting time of concrete especially in large pours.

NANOTECHNOLOGY

Nano Technology applied to concrete includes the use of nanomaterial's like Nano silica, Nano fibres etc. By adding the Nanomaterial's, concrete composites with superior properties can be produced. Addition of Nano silica (NS) in concretes and mortars results in more efficient hydration of cement. Due to the 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, NS improves the microstructure and reduces the water permeability of concrete thus making it more durable. Concretes with strengths as high as 100 MPa with high workability, anti-bleeding properties and short de-moulding time can be produced. Nano silica can be used as an additive to eco concrete mixtures.

2. OBJECTIVE

- The main objective of this project is to determine experimental investigation on behavior of Nano material with various ratios. Nano technology can modify the molecular structure of the concrete material to improve the material properties. Effect of Nano silica dosages on compressive strength, tensile strength, Flexural strength of concrete.
- The Nano materials such as Nano silica (SiO_2) of varying percentage are used to determine the strength of concrete specimens. (Cube, cylinder & prism) between control concrete and Nano material %.

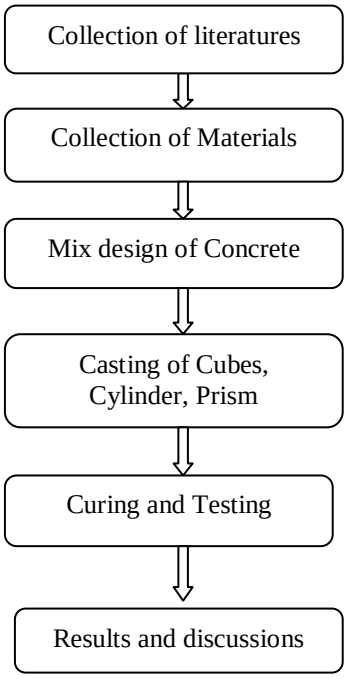
3. METHODOLOGY

The main aim of this project is to determine experimental investigation on behavior of Nano material with various ratios. Controlled concrete slabs. The following steps are involved.

- Initially the materials used are tested and the test results are shown in table 1.

- Cubes, cylinders and prisms are casted for varying percentage of Nano silica and they are used for determining the compressive strength split tensile strength and flexural strength of concrete using varying percentage of Nano silica
- Tests are conducted using compression testing machine and also cylinders are tested using split tensile testing machine.
- After determining the test results suitable percentage of Nano silica is determined to cast the Nano silica.
- . The replacement of cement with 3% Nano-Silica results in higher strength and reduction in the permeability than the controlled concrete.
- The experimental works were conducted on concrete laboratory by applying load.

The following flow chart shows the methodology of this project



4. EXPERIMENTAL WORKS

The preliminary tests were conducted on cement, fine aggregate, coarse aggregate and the test results were obtained. Based on the results obtained the mix proportion for M_{25} concrete is done.

The properties of materials tested are as follows,

Table 1 Properties of Cement, FA, CA

Property	Cement	FA	CA
Fineness	1%	4.72	8.21
Consistency	30%		
Initial setting time	35 mins		
Specific gravity	3.15	2.67	2.78

Mix Proportion For M_{25} Concrete

Cement = 320 Kg/m^3
Fine aggregate = 794 Kg/m^3
Coarse aggregate = 1204 Kg/m^3
Water-cement ratio = 0.45
Water content = 140 Kg/m^3
C: FA: CA = 1:1.52:2.75

The mix proportion for M_{25} concrete is calculated using IS 456:2000, IS 10262:2009. Superplastizicer is also added to increase the workability of concrete.

Test Specimens

The compressive stress, split tensile strength and flexural strength of concrete are determined by casting cubes of size 150x150x150 mm, cylinders of size 300x150 mm and prisms of size 500mmx100mmx100mm and allowed for 7 and 28 days curing and the test results were obtained for various percentage of Nano silica.

Table 2 compressive stress of controlled concrete cubes and Nano silica cube

specimen	Compressive stress in 7 days (N/mm^2)	Compressive stress in 28 days (N/mm^2)
CC	18.99	27.60
NS 2.5%	25.95	29.15
NS 3%	27.75	34.80
NS 3.5%	26.66	32.50

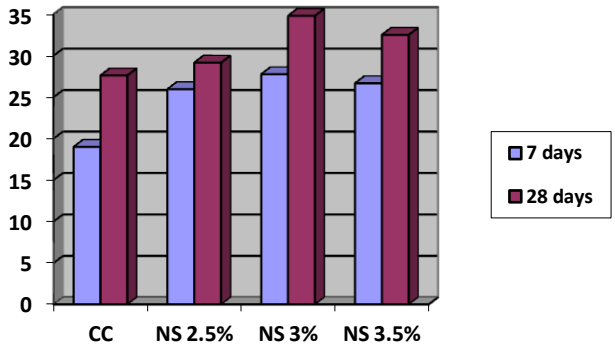


Figure 1 shows the compressive stress of cubes

Note: CC- controlled concrete, NS- Nano silica

Table 2 Split Tensile Strength Of controlled concrete Cylinders and Nano silica concrete cylinders

specimen	Split tensile strength in 7 days (N/mm^2)	Split tensile strength in 28 days (N/mm^2)
CC	2.87	3.51
NS 2.5%	3.26	3.98
NS 3%	3.82	4.64
NS 3.5%	3.45	4.31

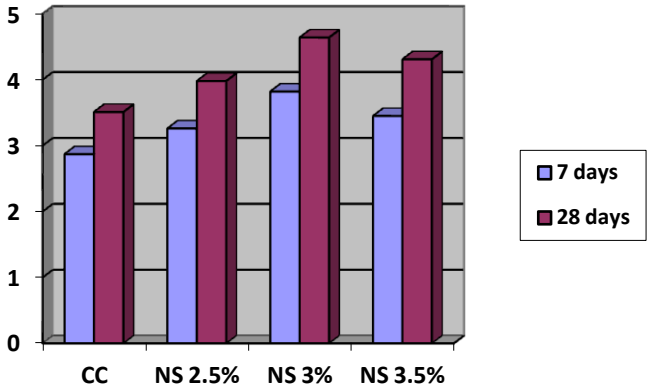


Figure 2 shows the split tensile strength of cylinders

Note: CC- controlled concrete, NS- Nano silica

Table 3 Flexural Strength Of controlled concrete prisms and Nano silica concrete prisms

specimen	Flexural strength in 7 days (N/mm^2)	Flexural strength in 28 days (N/mm^2)
CC	2.08	2.61
NS 2.5%	2.78	3.12
NS 3%	3.94	4.92
NS 3.5%	3.81	4.21

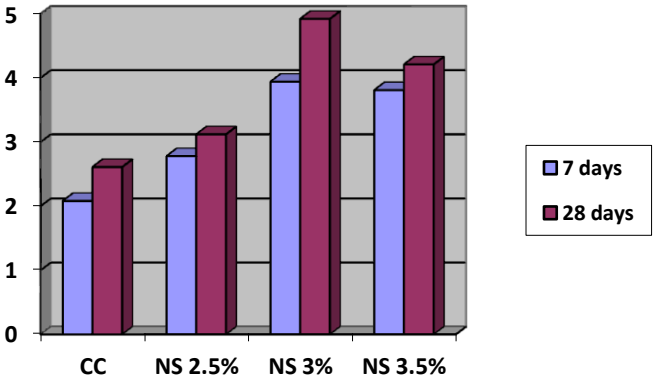


Figure 3 shows the flexural strength of concrete

Note: CC- controlled concrete, NS- Nano silica

Based on the test results obtained the strength of the concrete increases from 2.5% to 3% and it decreases gradually to 3.5%. The replacement of cement with 3% Nano-Silica results in higher strength and reduction in the permeability than the controlled concrete. The replacement of cement with Nano-Silica more than 3% results in the reduction of various properties of Nano-Silica concrete.

5. CONCLUSION

That the compressive strength of concrete initially increased up to 3% of Nano-Silica and with further increase in the Nano-Silica content the compressive strength of

concrete decreases. Concrete containing lower percentages (3%) of Nano-Silica possess higher values of compressive strength than that of controlled concrete.A considerable increase in flexural strength and split tensile strength of Nano-Silica concrete was observed compared to controlled concrete.

Based on the experimental results, use of Nano-Silica as partial replacement of cement in small quantities is advantageous on the performance of concrete. Nano-Silica added in small quantities can improve the strength and permeability resistance. It can also be concluded that the permeability of concrete decreases with the increase in the percentage of Nano-Silica up to 3% due to the effect of Nano-Silica filling the voids in concrete.

The initial and final setting times of cement mortar containing Nano-silica was found to decrease with increase in the replacement percentage. Use of Nano – silica in the concrete reduces the co_2 emission.

REFERENCES

[1] IS: 456-2000, Indian Standard "Plain and Reinforced Concrete", Code of Practice 2000. Bureau of Indian Standards, New Delhi 110002.

[2] IS: 516-1959, Indian Standard "Methods of testing for strength of concrete", Code of Practice. Bureau of Indian Standards, New Delhi 110002.

[3] IS: 10262-2009, Indian Standard "Recommended Guidelines for Concrete Mix Design", Code of Practice 2009. Bureau of Indian Standards, New Delhi 110002.

[4] IS: 383-1970, Indian Standard "Specification For Coarse And Fine Aggregates From Natural Sources For Concrete", Code of Practice 1970. Bureau of Indian Standards, New Delhi 110002.

[5] IS: 12269-1999, Indian Standard "Specification For 53 Grade Ordinary Portland Cement", Code of Practice 1999. Bureau of Indian Standards, New Delhi 110002.

[6] M.S.Shetty, "Concrete Technology", S.Chand and company ltd., New Delhi.

[7] Strength Efficiency Factor For Nano Silica At Different Age**,** C. K. Sridhar, S. B. Vanakudre, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3 Issue-6, August 2014.

[8] Comparative Studies on High Strength Concrete Mixes Using Micro Silica and Nanosilica**,** Siva Sai, International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869, Volume-1, Issue-7, September 2013.

[9] Experimental Investigation on The Properties of Nanosilica Concrete**,** Dr. D. V. Prasada Rao, Associate Professor, Department of Civil Engineering, Sri Venkateswara University College of Engineering, Andhra Pradesh, International Journal of Civil Engineering and Technology (IJCIET) ISSN 0976 – 6308 (Print) Volume 5, Issue 6, June (2014), pp. 116-124.

[10] Experimental Investigation on Nanomaterial Concrete**,** Saloma, Lecturer, Faculty of Civil Engineering, Sriwijaya University, International Journal of Civil & Environmental Engineering (IJENS 137403-5858 Vol: 13, No: 03, pp.15-20, June 2013),

[11] Study And Performance of High Strength Concrete Using With Nano Silica and Silica Fume**,** Seelanani Janardhana, Siddartha Educational Academy Group of Institutions, Tirupathi, Andhra Pradesh, International Journal of Civil Engineering and Technology (IJCIET_06_11_019, Volume-6, Issue 11, pp. 184-196, Nov 2015).