

# EXPERIMENTAL STUDY ON COMPRESSIVE STRENGTH OF NANO SILICA CONCRETE

Shailja dubey<sup>1</sup>, Prof. Ajet Saxena<sup>2</sup>, Prof. K. G. Kirar<sup>3</sup>

<sup>1</sup>M.Tech Scholar Radharaman College of Technology Bhopal, M.P.

<sup>2,3</sup>Professor, Dept. of Civil Engineering, Radharaman College, Bhopal, M.P., India

\*\*\*

**ABSTRACT:-** The application of nanotechnology in concrete structures has added a new dimension towards improvement of its properties. Nano-materials, due to its very small size particles it affects the concrete properties by altering the microstructure. This study concerns with the use of nano silica of powder form to improve the compressive strength of concrete. An experimental investigation has been carried out by replacing the cement with Nano silica by 0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5% and 3.0% for M20 (1:1.5:3 grade of concrete with water cement ratio 0.42). The tests conducted on it shows a considerable increase in early-age compressive strength of concrete on 7th day, 14th day and 28th day of curing. The Workability and Strength increase was observed with the increase in the percentage of nano silica upto a limit and further it decreases.

**Keywords:** Concrete, Cement, Nano silica, Compressive Strength, Tensile Strength and Workability.

## UNIT I INTRODUCTION

The bulk use of cement is vital in attaining a higher compressive strength. The use of nano- SiO<sub>2</sub> materials by replacement of a percentage of binding material cement can lead to a rise in the compressive strength of the concrete as well as a check to pollution. The use of a very minute quantity of Nano SiO<sub>2</sub> can influence the properties and character of concrete largely, a proper study of its microstructure is essential in understanding the reactions and the effect of the nano-particles.

The properties in fresh state (flow properties and workability) are for instance governed by the particle size distribution (PSD), but also the properties of the concrete in hardened state, such as strength and durability, are affected by the mix grading and resulting particle packing. One way to further improve the packing is to increase the solid size range, e.g. by including particles with sizes below 300 nm. However, these products are synthesized in a rather complex way, resulting in high purity and complex processes that make them non-feasible for the construction industry. The aim of this research is to create a practical application method and a model to apply newly developed nS in concrete. This experiment is effort to

explain the impact of a nano-silica on the compressive strength character of concrete by explaining its microstructure.

The current experiment incorporates mix design based on Indian Standard code IS 10262-2009. The nano-silica used is imported from a supplier. The admixture is strictly prohibited in the design of mix. The water content has been kept stable to facilitate a better assessment for different samples. The compressive strength measurements are carried out for 7-day, 14 day and 28-day.

## UNIT II LITERATURE REVIEW

### 1. MOHAMMAD MEHDI CHOOLAEI et.al:

In this research, the concert of nano SiO<sub>2</sub> in cement-sand mortars was experimentally studied. In accumulation, there was no extra water used in the designed slurries. Results indicated that by using this nano SiO<sub>2</sub>, the setting time of concrete and the length of the dormant period were decreased. Also, studying the porosity of cements designed using nano SiO<sub>2</sub> showed a decrease in cement porosity as the amount of nano SiO<sub>2</sub> was increased in the investigated slurries.

### 2. MOUNIR LTIFIA ET.ALL:

As per author the properties of cement mortars including nano-SiO<sub>2</sub> were experimentally studied. The unstructured or glassy silica, which is the major ingredients of a pozzolan, action with calcium hydroxide formed by calcium silicate hydration. As per auther the effects of the addition of nano-particles on the performance of pastes of cement mortars, nano-particles of silica amorphous were integrated at a rate of 3 and 10% by weight of binding material cement. The compressive strengths of other mortars increase with the increasing of the amount of nano-SiO<sub>2</sub>. The persuade of nano-SiO<sub>2</sub> on setting time and consistency are different. Nano-SiO<sub>2</sub> accelerates the cement hydration process and give cement paste thicker.

### 3. Dr. SOMASEKHARAI AH et al.:

Concrete is a usually used construction material, consumes natural resources like lime, aggregates, water. In this present investigation there is replacement of composite concrete material with industrial wastes in the present investigation, a study has been made for the development of high performance concrete using mineral admixture such as Metakaolin and Nano-silica as feasibility made to know the strength on Concrete. The combine proportion is arrived from 0%, 10%, 20% and 30% of cement is interchanged with Metakaolin. Different water : cement ratio of 0.275, 0.325 and 0.375 and aggregate ratio of 2.0 is used In this experiment, In this connection series of concrete cubes of size 100 x 100 x 100, cylinders of 200 x 100 and beams of 100 x100 x 500 size were cast with various mix proportions and were cured for 7 and 28 days.

The review of a number of literatures shows the importance of this field of research. The findings shows that a number of nano materials like SiO<sub>2</sub>, TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, colloidal nano silica, metakaolin and others can be incorporated to improve the properties of concrete. Nano-silica is used upto 2% of cement by weight. The Researches shows the improved characteristics of the blended concrete in terms of flexural strength compressive and tensile strength. Apart from that the permeability of the specimen can also be increased by adding a small percentage of the nano material. The current study is concerned with the incorporation of Nano SiO<sub>2</sub> more than 2% of nano silica particles in concrete.

### UNIT III MATERIAL AND METHODOLOGY

**WATER:** the number of water in concrete controls several recent and hardened properties in concrete together with workability, compressive strengths, permeableness and water tightness, sturdiness and weathering, drying shrinkage and potential for cracking. For these reasons, limiting and dominant the number of water in concrete is very important for each constructability and repair life.

**PORTLAND CEMENT:** cement is that the commonest style of cement generally use round the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout. It was developed from different varieties of hydraulic lime in European nation within the middle nineteenth century, and usually originates from limestone. It is a fine powder, produced by heating limestone and clay minerals in a kiln to form clinker, grinding the clinker, and adding 2 to 3 percent of gypsum. Several types of Portland cement are available

**AGGREGATES:** Fine aggregates generally consist of natural sand or crushed stone with most particles smaller than 5 mm (0.2 in.). Coarse aggregates (Fig. 5-2) consist of one or a Aggregates for Concrete bination of gravels or crushed stone with particles predominantly larger than 5 mm (0.2 in.) and generally between 9.5 mm and 37.5 mm (3 /8 in. and 11 /2 in.). Some natural combination deposits, called pit-run gravel, consist of gravel and sand that can be readily used in concrete after minimal processing.

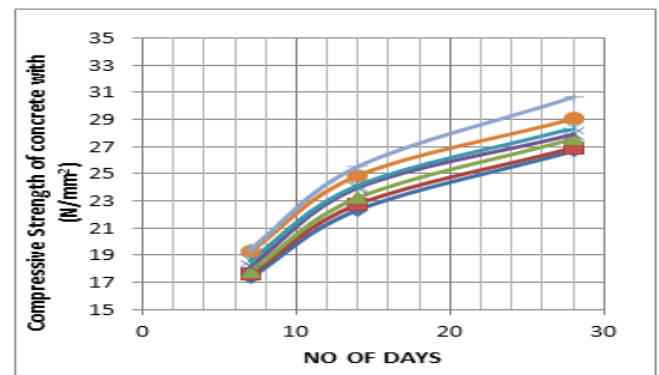
### NANO SILICA

Nano-silica created by this technique may be a terribly fine powder consisting of spherical particles or microspheres with full force diameter of a hundred and fifty nm with high specific area (15 to twenty five m<sup>2</sup>/g). By means that of this technique, nano particles having a spherical shape with 88% process efficiency can be obtained. These particles were created by feeding worms with rice husk, biological waste material that contain 22% of SiO<sub>2</sub>. Finally, NS may be created by precipitation technique

### UNIT IV RESULT AND ANALYSIS

#### COMPRESSIVE STRENGTH TEST

The combined Graph of compressive strength of various proportions by replacing cement with nano-silica, The material has been collected and used as a replacement of cement because it is having Pozzolana property. The proportions of nano-silica replaced cement are taken as 0%, 0.5% 1.0%, 1.5%, 0.20%, 2.5% and 3.0% and compressive test result is 26.67N/mm<sup>2</sup>, 26.92 N/mm<sup>2</sup>, 27.58 N/mm<sup>2</sup>, 27.91 N/mm<sup>2</sup>, 28.37 N/mm<sup>2</sup>, 29.05 N/mm<sup>2</sup>, 30.65 N/mm<sup>2</sup> respectively on 28th day of curing. The compressive strength of concrete using nano- silica increases as content of silica increases.. The maximum result is by replacing 3% of cement by nano-silica is 19.43N/mm<sup>2</sup>, 25.54N/mm<sup>2</sup> and 30.65 N/mm<sup>2</sup> on 7th, 14th and 28th day of curing.



**UNIT V CONCLUSIONS**

- From the above experiment it is observed that the Workability of concrete with use of nano-silica improve upto a limit than it decreases. The workability is in escalating order upto 2.5% of replacement of Nano-Silica with cement.
- The Compressive Strength of partially replaced cement by nano silica concrete of grade M 25 for proportions of 0%, 0.5%, 0.10%, 1.5%, 2%, 2.5% and 3% are 26.67MPa, 26.92MPa, 27.58MPa, 27.91MPa, 28.37MPa, 29.05MPa and 29.65MPa respectively at 28th day of curing. The Compressive Strength increases upto 3%.
- With the use of 3% of Nano-Silica concrete gives the maximum result in compression as 19.43MPa, 25.54MPa and 30.65MPa at 7th day, 14th day and 28th day of curing respectively.

**UNIT VII BIOGRAPHIES**

Shailja Dubey  
M.Tech Student  
Radharaman college, Bhopal,  
M.P., India



Prof. Ajeet Saxsena  
Assistant Professor  
Radharaman college, Bhopal,  
M.P., India



Prof. K. G. Kirar  
Assistant Professor  
Radharaman college, Bhopal,  
M.P., India

**UNIT VI REFERENCE**

1. Hui Li, Hui-gang Xiao, Jie Yuan and Jinping Ou. (2004). Microstructure of cement mortar with nanoparticles. Composites: Part B 35, 185-189.
2. IS 2386 (Part1&3):1963 "Methods of test for aggregates for concrete."
3. IS 516:1959 "Method of test for strength of concrete."
4. IS 7320:1974 "Specification for concrete slump test apparatus."
5. IS 8112:2013 "OPC 43 grade -Specification."
6. IS:2386-1963 (Part-III). Methods of Test for aggregates for concrete Part III Specific gravity, density, voids, absorption and bulking. Bureau of Indian Standards.
7. IS:383-1970. Specification for coarse aggregate and fine aggregate from natural sources for concrete. Bureau of Indian Standards.
8. IS:455-1989. Portland Slag Cement- Specification. Bureau of Indian Standards.
9. IS:456-2000. Plain and Reinforced concrete code of practice (Fourth Revision). Bureau of Indian Standards.
10. Ji T. (2005) "Preliminary study on the water permeability and microstructure of concrete incorporating nano-SiO<sub>2</sub>", Cem. and Con. Res., 35, 1943-1947.