

COMPARATIVE STUDY ON NANO SILICA CONCRETE AND NANO ALUMINA CONCRETE

R.NIRMALA*, B.PRIYADHARSHINI*, RAJENDRAN KAVYA*, K.MUTHUKUMAR**

***STUDENT, **ASSISTANT PROFESSOR DEPARTMENT OF CIVIL PRATHYUSHA ENGINEERING COLLEGE, TAMIL NADU.**

ABSTRACT

Generally a concrete made with portland cement particles that are less than 500 nm as a cementing agent is known as nano concrete. The nano-particles will help to reduce the formation of micro pores by acting as a filler agent, producing a high dense concrete. In present project deals about comparative study of nano concrete incorporating by nano particles. In this project nano-alumina and nano-silica is going to be used. The purpose of using these nano particles is to increase the strength and durability of concrete. Resists strong acid and alkali attack at elevated temperatures. The percentage of nano-silica is 1%,1.5%,2% and for nano-alumina is 1%,1.5%,2%.Laboratory tests were conducted and determined the compressive strength, split tensile , flexural strength and durability of nano concrete by using nano silica and nano alumina.

KEYWORDS: Nano silica, Nano alumina, Portland cement, sand.

1.INTRODUCTION

Generally a concrete made with portland cement particles that are less than 500 nm as a cementing agent is known as nano-concrete. The nano particles will help to reduce the formation of micro pores by acting as a filler agent, producing a high dense concrete. In our project nano silica and nano alumina are going to be incorporated with concrete. A comparative study is going to be considered between nano silica and nano alumina by carrying out various test such as compressive strength, split tensile strength, flexure strength and durability test. Silicon dioxide nano-particles, are also known as silica nano-particles or nano-silica, are the basics for a great deal of biomedical research due to their stability, low toxicity and ability to be functionalized with a range of molecules of molecules and polymers. Nano-silica particles are divided into P-type and S- type according to their structure. Here, a cube of size $150 \times 150 \times 150$ mm is used to find the compressive strength, a cylinder of size 150×300 mm is used to find the split tensile strength, a prism of size $500 \times 100 \times 100$ is used to find the flexure strength of the concrete. This nano concrete gives high strength and durability of the structure. This nano concrete is more economical. It used in various construction areas.

ADVANTAGES OF NANO CONCRETE:

- ❖ Low maintenance
- ❖ Low life cycle cost
- ❖ Reduces the thermal transfer rate
- ❖ Corrosion resistance

DISADVANTAGES OF NANO CONCRETE:

- ❖ Require a lot of energy
- ❖ Nano tubes might cause lung problem
- ❖ The research is in it's early stage yet

APPLICATIONS OF NANO SILICA:

- ❖ As an additive for rubber and plastics.
- ❖ As a strengthening filler for concrete and other construction composites.
- ❖ As a stable, non-toxic platform for biomedical applications such as drug delivery and theranostics.

APPLICATIONS OF NANO ALUMINA:

- ❖ Nano-alumina particles are highly effective catalysts.
- ❖ Dispersion-strengthening.
- ❖ Heat transfer fluids.
- ❖ Transparent optical coatings.

OBJECTIVES:

- ❖ To find the strength by conducting various test such as compressive, flexure and split tensile test.
- ❖ To compare the properties of nano-silica and nano-alumina.
- ❖ To find best among nano silica concrete and nano alumina concrete.

II. METHODOLOGY

To find the optimum mix proportion for nano silica concrete and nano alumina concrete. Some the specimens which have been used are cube, cuboid and cylinder of standard dimension and design mix calculation is done as per IS 516-1959 (methods of testing for strength of concrete). Materials are batched for mixing as per mix design and uniformly mixed. Some of the primary test performed are water absorption test, impact test, specific gravity test, sieve analysis test, slump test, initial and final setting time by using vicat apparatus. In addition to the cement, fine aggregate, coarse aggregate and nano materials such as nano silica and nano alumina have been incorporated in various percentage of 1,1.5 and 2 from the actual weight of cement. The various specimens are allowed to hardened for 24 hours and then allowed for curing. The specimens are placed in curing tank for 7 days and 28 days. The various test results such as compressive strength, split tensile strength and flexural strength for various mixes have been achieved for 7 days and 28 days.

III. MATERIALS

Nano silica is act as a filler agents. It is used to reduce voids in the concrete and increases the strength in durability of the concrete. By using nano silica we can reduce the cement content in addition to its economical and environmental benefits. Nano alumina improves the mechanical properties of the concrete such as compressive and tensile strength. It also decreases the water absorption and chloride penetration. It improving the durability of concrete. This chemical admixtures are used to attain the compressive strength in concrete.

IV. MIX DESIGN

MIX CALCULATION FOR CUBE

COMPRESSIVE STRENGTH OF CUBE

Volume of cube = $l \times b \times h$

$$= 0.15 \times 0.15 \times 0.15 = 3.375 \times 10^{-3} \text{ m}^3$$

Unit weight of cement = 24 kg/m^3

Unit weight of concrete = $2400 \times 3.375 \times 10^{-3} = 8.1 \text{ kg}$

Adding 20% wastage, Mix ratio 1:1:2, W/C = 0.45

Weight of concrete = 9.72 kg

Weight of cement = $1/4 \times 9.72 = 2.43 \text{ kg}$

Weight of fine aggregate = $1/4 \times 9.72 = 2.43 \text{ kg}$

Weight of coarse aggregate = $2/4 \times 9.72 = 4.86 \text{ kg}$

For 1 % of NS = 0.0243 kg

For 1.5 % of NS = 0.0364 kg

For 2 % of NS = 0.044 kg

As same for NA

V. TEST AND RESULTS

MATERIAL TESTING:

1. Specific gravity of coarse aggregate : The specific gravity of coarse aggregate is determined by using pycnometer and the result was found to be 2.73.

2. Specific gravity of fine aggregate: The specific gravity of coarse aggregate is determined by using pycnometer and the result was found to be 2.69.

3. Initial and final setting time of cement : Initial and final setting time is determined by vicat's apparatus and the result was found to be 560 min.

4. Standard Consistency Test : The standard consistency of a cement paste is determined by vicat's apparatus and the result was found to be 560 min.

5. Water absorption test : To determine the water absorption of coarse aggregates as per IS : 2386 (Part III) 1963. It is determined by pycnometer and the result is 0.91%.

STRENGTH TESTING:



Compression test of a cube



Split tensile test of a cylinder



Flexure test of a cuboid

Compressive strength for NS and NA

S.NO	Material used (NS) and its %	Compressive strength	
		7 days	28 days
1	NS-1%	24.8	35.55
2	NS-1.5%	25.2	36
3	NS-2%	25.51	36.44

S.NO	Material used (NA) and its %	Compressive strength	
		7 days	28 days
1	NA-1%	29.55	42.22
2	NA-1.5%	28.31	40.44
3	NA-2%	27.37	39.11

Spilt tensile strength for NS and NA

S.NO	Material used (NS) and its %	Split tensile strength	
		7 days	28 days
1	NS-1%	2.16	3.09
2	NS-1.5%	2.13	3.04
3	NS-2%	2.065	2.95

S.NO	Material used (NA) and its %	Spilt tensile strength	
		7 days	28 days
1	NS-1%	2.36	3.38
2	NS-1.5%	2.23	3.18
3	NS-2%	2.16	3.09

Flexural strength

for NS and NA

S.NO	Material used (NS) and its %	Flexural strength	
		7 days	28 days
1	NS-1%	4.64	6.64
2	NS-1.5%	4.48	6.4
3	NS-2%	4.2	6

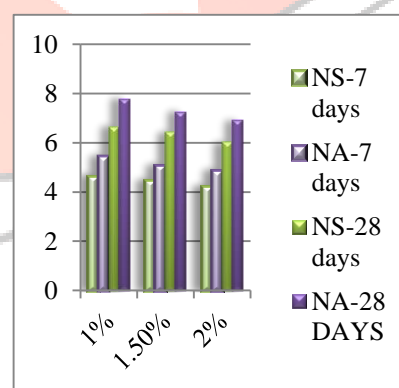
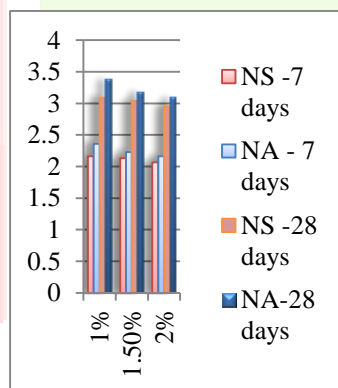
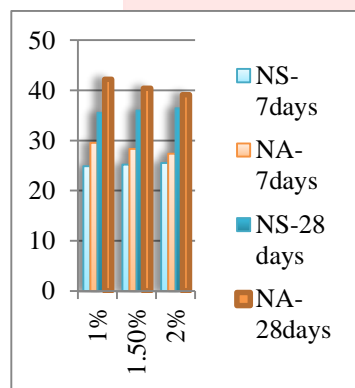
S.NO	Material used (NS) and its %	Flexural strength	
		7 days	28 days
1	NA-1%	5.43	7.77
2	NA-1.5%	5.07	7.25
3	NA-2%	4.87	6.9

GRAPHS:

Compressive strength for NS and NA

Split tensile strength for NS and NA

Flexural strength for NS and NA



CONCLUSION:

The maximum compressive strength have been achieved in Nano alumina at 1% (42.22 N/mm²) than Nano silica (35.55N/mm²).The maximum spilt tensile strength is attained in Nano alumina at 1% (3.38 N/mm²) than Nano silica (3.09N/mm²).As the same as above mentioned the maximum flexural strength is also obtained in Nano alumina at 1% (7.77N/mm²) rather than the Nano silica (6.64N/mm²).The maximum value have been attained at the optimum percentage of 1 in Nano alumina.In addition to this the water absorption test have been performed for both Nano silica and Nano alumina in which the amount of water absorbed is lesser in Nano alumina when compared with Nano silica and hence it is more durable than Nano silica.Hence Nano alumina is effective while compared to Nano silica due to its proper binding properties than Nano silica.

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