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EFFECT OF NANOSILICA ON COMPRESSIVE STRENGTH OF CONCRETE

Irfan Husain[1], Dr. Komal Kumari[2]

[1]PG student,Master of structural Engineering Bit Sindri Dhanbad Jharkhand India

[2]Assistant Professor Department of Civil Engineering Bit Sindri Dhanbad Jharkhand, India

Abstract : - This review paper is all about the effect of nano silica on concrete in it's compressive strength. Nano silica is a compound which is highly active in nature and used as a pozzolanic material that significantly improves the compressive strength of concrete ,This increase in strength is due to its ultra-fine particle size and high surface area, due to which it easily fills the pores and voids of concrete microstructure , which results the structure more dense and compact. By recent studies it can be observed that replacing cement with the nano silica in different percentage by weight of cement in concrete the strength increases in different manner so we did the replacement of cement with silica by 0.3% , 0.6% and 1% by weight of cement. The compressive strength of concrete is measured in different time period that is in 7-day,14 day, 21 days and 28 day.

Keywords – Nano silica, Samples, supplier.

1.INTRODUCTION

Concrete is the second-most-used substance in the world after water, and is the most widely used building material. Its usage worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminium combined. Concrete is used in a wide range of structures, including buildings, bridges, pavements, dams, and tunnels. Now this concrete gain its strength by the hydration process which takes some time during its curing period. So to enhance this strength we sometimes add some admixtures which has different properties. The different materials used in this concrete have some unique features which enhance the properties of this concrete. So we use Nano silica in concrete to enhance its strength.

Nano silica, also known as nano-SiO2, is a nanomaterial having particle size less than 100 nanometers.It is a highly reactive form of silica that has been shown to improve the properties of concrete, including its compressive strength. The addition of Nano silica to concrete has several beneficial effects. As we know that the permeability in concrete due to the small pores present in it reduces its durability which is not good for long term load bearing capacity of concrete. So by addition of the Nano silica enhances the durability by filling up the little pores and voids present in the concrete matrix, by which there is reduction in the permeability of the concrete and makes it more resistant to water and other aggressive chemicals(Tao Ji,2005). And makes the concrete more durable. Nano silica also reacts with the calcium hydroxide in the concrete to form a denser and more durable calcium silicate hydrate (C-S-H) gel. C-S-H gel is the main binding agent in concrete, and its strength and durability are critical to the overall performance of the concrete.

Studies have shown that the addition of Nano silica to concrete in different percentage can significantly improve its compressive strength. For example, one study shows that the addition of 1% Nano silica to concrete increased its compressive strength by up to by 20%Alirza (Naji Givi et.al ,2010). Another study found that the addition of 2% Nano silica to concrete increased its compressive strength by up to 30%.This improvement in the compressive strength of concrete is due to the formation of denser material by filling up the voids present in the concrete and increase in the bond between concrete and aggregate

Motivation for this work is that as we know that concrete is very much costly in todays life so its very much required to change the proportion of the concrete content to reduce its cost. Now the nano silica is not very much costly and its replacement with the cement gives a very much good result in the compressive strength and also enhance the other properties of the concrete like its permeability,durability, and also increase the re-sistace to the environmental actions(Surya Abdul Rashid et.al. ,2011). So its very much worth to replace the cement with the nano silica. And also its required to do deep analysis of the nano silica at the micro level which can give more good result for the future.

2.MATERIALS USED AND ITS PROPERTY

The cement used in this experiment is ordinary Portland cement .The aggregates used in concrete are collected from the river bed.The nano silica used here as a pozzolanic material to improve the hardened properties of concrete.

2.1 MATERIALS PROPERTIES

The materials used to make concrete are tested and listed below

2.1.1 Properties of cement

Here Portland slag cement(according to IS:455-1989) of grede 43 is used for preparing the concrete. The properties of cement is shown in Table-1

Table 1: Properties of cement

Specific gravity	Fineness by sieve analysis	Normal consistency
3.018	2.02%	33%

2.1.2 Properties of Nano silica

The different properties of nano silica is shown in table-2

Table 2: Properties of Nano Silica

Property	Result
Specific surface area	203 m^2/g
pH value	4.15
Wt, per gallon	18.5 lb
Sieve Residue	0.02% max
Bulk Density	3.1 lb/ft^3 max
Loss on Heating	15% max
Loss on Ignition(@1000®C)	2% wt
Specific Gravity	2.3 g/cm^3
Average Particle Length	0.2-0.3 microns
Refractive Index	1.46

2.1.3 Properties of water

Tap water is used in this experiment. The properties are same as a normal water. The specific gravity is taken as 1.00

2.1.4 Properties of coarse aggregate and fine aggregate

The aggregate is tested by different apparatus and there properties are noted which are as shown in table-3

Table 3: Properties of coarse and fine aggregates

Properties	Coarse aggregate	Fine aggregate
Specific gravity	2.73	2.66
Bulk density	1.41	-
Loose bulk density	1.23	-
Water absorption%	4.465	0.0653
Impact value	26.911	-
Crushing value	26.512	-
Fineness modulus	3.39	2.83

2.2 Mix Proportioning and Curing:

The cement is partially replaced by the nano silica in different percentage by the weight of cement. The percentage are 0.3%,0.6% and 0.1% by the weight of the cement nano silica is added to the concrete at the time of mixing.

2.3 Sample Preparation and Testing

A concrete cube of size 150X150X150mm is prepared by proper compaction for testing the compressive strength with and without adding silica in 7 days, 14 days and 28 days.

3.RESULTS DATA-

After preparing the cement concrete cubes we performed compressive strength tests on the concrete in the compression testing machine in 7 days, 14 days, and 28 days and we got some results which are as follows

Comparison of compressive strength for 7 day

7 –DAY RESULT	STRENGTH	INCREASE IN SRENGTH %
CONTROL	**26.49**	-
NS 0.3% b.w.c	27.63	4.30
NS 0.6% b.w.c	31.12	17.74
NS 1% b.w.c	34.58	30.53

Comparison of compressive strength for 14 days

14 –DAY RESULT	STRENGTH	INCREASE IN SRENGTH %
CONTROL	**30.37**	-
NS 0.3% b.w.c	30.61	0.79
NS 0.6% b.w.c	33.31	9.68
NS 1% b.w.c	35.53	16.99

Comparison of compressive strength for 28 days

28 –DAY RESULT	STRENGTH	INCREASE IN SRENGTH %
CONTROL	**35.89**	-
NS 0.3% b.w.c	35.98	0.25
NS 0.6% b.w.c	36.46	1.58
NS 1% b.w.c	39.83	10.97

*Compressive Strength = (Load× normal gravity × specific gravity of water) ÷ (surface area)

Table 4: Compressive Strength of conventional specimen for 7 day

7- DAYS TEST RESULTS			
Sample No.	**Weight(Kg)**	**Load(tonne)**	**Compressive Strength(MPa)**
1	8.11	52	22.67
2	8.33	68	29.64
3	8.35	63	27.46
Mean			**26.59**

Table 6: Compressive strength of conventional specimen in 14 day

14- DAYS TEST RESULTS			
Sample No.	**Weight(Kg)**	**Load(tonne)**	**Compressive Strength(MPa)**
1	8.26	68	29.64
2	8.30	69	30.09
3	8.35	72	31.39
Mean			**30.37**

Table 7: Comressive strength of conventional specimen in 28 days

28- DAYS TEST RESULTS			
Sample No.	**Weight(Kg)**	**Load(tonne)**	**Compressive Strength(MPa)**
1	8.43	85	37.06
2	8.38	86	37.49
3	8.16	76	33.14
Mean			**35.89**

3.1 GRAPHICAL RESULTS-

The following graphs shows the results of compressive strength tested in 7 days, 14 days and 28 days -

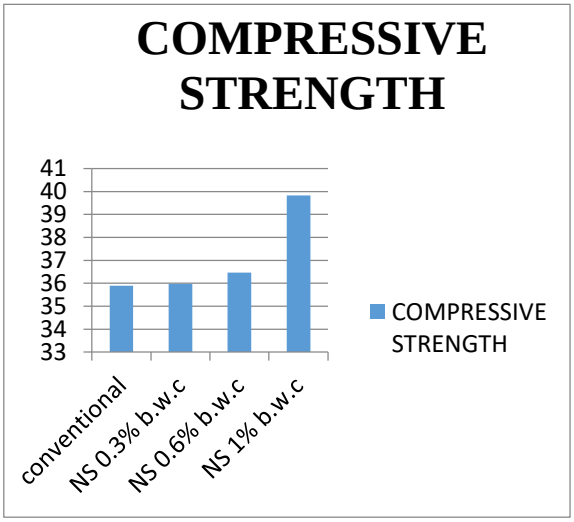

Fig- Compressive strength of conventional concrete in 14 days

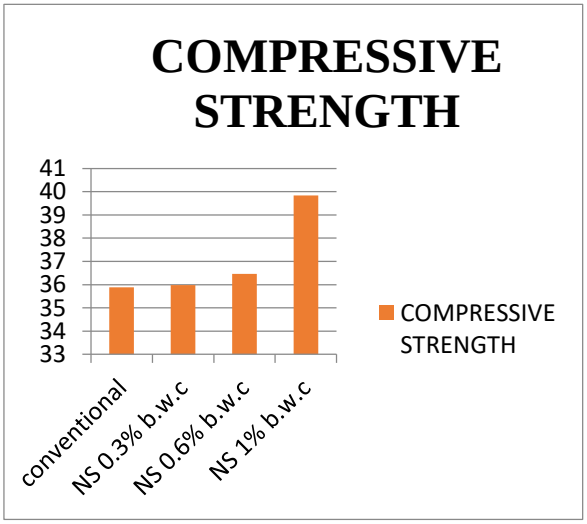

Fig- Compressive strength of conventional concrete in 7 days

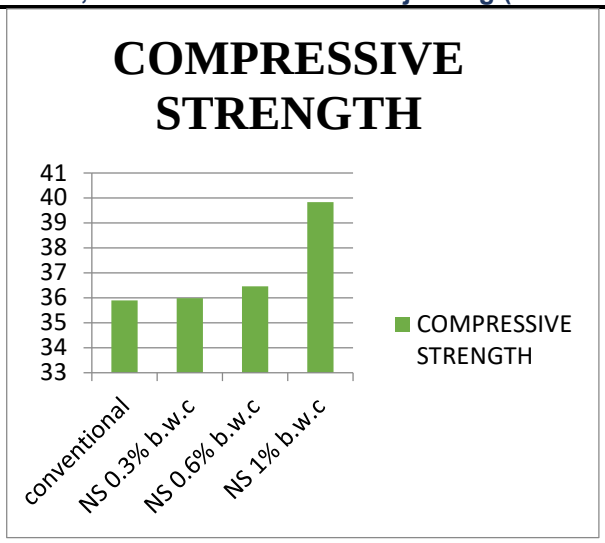

Fig- compressive strength of conventional concrete in 28 days

4.DISCUSSION-

Here by the graph we can observe that the compressive strength of the concrete increases by the addition of the nano silica by the different percentage and the increment at 1% of is maximum.The amount of nano silica that needs to added to concrete to achieve the desired improvement in compressive strength depends on a number of factors,including the water to cment ratio,the type of cement,and the aggregate type. However in general we found that adding 1-2% nano silica by weight of cement can increase the compressive strength by 20%. So its very much required to monitor the percentage of the nano silica to get the desire results.

5.CONCLUSION-

1.The addition of the nano silica in concrete gives very much promising result in the compressive strength and also due to this addition the overall cost of the concrete decreases which is good for the economical construction.
2.Addition of nano silica also shows sufficient increase in early age strength of concrete compared to the 28 days compressive strength.
3.It also increases the durabily of concrete by reducing the permeability of the concrete which also increases the resistace to the environmental condition.

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