International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Special Issue - .inSIGHT'20

Effect of Nanosilica

[1]Pritam Pabale, [2]Abbas Kasia
[1]MBA [1]Project & Construction Management, [1]Research Scholar, MIT College of Management, Loni-Kalbhor, Pune, India.

Abstract - The present study incorporates mix design based on the guidelines as per Indian Standard code IS 10262-2009. The nano-silica used is imported from a supplier. The use of any kind of admixture is strictly prohibited in the mix design. The water content has been kept constant to facilitate a better comparison for different samples. The compressive strength measurements are carried out for 7-day 14 day 21 day and 28-day. The size of the nano-silica was identified using Particle Size Analyzer.

Keywords – Nano silica, IS 10262-2009, Samples, supplier.

I. INTRODUCTION

Concrete is the material of present as well as future. The wide use of it in structures, from buildings to factories, from bridges to airports, makes it one of the most investigated material of the 21st century. Due to the rapid population explosion and the technology boom to cater to these needs, there is an urgent need to improve the strength and durability of concrete.

Out of the various materials used in the production of concrete, cement plays a major role due its size and adhesive property. So, to produce concrete with improved properties, the mechanism of cement hydration has to be studied properly and better substitutes to it have to be suggested.

Different materials known as supplementary cementitious materials are added to concrete improve its properties. Some of these are fly ash, blast furnace slag, rice husk, silica fumes and even bacteria. Of the various technologies in use, Nano-technology looks to be a promising approach in improving the properties of concrete.

II. RESEARCH METHODOLOGY

In this chapter the works of various authors on the use of Nanomaterials in concrete has been discussed in brief. A great number of researches have been performed to understand the nature of Nanomaterials and their effect on the properties of concrete. A number of Research & Development work dealing with the use of Nanomaterials like Nano silica, colloidal Nano Silica (CNS), Al_2O_3, TiO_2, ZrO_2,Fe_2O_3, carbon nanotubes (CNT) in cement based materials are discussed in the literature.

The pozzolanic activity of the material is essential in forming the C-S-H gel and hence the CH crystals are prevented from growing and their number reduces. Thus the early age strength of hardened cement paste is increased.

A comparative analysis of this work has been presented in the summary of this chapter which will highlight the significance of each work. Out of the numerous work done in the field only a few relevant works have been highlighted in the next section.

III. LITERATURE REVIEW

- Li et. al. (2004) experimentally investigated the mechanical properties of nano-Fe_2O_3 and nano-SiO_2 cement mortars and found that the 7, 14, 21 and 28 day strength was much higher than for plain concrete.
- Tao Ji (2005) experimentally studied the effect of Nano SiO2 on the water permeability and microstructure of concrete. The findings show that incorporation of Nano SiO2 can improve the resistance to water of concrete and the microstructure becomes more uniform and compact compared to normal concrete.
- Li et.al. (2006) studied the abrasion resistance of concrete blended with nano particles of TiO_2 and SiO_2 nano particles along with polypropylene (PP) fibers. It was observed that abrasion resistance can be improved considerably by addition of nano particles and PP fibers. Also the combined effect of PP fiber + Nano particles shows much higher abrasion resistance than with nano particles only. It was found that abrasion resistance of nano TiO_2 particles is better than nano SiO_2 particles. Also relationship between abrasion resistance and compressive strength is found to be linear.
- Sadrmotazi et.al. (2010) studied the effect of PP fiber along with nano SiO2 particles. The nanosilica was replaced up to 7% which improved the compressive strength of cement mortar by 6.49%. A PP fiber amount beyond 0.3% reduces the compressive strength but beyond 0.3% dose of PP fiber increases the flexural strength, showing the effectiveness of nano SiO2

 DOI : 10.35291/2454-9150.2020.0534

particles. Also up to 0.5% PP fibers in mortar water absorption decreases which indicates pore refinement.

- Jo et. al. (2007) studied the characteristics of cement mortar with Nano SiO2 particles experimentally and observed higher strength of these blended mortars for 7, 14, 21 and 28 days. The microstructure analysis showed that SiO2 not only behaves as a filler to improve microstructure, but also as an activator to the pozzolanic reaction.
- Nill et.al. (2009) studied the combined effect of micro silica and colloidal nano silica on properties
- of concrete and found that concrete will attain maximum compressive strength when it contains 6% micro silica and 1.5% nano silica. The highest electrical resistivity of concrete was observed at 7.5% micro and nano silica. The capillary absorption rate is lowest for the combination of 3% micro silica and 1.5% nano silica.

Descriptive Studies -

This section elaborates the proper statistical models which are being used to forward the study from data towards inferences. The detail of methodology is given as follows.

- For conducting compressive strength test on concrete cubes of size 150 mm are casted. A rotary mixture is used for thorough mixing and a vibrator is used for good compaction.
- After successful casting, the concrete specimens are de-moulded after 24 hours and immersed in water for 7, 14, 21 & 28 days maintaining 27 C.

c	7 days	14 days	21 days	28 days
0.3%	3	3	3	3
0.6%	3	3	3	3
1%	3	3	3	3
Conventional concrete	3	3	3	3
Total				48

IV. RESULTS & DISCUSSION

Compressive Strength = (Load× Normal Gravity× Specific gravity of water)÷(surface area of cube)

(52×9.81×1000)÷(150×150)= 22.67 MPa

7-DAY RESULTS	STRENGTH (MPa)	INCREASE IN STRENGTH (%)
CONTROL	26.30	-
NS 0.3% b.w.c	27.61	4.98
NS 0.6% b.w.c	31.10	18.25
NS 1% b.w.c	34.59	31.52

Comparison of compressive strength for 7 day

14-DAY RESULTS	STRENGTH (MPa)	INCREASE IN STRENGTH (%)
CONTROL	29.2	-
NS 0.3% b.w.c	30.5	4.45
NS 0.6% b.w.c	33.2	13.69
NS 1% b.w.c	35.3	20.89

Comparison of compressive strength for 14 day

21-DAY RESULTS	STRENGTH (MPa)	INCREASE IN STRENGTH (%)
CONTROL	32.62	-
NS 0.3% b.w.c	33.16	1.65
NS 0.6% b.w.c	35.13	7.69
NS 1% b.w.c	38.33	17.50

Comparison of compressive strength for 21 day

28-DAY RESULTS	STRENGTH (MPa)	INCREASE IN STRENGTH (%)
CONTROL	35.31	-
NS 0.3% b.w.c	35.98	1.90
NS 0.6% b.w.c	36.48	3.31
NS 1% b.w.c	39.82	12.77

Comparison of compressive strength for 28 day

Results of descriptive statistics of study –

7 day test result			
Sample No.	Weight (kg)	Load (tonne)	Compressive Strength (MPa)
1	8.10	52	22.67
2	8.34	68	29.65
3	8.36	61	26.59
Mean			**26.30**

Compressive Strength of conventional concrete specimen for 7 day

14 day test result			
Sample No.	Weight (kg)	Load (tonne)	Compressive Strength (MPa)
1	8.25	69	30.08
2	8.29	68	29.64
3	8.36	71	30.96
Mean			**30.5**

Compressive Strength of conventional concrete specimen for 14 day

21 day test result			
Sample No.	Weight (kg)	Load (tonne)	Compressive Strength (MPa)
1	8.35	72	31.40
2	8.29	75	32.70
3	8.09	77	33.76
Mean			**32.62**

Compressive Strength of conventional concrete specimen for 21 day

28 day test result			
Sample No.	Weight (kg)	Load (tonne)	Compressive Strength (MPa)
1	8.42	84	36.62
2	8.36	84	35.62
3	8.14	75	32.70
Mean			**35.31**

DOI : 10.35291/2454-9150.2020.0534

ISSN : 2454-9150 Special Issue - .inSIGHT'20

Compressive Strength of conventional concrete specimen for 28 day

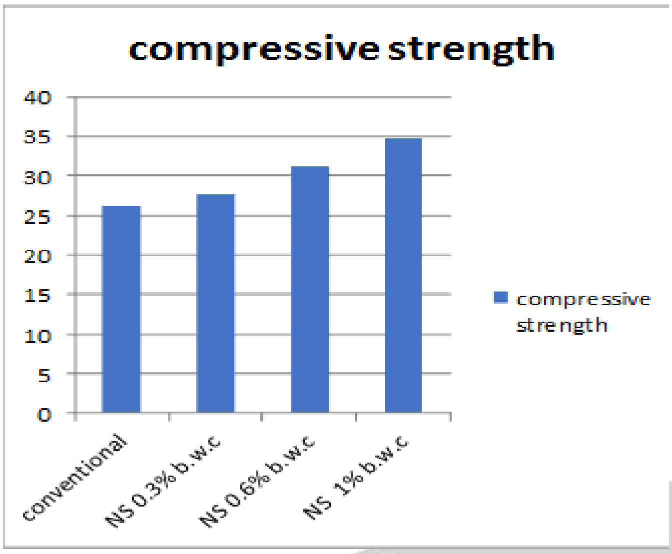

Fig 7-day compressive strength of four specimen

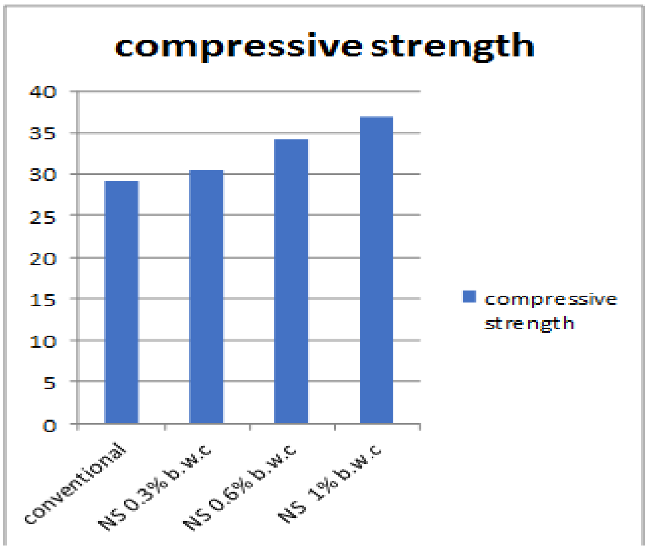

Fig 14-day compressive strength of four specimen

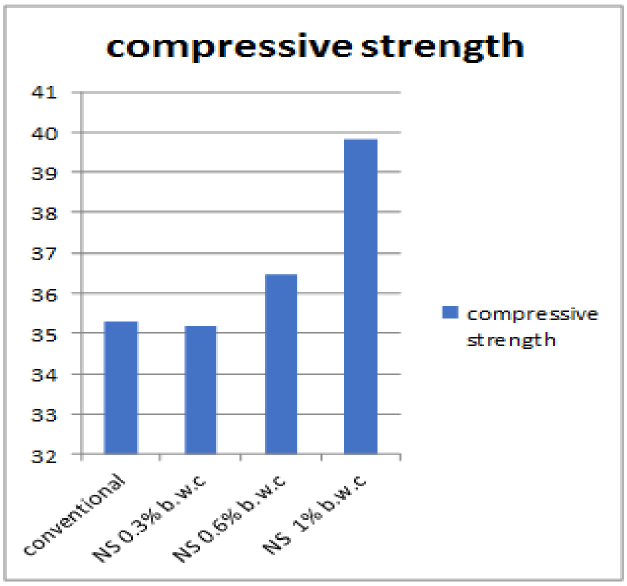

Fig 21-day compressive strength of four specimen

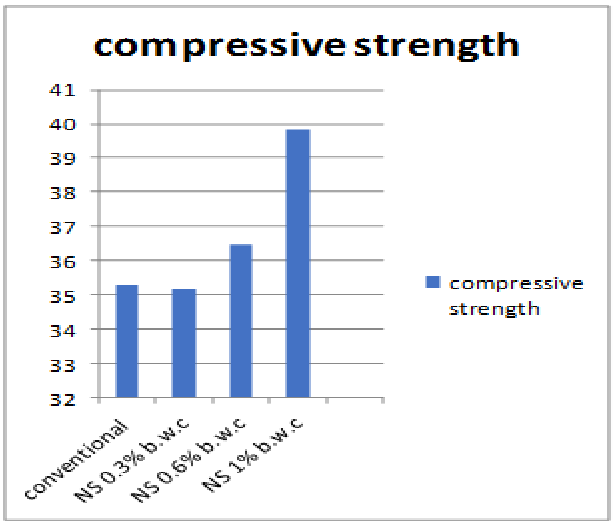

Fig 28-day compressive strength of four specimen

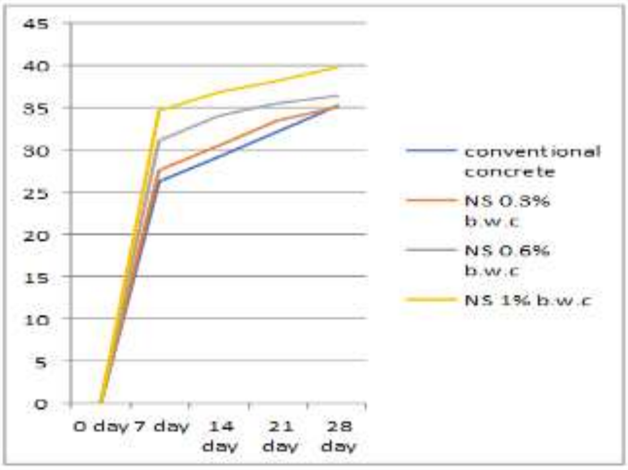

Fig – 15 Change in compressive strength of four specimen from 7 to 28 day

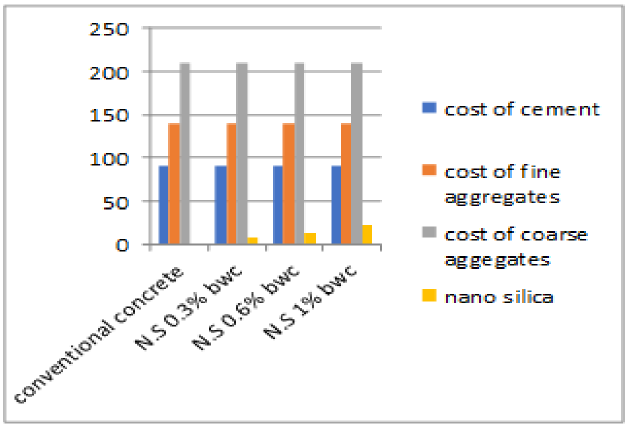

Fig – 16 Cost of 6 cubes of each proportion

V. CONCLUSION

From the test results, the SEM micrographs and the relative chemical composition of the specimen a number of conclusions can be drawn. These conclusions are justified in the next section.

The conclusions drawn are:

i. From the compressive strength results, it can be observed that increase in compressive strength of concrete is observed on addition of a certain minimum quantity of

DOI : 10.35291/2454-9150.2020.0534

Nano SiO2. The increase in strength is maximum for NS 1% b.w.c and least for NS 0.3% b.w.c.

ii. On addition of Nano SiO2 there is a substantial increase in the early-age strength of concrete compared to the 28 day increase in strength.

REFERENCES

[1] Li.H,Xiao Hui-gang, YuanJie and JinpingOu. (2004). “Microstructure of cement mortar with nanoparticles”Composites: Part B 35, 185-189.

[2] Nill, Ehsani, A. and Shabani K. (2009).”Influence of nano SiO2 and microsilics on concrete performance”Bu-Ali Sina University Iran.

[3] Givi.Alireja.Naji, Rashid.Suraya.Abdul, Nora.Farah.A,Salleha.Mohd.Amra.Aziz (2010)

[4] “Experimentally investigation of the size effect of SiO2nano particles on mechanical properties on binary blended concrete” composites: B 41, 673-677

[5] Rashid.S.A, Givi.A.N(2011) “The effect of lime solution on the properties of SiO2nano particles binary blende concrete, composites (part B) Vol.42, 562-569.

[6] Said.A.M, Zeidan.M.S, Bassoumi.M.T, (2012) “properties of concrete incorporating nano silica. Construction and building material 36,838-844.

[7] IS:455-1989. Portland Slag Cement- Specification. Burea of Indian Standards.

[8] IS:456-2000. Plain and Reinforced concrete- code of practice (Fourth Revision). Bureau of Indian Standards.

[9] IS:383-1970. Specification for coarse aggregate and fine aggregate from natural sources for concrete. Burea of Indian Standards.

[10] IS:455-1989. Portland Slag Cement- Specification. Burea of Indian Standards.

[11] IS:456-2000. Plain and Reinforced concrete- code of practice (Fourth Revision). Bureau of Indian Standards.

 DOI : 10.35291/2454-9150.2020.0534