AN EXPERIMENTAL STUDY ON THE EFFECT OF NANO SILICA AND THE BEHAVIOUR OF OPC AND BLENDED CEMENT

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Abstract - *Recent improvements in Nano-innovation and accessibility of Nano-silica have utilized such materials in substantial conceivable. Nano-silica (NS) is a Nano-sized, exceptionally receptive indistinct material. Because of their little molecule sizes and high surface regions contrasted with those of silica smolder, NS might improve the early compressive qualities of substantial more really than silica fume.As NS particles are exceptionally fine and they will quite often agglomerate because of high surface communication, uniform scattering of NS is a significant issue to get its useful effects.Nano materials are minimal estimated materials with atom gauge in nano meters. These materials are extraordinarily fruitful in changing the properties of concrete at the ultrafine level by the uprightness of their little size. The little size of the particles in like manner suggests a more conspicuous surface region. The quality and porosity of cement can be worked on by the expansion of these nano-materials as they occupy minute spaces in the microstructure. The compressive, flexural and split-elasticity of cement is expanded because of purpose of nano-silica in concrete mix.This proposal gives an understanding on the impact of Nano - silica of size 236nm on the mechanical properties of cement. Nano - silica of 0, 1%,1.5% 2%, and 3% b.w.c. was utilized for trial reason, significant expansion in early-age compressive, split-tensile and flexural strength and a progressively expansion in the generally speaking compressive, split-tensile and flexural strength of cement was noticed..*

Key Words: (Aluminum powder, FlyAsh, compressive strength,ultra sonic pulse velocity)

1. INTRODUCTION

oncrete is one of the flexible heterogeneous materials, structural designing has at any point known. With the coming of cement structural designing has contacted most elevated pinnacle of innovation. Concrete is a material with which any shape can be projected and with equivalent strength or maybe more strength over the traditional structure stones. It is the material of decision where strength, execution, sturdiness, im-penetrability, imperviousness to fire and scraped area obstruction are required.

Concrete cement is one of the apparently straightforward however complex materials. The properties of cement for the most part rely upon the constituents utilized in substantial making. The vitally significant material utilized in making concrete are concrete ,sand, squashed stone and water .Even however the maker ensures the nature of concrete it is hard to create an issue evidence concrete. It is a direct result of the way that the structure material is concrete and not just concrete. The properties of sand, squashed stone and water, in the event that not utilized as indicated, bring impressive hardship in concrete. What's more, workmanship, quality control and strategies for putting additionally assume the main part on the properties of cement.

The Aluminum powder can be ordered into three sorts: atomized, drop and granules. If there should be an occurrence of an atomized molecule, its length, width and thickness are all of roughly a similar request where the length or width of a piece molecule perhaps a few hundred times it thickness. Aluminum powder in the AAC business is frequently produced using foil scrap and exists of minuscule piece molded aluminum particles. Aluminum powder with grain size under 100μm and especially with divisions under 50μm, can without much of a stretch structure profoundly combustible air suspensions.

Compressive strength of substantial comes principally from the hydration of alite and belite in Portla nd concrete to frame C-S-H. Alite hydrates quickly to shape C-S-H and is answerable for early strength gain; belite has a more slow hydration rate and is liable for the drawn out strength enhancements.

Alite: $2Ca3SiO5 + 6H2O \rightarrow 3CaO•2SiO2•3H2O + 3Ca\ (OH)\ 2$

Belite: $2C2S + 4H2O = C3S2H3 + CH$

When a late and be late hydrate they produce a by-product, calcium hydroxide (CH), which crystallizes around the aggregate to create a weak zone called the interfacial transition zone (ITZ) . The ITZ is where concrete paste has a higher porosity and lower strength than the surrounding paste and allows the greatest penetration of harmful containments.

2. LITERATURE REVIEW

S. Bhanjaa, B. Sengupta based on 28-day strength results have proposed changed strength water-cementations material proportion connections for concrete containing concrete in addition to silica seethe as a strengthening cementations material to assess the strength of silica rage concrete for getting high strength substantial blends.

Schoepfer and Maji (2009) examined the impact of silica of different molecule sizes (150, 100, 40, 12, 7 nm) on the compressive strength improvement of cement with limited quantities (around 18%) of fly debris. They observed that compressive strength of cement was expanded with diminishing size of silica aside from combination with 7-nm nano-silica. Not an obvious reason was given for the diminished compressive strength of cement with 7-nm silica.

This investigation is mainly focused on the strength properties of M40 grade of concrete blended with nano silica. In this study nano silica replacement level was kept at 3% .

3. EXPERIMENTAL PROGRAM

3.1NANO SILICA

At present a wide range of silica products is manufactured industrially for a diverse array of applications. Silicas are mainly used for reinforcing, thickening and flattening purposes. In1999 the world precipitated silica production capacity was 1100 kilotons. There are two main routes for the productions of synthetic amorphous silica.

Table 3.1 Properties of Nano Silica

Property	Characteristics
Surface Area (m2/g)	200 ± 30
Tamped Bulk Density (g/l)	Approx. 40
Moisture (%)	< 1.5
Loss on Ignition (%)	< 1.5
PH Value (4 % dispersion in Water)	3.8 – 4.3

Property	Characteristics
SiO2 content (%)	> 99.8
Al2O3 Content (%)	< 0.05
Fe2O3 Content (%)	< 0.005
TiO2 Content (%)	< 0.003

3.2 TESTS ON HARDENED CONCRETE

In the ongoing review the examples have been casted. 3D shape examples for testing pressure test, pillar examples for flexure test and round and hollow examples for split strength have been projected and saved for restoring for a time of 28 days and afterward tried for their particular assets.

3.2.1Compression Strength Tests on Concrete

At the time of testing the cured cubes are surface dried. It is then placed centrally over the lower plate of the universal testing machine (UTM). The top plate is lowered till it touches the top surface of the cube. The cube is compressed by operating the UTM at a constant rate of $14 N/mm^2$ and the dial gauge reading is noted when the cube yields.

Fig 3.1 Compressive strength machine

3.2.2. Split Tensile Test on Concrete

The ingredients of concrete were mixed using the mixer. Cast iron cylindrical moulds of 150 mm diameter and 300 mm length were used as the cylinder specimens. Once the concrete was poured in moulds, they were compacted thoroughly by placing on table vibrator. De-Moulding was done 24 hours after casting and then the specimens were kept for curing in the curing tank.

3.2.3. Flexure Test on Concrete:

The ingredients of concrete were mixed using the mixer. Cast iron rectangular moulds of size 100mm X 100mm X 700mm were used as the cylinder specimens. Once the concrete was poured in moulds, they were compacted thoroughly by placing on table vibrator. Demolding was done 24 hours after casting and then the specimens were kept for curing in the curing tank. The flexure test was carried out after 28 days of casting.

3.3MIXTURE PROPORTIONS:

Table 3.2. M 25CC mix proportions

Grade Designation	M40
Type of Cement	OPC 43 Grade
Maximum Nominal size of Aggregate	20 mm
Minimum content of Cement	380 Kg/m^3
Maximum Water Cement ratio	0.40
Specific Gravity of Cement	3.15
Specific Gravity of Coarse Aggregate	2.61
Specific Gravity of Fine Aggregate	2.44

4. RESULTS AND DISCUSSION

Tests were conducted for workability on fresh concrete, compressive strength, split tensile strength and flexural strength on hardened specimens. Standard procedures were adopted for testing.

4.1 COMPRESSIVE STRENGTH

The results of the experimental investigations are presented and discussed herein.The compressive strength results with CSF and NS are given in Table 5.1 for M40 grade of concrete

4.1 Compressive Strength for M40

Sample	Compressive Strength (N/mm^2)		
	3 Days	7 Days	28 Days
Conventional Concrete(0)	21.77	31.86	48.49
Nano silica (1%)	26.21	28.92	51.21
Nano silica (1.5%)	27.62	29.77	53.12
Nano silica (2%)	28.06	30.21	54.22
Nano silica (3%)	27.16	29.56	52.92

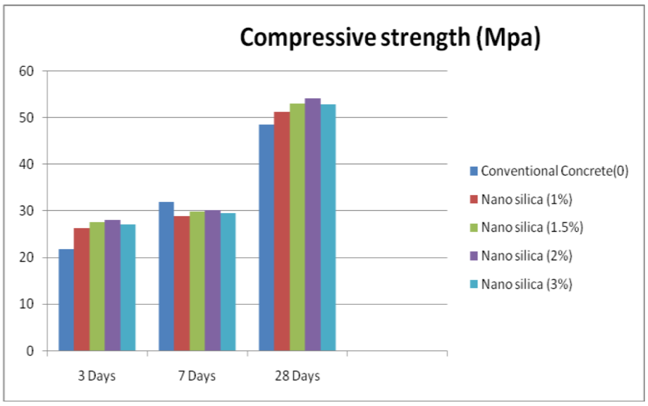

Fig 4.1 compressive strength for M40 grade

While observing above tabular values and graphical representation the percentage of nano silica is increases the strength values are also increases upto 2% when it is compared with conventional concrete. The 7 days strength was more for conventional concrete when compared with nano silica content. while for 3days and 28 day of silica fume blended concrete the strength value is more than the conventional concrete. For 3% of silica fume the compressive strength value is decreased, But it is greater value than the normal concrete.

4.2 SPLIT TENSILE STRENGTH :

Table 4.2 Split tensile Strength

Sample	Split Tensile strength (N/mm^2)		
	3 Days	7 Days	28 Days
Conventional Concrete(0)	2.42	2.55	2.78
Nano silica (1%)	2.52	2.89	2.96
Nano silica (1.5%)	2.72	3.02	3.24
Nano silica (2%)	2.63	2.86	3.01
Nano silica (3%)	2.51	2.72	2.83

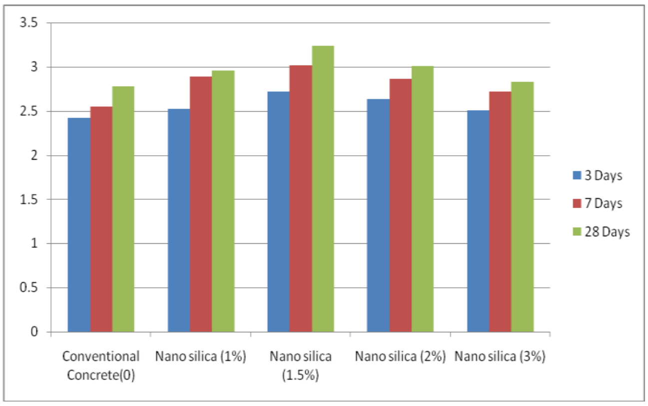

Fig 4.2 Graphical representation of split tensile strength

By observing the split tensile property, the strength values are gradually increases with increasing with nano silica upto 1.5%.From 2% of nano silica the tensile strength value is decreases with increasing in nano silica content. when compare to the conventional concrete upto 3% adding of nano silica the strength properties are increased. The highest strength achieved at 1.5% of silica fume.From starting 3 days to 28 days the strength values are gradually increased upto 1.5% of nano silica.

4.3 FLEXURAL STRENGTH

Table 5.3 Flexural strength results

	Flexural strength (N/mm2)		
	3 Days	7 Days	28 Days
Conventional Concrete(0)	5.12	5.23	5.36
Nano silica (1%)	5.22	5.69	5.81
Nano silica (1.5%)	6.1	6.42	6.72
Nano silica (2%)	6.21	6.86	7.12
Nano silica (3%)	5.81	6.52	6.85

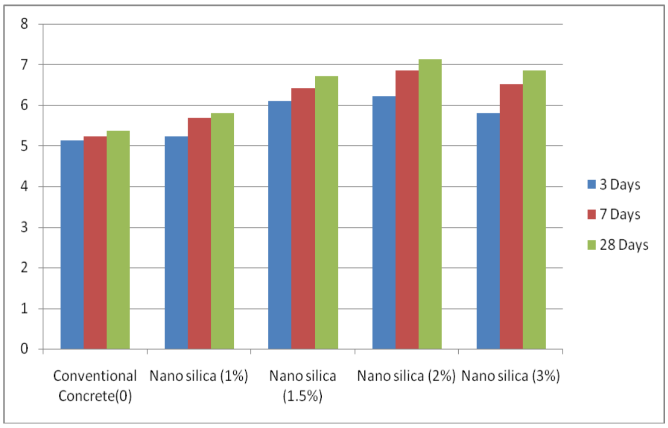

Fig 4.3 Graphical representation of Flexural strength

From flexural strength results we can decide the how much bending nature of concrete.In this investigation the flexural strength value is increased with increasing with nano silica content upto 2% .from the results when we compared it with the conventional concrete the flexural strength value is increases.

5. CONCLUSIONS

In this whole experimental program, the nano silica effect to concrete was studied; their effect on the compressive, flexural and split-tensile strength of concrete cubes, cylinders and prisms

- The compressive strength of cubes is increased by the addition of Nano-silica the cubes show increase in compressive strength by minimum addition of Nano-silica even at 1% and shows maximum increase in compressive strength at 2% Nano-silica but after that there is a decrease in compressive strength as compared to 2% Nanosilica sample.
- The split-tensile strength of concrete cylinder is increased by the addition of Nano-silica the prisms show increase in split-tensile strength by the presence of minimum addition of Nano-silica at 1% and shows max increase in Split-tensile strength at 1.5% Nano-silica but after that there is a decrease in Split-tensile strength as compared to 1.5% Nano-silica sample.
- The flexural strength of concrete prism is increased by the addition of Nano-silica, the prisms show increase in flexural strength by the presence of minimum addition of Nano-silica at 0.3% and shows max increase in Flexural strength at 2% Nano-silica but after that there is a decrease in Flexural strength as compared to 2% Nano-silica sample.
- Maximum increase in Compressive strength at 2% Nano-silica was recorded and it showed an optimum value of 54.22 mpa at 28days
- Maximum increase in split strength at 1.5% Nano-silica was recorded and it showed an optimum value of 3.24 mpa at 28days
- Maximum increase in Flexural strength at 2% Nano-silica was recorded and it showed an optimum value of 7.12 mpa at 28days

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