International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-6, August 2019

Influence of Nano Silica on the Strength and Durability of Self Compacting Concrete

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***Abstract:** The principle target of the study is to evaluate the probability of using nano silica as cement replacement materials and copper slag as fragmented fine aggregate in Self- compacting concrete. The degree of the present study joins the examination of convenience, mechanical and quality properties of Self-compacting concrete combining distinctive replacement levels of above materials.*

Nano silica is another mineral admixture with particle size in the Nano metric range and high express surface region. Its potential points of interest in cement based materials are not totally recognized in light of limited asks about in the field of Nano fabricated cementations composites. Concrete with suitably dissipated Nano silica of perfect sum realizes incredible quality and solidness properties. Use of mineral admixtures reduces the measure of cement for concrete generation which, accordingly, diminishes the outpouring of CO2 into the air.

The degree of Nano silica replacement is 0%, 0.5%, 1%, 1.5%, 2%, 2.5% and 3% by weight of cement. A relentless water-spread ratio of 0.31 is gotten for all the concrete mixes. The usefulness of SCC mixes are kept up in the hang extent of 25 – 50 mm by fluctuating the substance of super plasticizer. The perfect measure of Nano silica, is managed by coordinating usefulness, mechanical and strength tests. Nano silica improves the early nature of concrete on account of its high Pozzolanic reactivity. Extension of Nano silica improves the quality at 1 – 3 days of calming. This is credited to the high unequivocal surface zone of Nano silica.

I. INTRODUCTION

Concrete is a mixture of cement, fine total, coarse total and water in foreordained extent, delivered to accomplish wanted quality at the predefined age. The constituents of concrete are gotten from different sources, with the end goal that, they contrast in physical, substance and reactivity properties.

Use of such gigantic mass of concrete outcomes in the consumption of common assets, by utilizing crude materials for cement creation, waterway sand and coarse total quarrying and so on. Additionally, creation of cement includes different operations from which CO2 outflows are high. About 80% of all out CO2 outflows from concrete are because of cement.

Revised Manuscript Received on August 30, 2019.
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It is evaluated that, out of all out CO2 emanations on the planet, cement businesses contribute about 7%, which needs uncommon consideration. It is the ideal time to discover legitimate measures to defeat these issues to hold a practical situation. With the approach of industrialization, generation of modern waste expands numerous folds and businesses find troublesome in dumping and arranging them. Non designed transfer of modern waste influence the earth which thus influences the maintainability. Numerous inquires about are being done to locate the conceivable method for usage of modern waste in the development part. The expansion of certain materials like fly slag, silica rage, and so on., is found to improve the properties of cement and concrete with the end goal that their use is very basic in different useful applications

Nano Silica

"There's a lot of room at the base" the celebrated articulation of Richard Feynman has opened new roads in the zone of nanotechnology look into (Feynman 1960; Gann 2002). Drexler et al. (1991) characterized nanotechnology as the control of the structure of issue dependent on particle by-atom control of items and side-effects. The word 'nano' is a Greek prefix importance predominate and portrays one billionth (10-9) of a unit. The field of nanotechnology is increasing logical enthusiasm for the ongoing years because of the decrease of particles to nanometer scale. The uses of nano materials are limited in the field of Civil Engineering because of inadequate learning and instrumentation offices to envision the advantages of nano particles in cementitious composites, challenges in creating nano particles everywhere scale, cost of generation of nano particles, taking care of issues related with its physical state, issues identified with legitimate scattering of nano particles, variety in ideal amount of nano particles dependent on its sort and normal molecule size, and limited research in the field of nano harmfulness. Numerous inquires about are done to assess the properties of nano particles joined development materials, particularly concrete. The physical and response properties of materials that are diminished to nano size change to a bigger degree.

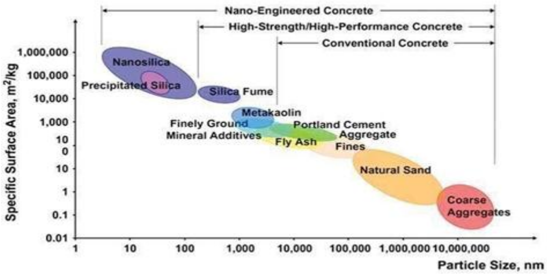

Figure 1 Particle size and specific surface area related to concrete materials

Figure 1 demonstrates the conveyance of molecule size and explicit surface territory of customary concrete, elite concrete and nano-built concrete. Nano silica particles have exceptionally high explicit surface zone and the molecule size of upto 5 nm level.

II. LITERATURE REVIEW

Hassan et al. (2000) displayed the impact of silica smoke and fly fiery debris on the properties of super plasticized high – execution concrete. For creating the concrete mixes, the silica smoke and fly fiery remains was supplanted at 10% and 30% by weight of cement individually. The examples were relieved at 20 °C and 65% relative stickiness up to the age of 1 year. The mineral admixtures was accounted for to improve the properties of superior concrete however at different rates, in view of the folio type. Consideration of silica smoke added to both short and long haul properties of concrete though, fly fiery remains requires a moderately longer time to acquire its advantages.

Björnström et al. (2004) examined the hydration procedure of Ca3SiO5 (C3S) cement and the quickening endless supply of colloidal nano silica. C3S glues were set up with water to C3S ratio of 0.4 and the dose of colloidal nano silica utilized were 1 and 5 level of weight of the sol, regarding the heaviness of C3S clinker stage. DR-Fourier Transform Infrared (DR-FTIR) and Differential Scanning Calorimetry (DSC) estimations were made on C3S glues. Disintegration of C3S stage was quickened by colloidal nano silica expansion and fast arrangement of calcium – silicate – hydrate restricting stage was accounted for. The reason was credited to the exceedingly receptive and enormous surface zone of the nano particles. The surface DR – FTIR and mass DSC information suggested that, colloidal silica particles go about as buildup focuses and the hydration was quickened by colloidal silica during starting stages for example 4 – 12 hours. The job of water and concealment of water evaporation during hydration procedure was additionally examined.

Qing et al. (2006) thought about the pozzolanic movement of nano silica and silica rage by X – beam diffraction (XRD), Differential filtering calorimetry (DSC), Scanning electron microscopy (SEM), compressive quality, bond and twisting qualities of solidified glue and concrete. Calcium hydroxide powder was utilized to somewhat supplant with nano silica and silica smolder. The fourteenth day quality accomplished by the mix of Ca(OH)2 with silica smoke was equivalent to the one day quality accomplished by the blend of Ca(OH)2 with nano silica. The pozzolanic movement and speed of C-S-H gel shaped were accounted for a lot snappier for Ca(OH)2 with nano silica than Ca(OH)2 with silica seethe. The bond quality and bowing quality of concrete with 3% nano silica was found to increment at early ages than concrete with silica seethe

III. METHODOLOGY

TESTS ON FRESH CONCRETE

Usefulness of concrete is significant in crisp concrete. Usefulness is characterized as the straightforwardness with which a given arrangement of materials can be mixed into concrete and along these lines took care of, shipped, put and compacted with least loss of homogeneity. The estimation of functionality by droop test, compaction factor test, vee-honey bee consistometer test is done according to the BIS: 1199 – 1959 and it is depicted underneath.

Slump Test

The device for directing the droop test basically comprises of frustum of a cone having the base distance across of 200 mm, top measurement of 100 mm and tallness of 300 mm. The inside surface of the droop cone was completely cleaned and oiled to keep away from the grinding among concrete and droop cone. The shape was set on smooth flat, inflexible and non – permeable surface metal plate. The shape was loaded up with 4 layers of concrete, each roughly one fourth of the tallness of form. Each layer was packed with 25 passes up utilizing a steel packing pole of 16 mm width, 0.6 m long and adjusted toward one side. The stroke ought to be circulated in a uniform way over the whole cross area of form. For the second and consequent layers, packing pole ought to infiltrate into basic layer to such an extent that, the base layer ought to be packed all through its profundity. After the top layer was rodded, the concrete was hit off level with trowel. The form was lifted delicately in the vertical bearing. The droop value of concrete was estimated by deciding the distinction between stature of shape and that of the most elevated purpose of drooped concrete example. The droop test directed for SCC preliminary mixes is appeared in Figure 2

Figure 2 Slump test on fresh concrete

Vee – Bee Consistometer Test

Vee-Bee consistometer test (Figure 3) is increasingly reasonable for hardened concrete mixes having low and extremely low usefulness. For doing this test, at first concrete was poured in to the droop cone inside the tube shaped piece of the consistometer. Subsequent to evacuating the droop cone form, the glass circle was turned and set over the highest point of the concrete mass. Presently, controlled vibration was connected through electric vibrator and at the same time the stopwatch was begun. The vibrations were proceeded till the tapered state of concrete accept the round and hollow shape and time was noted. The time required for a total remolding of concrete (for example from funnel shaped to round and hollow shape) in seconds is communicated as Vee-Bee seconds or Vee-Bee Degree

Fig 3 Vee-bee consistometer test on fresh concrete

Cube compressive strength test

The compressive quality trial of concrete was completed with 100 x 100 x 100 mm 3D square examples according to BIS: 516-1959 determinations. For every preliminary mix blend, three 3D shapes were tried at the age of 1, 3, 7, 28, 56 and 90 days of relieving utilizing Lawrence and Mayo pressure testing machine of 3000KN limit as appeared in Figure 4.4. The heap was connected to the side essences of shape examples and expanded consistently at a rate of roughly 140 kg/sq.cm/min till the example falls flat. The most extreme burden connected to the example was recorded at the moment of burden inversion. The compressive quality (fck) in N/mm2 was dictated by the accompanying equation:

Compressive strength (C)= P/A. Compressive strength(C) = Load/Area

Where, P = maximum applied load in Newtons

A = Area of cross section of cube in mm2 (150mm x 150mm)

Fig 4 Testing For Compressive Strength Of Concrete

IV. RESULTS

Workability and density

The functionality of concrete is the simplicity with which concrete is mixed, moved, set and compacted with least loss of homogeneity, which is very impacted by the water prerequisites at the season of mixing the concrete. The water prerequisites of a concrete are subject to the properties of aggregates and admixtures utilized. Water request increments with decrease in the size of aggregates which, thusly, is the primary necessity for high evaluations of concrete. The physical attributes of the mineral admixtures that are added to concrete significantly impact the water request and usefulness of concrete mix. As a rule, superplasticizer is added to concrete containing admixtures to keep up the usefulness inside the attractive range. The water necessity of customary concrete is essentially founded on the most extreme size of aggregateutilized.

The test consequences of the usefulness of the present examination are displayed in Table5.1 . The measurement of superplasticizer was balanced for each mix to keep up the usefulness inside the predetermined range. From the test outcomes, it has been seen that with increment in the substance of nano silica and silicafume, functionality of SCC mixes as estimated from droop, compaction factor and Vee – Bee consistometer degrees diminishes and consequently the dose of superplasticizer was expanded.

Table 5.1 Workability test results

Sl. No.	Mix Designation	Dosage of super -plasticizer(% per weight of binder)	Workability			Densit y (Kg/ m^3)
			Slump (mm)	Compaction factor	Vee – Bee Time (sec)	
1	CON	0.4	41	0.877	8	23 44
NANO SILICA CONCRETE WITH 0% COPPER SLAG						
2	NS0.5	0.45	33	0.845	11	2375
3	NS1	0.45	29	0.833	13	2394
4	NS1.5	0.5	35	0.856	10	2411
5	NS2	0.55	36	0.86	9	2432
6	NS2.5	0.6	38	0.866	10	2423
7	NS3	0.65	37	0.871	11	2406
8	NS3.5	0.7	36	0.863	10	2399
9	NS4	0.7	29	0.831	15	2387
NANO SILICA CONCRETE WITH 10% COPPER SLAG						
10	NS0.5CS 10	0.45	39	0.877	9	2382
11	NS1CS10	0.45	33	0.863	9	2415
12	NS1.5CS 10	0.5	38	0.867	10	2432
13	NS2CS10	0.55	41	0.88	8	2455
14	NS2.5CS10	0.6	43	0.884	8	2434
15	NS3CS10	0.65	42	0.884	8	2421
NANO SILICA CONCRETE WITH 20% COPPER SLAG						
16	NS0.5CS20	0.45	42	0.881	7	2403
17	NS1CS20	0.45	39	0.876	9	2438
18	NS1.5CS20	0.5	44	0.888	8	2448
19	NS2CS20	0.55	47	0.89	7	2468
20	NS2.5CS20	0.6	48	0.893	7	2451
21	NS3CS20	0.65	49	0.903	7	2435
NANO SILICA CONCRETE WITH 30% COPPER SLAG						

Retrieval Number F9539088619/2019©BEIESP
DOI: 10.35940/ijeat.F9539.088619
Journal Website: www.ijeat.org

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22	NS0.5CS30	0.4	35	0.859	10	2429
23	NS1CS30	0.4	28	0.836	14	2456
24	NS1.5CS30	0.45	33	0.847	12	2463
25	NS2CS30	0.5	36	0.865	9	2484
26	NS2.5CS30	0.55	40	0.88	8	2477
27	NS3CS30	0.6	41	0.88	8	2452
NANO SILICA CONCRETE WITH 40% COPPER SLAG						
28	NS0.5CS40	0.4	39	0.879	8	2454
29	NS1CS40	0.4	32	0.857	12	2471
30	NS1.5CS40	0.45	38	0.866	10	2489
31	NS2CS40	0.5	42	0.883	8	2502
32	NS2.5CS40	0.55	45	0.888	8	2493
33	NS3CS40	0.6	47	0.891	7	2479
NANO SILICA CONCRETE WITH 50% COPPER SLAG						
34	NS0.5CS50	0.35	43	0.885	7	2441
35	NS1CS50	0.35	37	0.873	9	2462
36	NS1.5CS50	0.4	45	0.887	8	2478
37	NS2CS50	0.45	46	0.891	7	2493
38	NS2.5CS50	0.5	48	0.898	7	2484
39	NS3CS50	0.55	50	0.908	7	2463

CUBE COMPRESSIVESTRENGTH

The solid shape compressive quality outcomes at the age of 1, 3, 7, 28, 56 and 90 days for SCC mixes with 0%,0.5%,1%,1.5%,2%,2.5%and3%ofnanosilica,as incomplete replacement of cement and 0%, 10%, 20%, 30%, 40% and half of copper slag as halfway replacement of fine aggregate are exhibited in Table 5.2

Table 5.2 Compressive strength results at different ages

Sl.No.	Mix Designation	Compressive strength (MPa)					
		1 Day	3 Days	7 Days	28 Days	56 Days	90 Days
1	CON	14.6	27.1	42.5	60.4	65.9	67.4
NANO SILICA CONCRETE WITH 0% COPPER SLAG							
2	NS0.5	20.9	37.5	50.5	63.4	67.7	69.5
3	NS1	23.9	39.6	52.6	65.7	70.3	72.3
4	NS1.5	26.2	42.1	55.3	67.5	73	75.4
5	NS2	28.9	46.3	58.6	70.3	76.3	78.9
6	NS2.5	27.1	43.8	56.2	68.9	74.7	76.4
7	NS3	25.9	42.2	55	67.6	73.1	74.7
8	NS3.5	23.6	40.6	53.3	66.3	71.6	73.1
9	NS4	21.8	38.7	51.5	64.1	69.1	70.4
NANO SILICA CONCRETE WITH 10% COPPER SLAG							
10	NS0.5CS10	19.3	36.9	49.8	62.2	66.5	68.9
11	NS1CS10	22.1	38.7	51.7	64.1	68.7	71.5
12	NS1.5CS10	25.6	41.2	54.7	66.5	71.5	74.8
13	NS2CS10	28.2	45.1	57.3	69.1	74.5	78.1
14	NS2.5CS10	26.6	43.5	55.7	67.4	72.5	75.2
15	NS3CS10	25.4	41.9	54.6	66.9	71.8	74.1
NANO SILICA CONCRETE WITH 20% COPPER SLAG							
16	NS0.5CS20	21.5	38.1	51.1	63.9	68.1	70.3
17	NS1CS20	24.3	40.5	53.7	66.3	71.4	74.2
18	NS1.5CS20	26.7	43.8	56.6	68.9	74.8	77.9
19	NS2CS20	29.5	47.7	59.7	71.3	77.5	81.5
20	NS2.5CS20	27.5	44.8	57.1	70.1	75.3	78.6
21	NS3CS20	26.4	43.1	55.4	68.7	74.5	76.5
NANO SILICA CONCRETE WITH 30% COPPER SLAG							
22	NS0.5CS30	23.2	39.5	52	65.2	69.2	70.9
23	NS1CS30	25.1	42	54.5	67.5	72.7	74.6
24	NS1.5CS30	27.3	45.5	57.9	71.6	77.5	80.1
25	NS2CS30	30.8	48.3	60.1	73.5	80.5	83.7
26	NS2.5CS30	29.5	46.4	58.8	72.2	78.4	81
27	NS3CS30	27.4	45.5	58.1	71.5	76.7	78.5
NANO SILICA CONCRETE WITH 40% COPPER SLAG							
28	NS0.5CS40	24.1	41.4	55.2	66.7	71.1	73.4
29	NS1CS40	26.9	44.1	58.6	69.9	75	78.1
30	NS1.5CS40	30.2	48.1	62.5	74.3	80.1	83.6
31	NS2CS40	32.5	49.8	64.2	76.1	83.3	87.1
32	NS2.5CS40	30.7	47.7	62.4	74.4	80.4	83.2
33	NS3CS40	29.5	47.1	61.8	73.8	78.7	80.8
NANO SILICA CONCRETE WITH 50% COPPER SLAG							
34	NS0.5CS50	23.4	40.8	52.2	64.8	69.5	71.9
35	NS1CS50	25.8	43.6	55	68.1	73.2	75.8
36	NS1.5CS50	28.3	46.4	58.1	71.2	77	80.1
37	NS2CS50	31.2	50.3	62.3	75.4	81.8	86
38	NS2.5CS50	29	47	60.1	73	79	81.7
39	NS3CS50	28.1	45.8	58.9	71.8	77.5	79.1

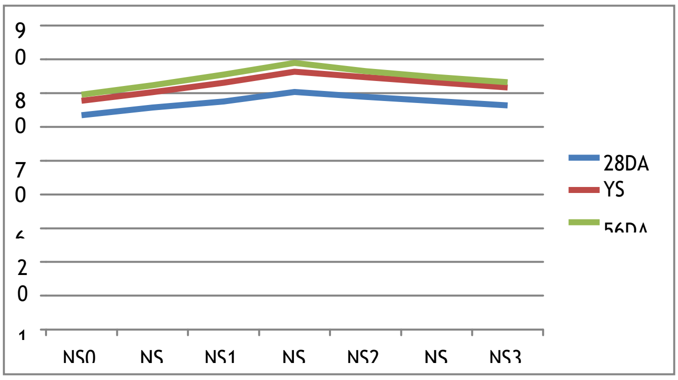

Figure 5.1 Development of compressive strength with age for nano silica concrete

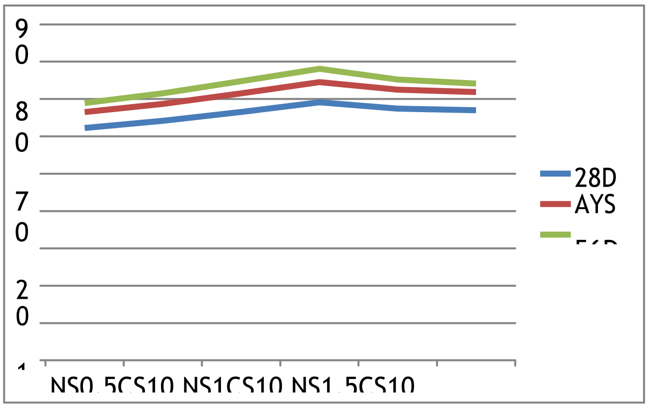

Figure 5.2 Development of compressive strength with age for nano silica concrete with 10% copper slag

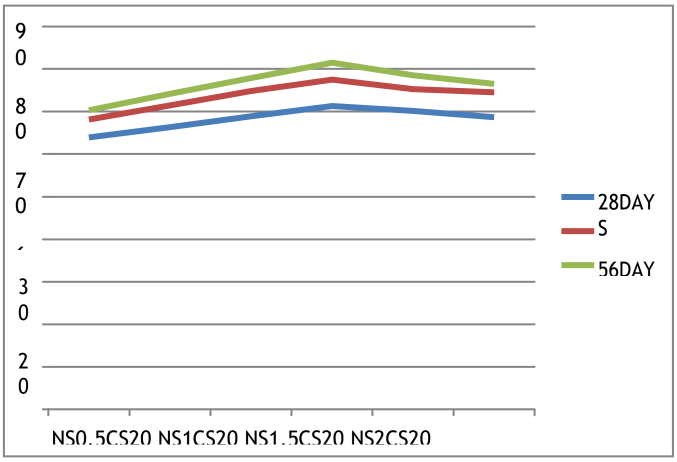

Figure 5.3 Development of compressive strength with age for nano silicaconcrete with 20% copperslag

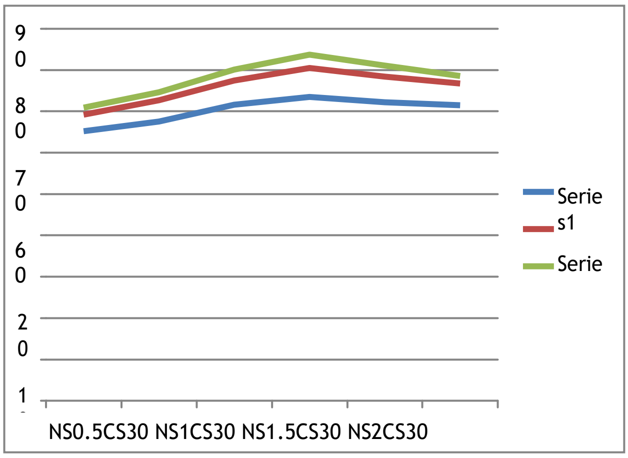

Figure 5.4 Development of compressive strength with age for nano silica concrete with 30% copperslag

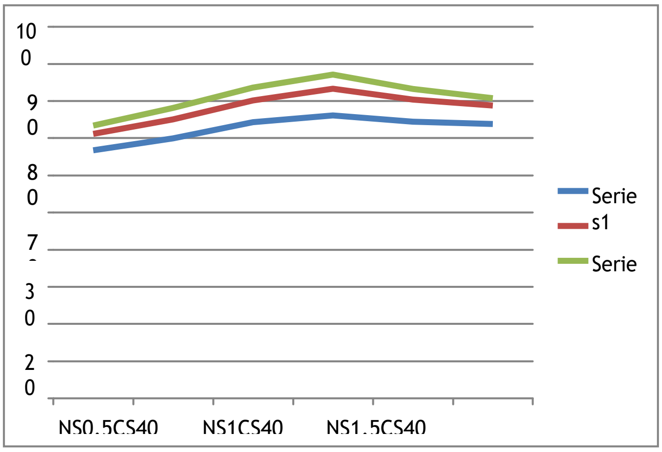

Figure 5.5 Development of compressive strength with age for nano silica concrete with 40% copperslag

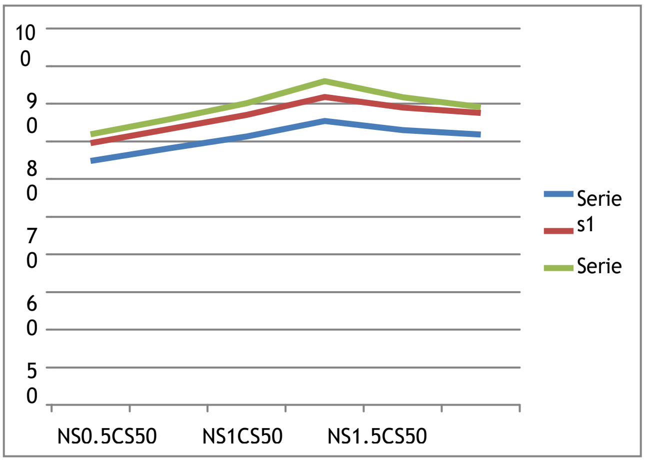

Figure 5.6 Development of compressive strength with age for nano silica concrete with 50% copperslag

Table 5.3 Rate of compressive strength development of SCC mixes corresponding to their respective 28 days compressive strength

Sl. No.	Mix Designation	nt corresponding to 28 Days Compressive strength					
		1 Day	3 Days	7 Days	28 Days	56 Days	90 Days
1.	CON	24.17	44.87	70.36	100	109.11	111.59
NANO SILICA CONCRETE WITH 0% COPPER SLAG							
2.	NS0.5	32.97	59.15	79.65	100	106.78	109.62
3.	NS1	36.38	60.27	80.06	100	107	110.05
4.	NS1.5	38.81	62.37	81.93	100	108.15	111.7
5.	NS2	41.11	65.86	83.36	100	108.53	112.23
6.	NS2.5	39.33	63.57	81.57	100	108.42	110.89
7.	NS3	38.31	62.43	81.36	100	108.14	110.5
8.	NS3.5	35.6	61.24	80.39	100	107.99	110.26
9.	NS4	34.01	60.37	80.34	100	107.8	109.83
NANO SILICA CONCRETE WITH 10% COPPER SLAG							
10.	NS0.5CS10	31.03	59.32	80.06	100	106.91	110.77

11	NS1CS 10	34.48	60.37	80.66	100	107.18	111.54
12	NS1.5CS10	38.5	61.95	82.26	100	107.52	112.48
13	NS2CS 10	40.81	65.27	82.92	100	107.81	113.02
14	NS2.5CS10	39.47	64.54	82.64	100	107.57	111.57
15	NS3CS 10	37.97	62.63	81.61	100	107.32	110.76
NANO SILICA CONCRETE WITH 20% COPPER SLAG							
16	NS0.5CS20	33.65	59.62	79.97	100	106.57	110.02
17	NS1CS 20	36.65	61.09	81	100	107.69	111.92
18	NS1.5CS20	38.75	63.57	82.15	100	108.56	113.06
19	NS2CS 20	41.37	66.9	83.73	100	108.7	114.31
20	NS2.5CS20	39.23	63.91	81.46	100	107.42	112.13
21	NS3CS 20	38.43	62.74	80.64	100	108.44	111.35
NANO SILICA CONCRETE WITH 30% COPPER SLAG							
22	NS0.5CS30	35.58	60.58	79.75	100	106.13	108.74
23	NS1CS 30	37.19	62.22	80.74	100	107.7	110.52
24	NS1.5CS30	38.13	63.55	80.87	100	108.24	111.87
25	NS2CS 30	41.9	65.71	81.77	100	109.52	113.88
26	NS2.5CS30	40.86	64.27	81.44	100	108.59	112.19
27	NS3CS 30	38.32	63.64	81.26	100	107.27	109.79
NANO SILICA CONCRETE WITH 40% COPPER SLAG							
28	NS0.5CS40	36.13	62.07	82.76	100	106.6	110.04
29	NS1CS 40	38.48	63.09	83.83	100	107.3	111.73
30	NS1.5CS40	40.65	64.74	84.12	100	107.81	112.52
31	NS2CS 40	42.71	65.44	84.36	100	109.46	114.45
32	NS2.5CS40	41.26	64.11	83.87	100	108.06	111.83
33	NS3CS 40	39.97	63.82	83.74	100	106.64	109.49
NANO SILICA CONCRETE WITH 50% COPPER SLAG							
34	NS0.5CS50	36.11	62.96	80.56	100	107.25	110.96
35	NS1CS 50	37.89	64.02	80.76	100	107.49	111.31
36	NS1.5CS50	39.75	65.17	81.6	100	108.15	112.5
37	NS2CS 50	41.38	66.71	82.63	100	108.49	114.06
38	NS2.5CS50	39.73	64.38	82.33	100	108.22	111.92
39	NS3CS 50	39.14	63.79	82.03	100	107.94	110.17

Table 5.4 Strength development of SCC mixes with respect to the control mix

Sl. No.	**Mix Designation**	**Strength development w.r.t the control mix (%)**					
		1 Day	**3 Days**	**7 Days**	**28 Days**	**56 Days**	**90 Days**
1.	CON	0	0	0	0	0	0
NANO SILICA CONCRETE WITH 0% COPPER SLAG							
2.	NS0.5	43.15	38.38	18.82	4.97	2.73	3.12
3.	NS1	63.7	46.13	23.76	8.77	6.68	7.27
4.	NS1.5	79.45	55.35	30.12	11.75	10.77	11.87
5.	NS2	97.95	70.85	37.88	16.39	15.78	17.06

6.	NS2.5	85.62	61.62	32.24	14.07	13.35	13.35
7.	NS3	77.4	55.72	29.41	11.92	10.93	10.83
8.	NS3.5	61.64	49.82	25.41	9.77	8.65	8.46
9.	NS4	49.32	42.8	21.18	6.13	4.86	4.45
NANO SILICA CONCRETE WITH 10% COPPER SLAG							
10.	NS0.5CS10	32.19	36.16	17.18	2.98	0.91	2.23
11	NS1CS10	51.37	42.8	21.65	6.13	4.25	6.08
12	NS1.5CS10	75.34	52.03	28.71	10.1	8.5	10.98
13	NS2CS10	93.15	66.42	34.82	14.4	13.05	15.88
14	NS2.5CS10	82.19	60.52	31.06	11.59	10.02	11.57
15	NS3CS10	73.97	54.61	28.47	10.76	8.95	9.94
NANO SILICA CONCRETE WITH 20% COPPER SLAG							
16	NS0.5CS20	47.26	40.59	20.24	5.79	3.34	4.3
17	NS1CS20	66.44	49.45	26.35	9.77	8.35	10.09
18	NS1.5CS20	82.88	61.62	33.18	14.07	13.51	15.58
19	NS2CS20	102.05	76.01	40.47	18.05	17.6	20.92
20	NS2.5CS20	88.36	65.31	34.35	16.06	14.26	16.62
21	NS3CS20	80.82	59.04	30.35	13.74	13.05	13.5
NANO SILICA CONCRETE WITH 30% COPPER SLAG							
22	NS0.5CS30	58.9	45.76	22.35	7.95	5.01	5.19
23	NS1CS30	71.92	54.98	28.24	11.75	10.32	10.68
24	NS1.5CS30	86.99	67.9	36.24	18.54	17.6	18.84
25	NS2CS30	110.96	78.23	41.41	21.69	22.15	24.18
26	NS2.5CS30	102.05	71.22	38.35	19.54	18.97	20.18
27	NS3CS30	87.67	67.9	36.71	18.38	16.39	16.47
NANO SILICA CONCRETE WITH 40% COPPER SLAG							
28	NS0.5CS40	65.07	52.77	29.88	10.43	7.89	8.9
29	NS1CS40	84.25	62.73	37.88	15.73	13.81	15.88
30	NS1.5CS40	106.85	77.49	47.06	23.01	21.55	24.04
31	NS2CS40	122.6	83.76	51.06	25.99	26.4	29.23
32	NS2.5CS40	110.27	76.01	46.82	23.18	22	23.44
33	NS3CS40	102.05	73.8	45.41	22.19	19.42	19.88
NANO SILICA CONCRETE WITH 50% COPPER SLAG							
34	NS0.5CS50	60.27	50.55	22.82	7.28	5.46	6.68
35	NS1CS50	76.71	60.89	29.41	12.75	11.08	12.46

36	NS1.5CS50	93.84	71.22	36.71	17.88	16.84	18.84
37	NS2CS50	113.7	85.61	46.59	24.83	24.13	27.6
38	NS2.5CS50	98.63	73.43	41.41	20.86	19.88	21.22
39	NS3CS50	92.47	69	38.59	18.87	17.6	17.36

V. CONCLUSION

To study the impact of nano silica, and copper slag on quality attributes of SCC, tests were directed on usefulness, compressive quality, part rigidity, flexural quality, modulus of elasticity and bond qualities. The connections between the compressive quality with the part rigidity, flexural quality and modulus of elasticity likewise had beenarrived.

The finishes of the trial examinations are as per the following:

The impact of nano silica, copper slag on the new properties of SCC was controlled by usefulness tests. The functionality tests incorporate droop test, compaction factor test and vee honey bee consistometer test. The accompanying ends were drawn from the above test:

- Addition of nano silica diminished the usefulness of SCC mixes. To keep up the usefulness inside the predetermined range, the measurements of superplasticizer wasexpanded.
- An increment in the copper slag substance diminishes the water request of SCC mixes because of its smooth surface and low water retention.
- An increment in the nano silica substance brings about higher water request attributable to the high explicit surfacezone.
- A mix of copper slag with nano silica was powerful as far as usefulness and decreased the measure of superplasticizer added to the SCCmixes.
- An increment in density of around 6% was endless supply of 40 % copper slag because of its high explicitgravity.
- The expansion of nano silica in concrete expands the compressive quality at 1, 3, 7, 28, 56 and 90 days due to their pozzolanic response and fillerimpacts..
- The extreme compressive quality was acquired for the mix with the mix of 2% nano silica and 40% copper slag as incomplete replacement material for cement and fine aggregateindividually.
- The better execution of nano silica concrete was exceedingly impacted by the mixing strategies, measurement nature and relievingtechniques.
- The procedure of including nano silica and superplasticizer was seen to impactthe functionality and compressivequality.
- The concrete examples flop because of smashing of coarseaggregate.
- A decrease in quality past 2% nano silica was credited to the inadequate scattering of nano particles which has a high surfacevitality.
- The ideal replacement of nano silica was observed to be 2% and 7.5% individually for accomplishing the most extreme partelasticity.
- The most extreme part quality was gotten for the mix with the blend of 2% nano silica as incomplete cement replacement and 40% copper slag as halfway fine aggregate replacementlevel.
- The part rigidity increments alongside an expansion in the compressive quality of concrete. The part elasticity of SCC mixes is 7%to 10% of the solid shape compressive quality.
- The ratio of part elasticity to 3D square compressive quality changes between 8% to10% at medium ages and at last ages decreases to7%
- The ratio shifts between 0.066 – 0.069 for the concrete containing mix of nano silica and copper slag at 28 days and copperslag.

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