International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 01 | Jan-2018 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH NANO SILICA IN CONCRETE

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ABSTRACT: *The application of nanotechnology in concrete structures has added a new dimension towards improvement of its properties. Nano-materials, due to its very small size particles it affects the concrete properties by altering the microstructure. This study concerns with the use of nano silica of powder form to improve the compressive strength of concrete. An experimental investigation has been carried out by replacing the cement with Nano silica by 0%. 0.5%, 1.0%, 1.5%. 2.0%, 2.5% and 3.0% for M25 (1:1.4:2.74) grade of concrete with water cement ratio 0.42. The tests conducted on it shows a considerable increase in early-age compressive strength and a Split Tensile strength of concrete on 7th day, 14th day and 28th day of curing. The Workability and Strength increase was observed with the increase in the percentage of nano silica upto a limit and further it decreases.*

Keywords: Concrete, Cement, Nano silica, Compressive Strength, Tensile Strength and Workability.

I INTODUCTION:

Concrete is the material of present as well as future. Out of the various materials used in the production of concrete, cement plays a major role due its size and adhesive property. Thus to improve the quality and properties of concrete the mechanism of cement hydration has to be studied properly and best suitable suggestion has adopted. Different cementitious materials known as supplementary materials are added to concrete so that the improvement of properties can be done. Some of the materials are fly ash, blast furnace slag, rice husk, silica fumes and even bacteria. Out Of the various technologies in use for improvement of concrete, nano-technology looks to be a promising approach in improving the properties of concrete.

Nano silica is used in production of concrete and improves the performance of concrete. In concrete cement is the binder material and it binds the other material together. But one disadvantage of application of cement is it emits the large amount of CO2 in environment and pollute them. To reduce this pollution, use of Nano silica partials in concrete can be used. Means the replacement of cement by the different dosses of Nano silica by weight. Nano silica is one of the best Nano material to improve the different strength, physical, and mechanical properties of concrete than the other Nano material. Nano silica is effectively high pozzolanic material. The size of Nano silica is 1000 times smaller than the average size of cement partical. Use of Nano silica particles in concrete reduces the setting time and improves the compressive strength of concrete.

II LITERATURE REVIEW:

The review of a number of literatures shows the importance of this field of research. The findings shows that a number of nanomaterials like SiO_2, TiO_2, Al_2O_3, colloidal nanosilica, metakaolin and others can be incorporated to improve the properties of concrete. Nano-silica is used upto 1% of cement by weigth. The results show the improved characteristics of the blended concrete in terms of compressive, tensile and flexural strength. Apart from that the permeability of the specimen can also be increased by adding a small percentage of the nanomaterial. The current study is concerned with the incorporation of Nano SiO_2 more than 2% of nanosilica particles in concrete.

OBJECTIVE:

The main objectives of the present study are as mentioned below:

- To study the effect of nano-silica on the compressive strength of concrete.
- To study the effect of nano-silica on workability of concrete..
- To study the microstructure of the hardened cement concrete.

To explain the change in properties of concrete, if any, by explaining the microstructure

III MATERIAL AND METHODOLOGY:

WATER:

The water in the concrete mix should be clean and free of impurities. The change in water content with respect of cement decides the properties of the cement like how easily the concrete flows, but also affects the final strength of the concrete.

PORTLAND CEMENT:

On mixing the water, cement hardens and hence all the ingredients are bounded together. Portland cement is the most common cement used and is composed of alumina, silica, lime, iron, and gypsum. Small amounts of other ingredients are also included.

AGGREGATES:

Most of the concrete mixtures consist of both coarse and fine aggregates, and help in increasing the strength of concrete with respect to what cement can provide alone. Nowadays, sand, gravel, crushed stone, recycled materials, including blast furnace slag, glass (mostly for decorative purposes), and ground-up concrete are used as aggregates.

NANO SILICA:

Nano-silica produced by this method is a very fine powder consisting of spherical particles or microspheres with amain diameter of 150 nm with high specific surface area (15 to 25 m2/g). By means of this method, nanoparticles having a spherical shape with 88% process efficiency can be obtained. These particles were produced by feeding worms with rice husk, biological waste material that contain 22% of SiO2. Finally, nS can also be produced by precipitation method

IV RESULT AND ANALYSIS:

TEST RESULT OF CEMENT

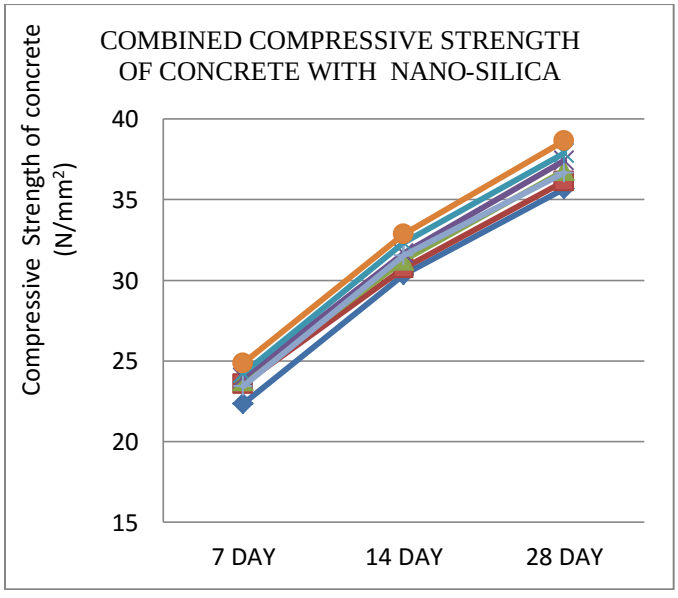
CEMENT TEST	RESULT
Fineness Test	4.8%
Consistency Test	32%
Initial Setting Time	31min 35 Sec
Final Setting Time	10 Hours

TEST RESULTS OF AGGREGATE:

AGGREGATE TEST	RESULT
Bulk Density	1590 Kg/m^3
Specific Gravity: Fine aggregate Course aggregate	 2.57 2.57
Fineness Modulus	6.96
Impact Value	12.95
Crushing Value	17.11

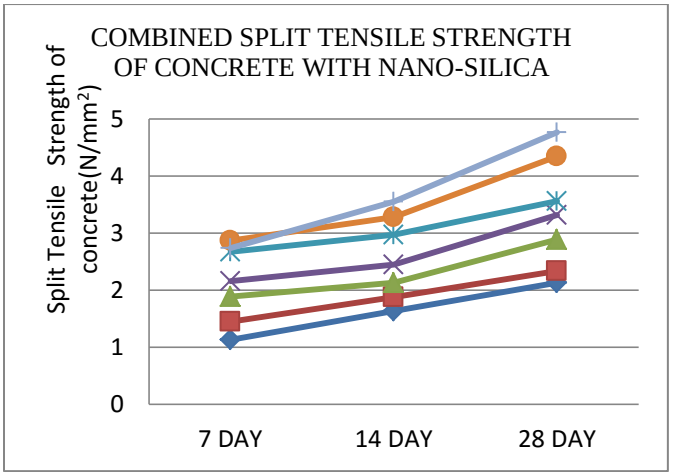
COMPRESSIVE STRENGTH TEST:

The combined Graph 1, compressive strength of various proportions by replacing cement with nano-silica. The material has been collected and used as a replacement of cement because it is having Pozzolana property. The proportions of nano-silica replaced cement are taken as 0%, 0.5% 1.0%, 1.5%, 0.20%, 2.5% and 3.0%and compressive test is 35.67N/mm2, 36.12 N/mm2, 36.78N/mm2, 37.41N/mm2, 37.87 N/mm2, 38.65 N/mm2 and 36.65 N/mm2 on 28th day respectively. The compressive strength of concrete using nano- silica increases upto use of 2.5% replacement of cement and after 2.0% strength of concrete deduces. The maximum result is by replacing 2.5% of cement by nano-silica is 24.23 N/mm2, 32.34N/mm2 and 37.87 N/mm2 on 7th, 14th and 28th day of curing.



TENSILE STRENGTH:

The combined Graph 2, Split Tensile Strength of various proportions by replacing cement with nano-silica. The material has been collected and used as a replacement of cement because it is having Pozzolana property. The proportions of nano-silica replaced cement are taken as 0%, 0.5% 1.0%, 1.5%, 0.20%, 2.5% and 3.0% and Split Tensile Strength test is 2.13N/mm2, 2.34 N/mm2, 2.89N/mm2, 3.32N/mm2, 3.56 N/mm2, 4.35 N/mm2 and 3.98 N/mm2 on 28th day respectively. The Split Tensile Strength of concrete using nano- silica increases upto use of 2.5% replacement of cement and after 2.5% strength of concrete deduces. The maximum result is by replacing 2.5% of cement by nano-silica is 2.87 N/mm2, 3.28N/mm2 and 4.35N/mm2 on 7th, 14th and 28th day of curing.



V CONCLUSION:

From the test results, graphs and the relative chemical composition of the specimen a number of conclusions can be drawn. The conclusions drawn are:

1. From the test result it is observed that the Workability of concrete with partial use of nano silica increases upto a limit than it decreases. The workability is in increasing order upto 2.5% of cement replaced with Nano-Silica.

2. The Compressive Strength of partially replaced cement by nano silica concrete of grade M 25 for proportions of 0%, 0.5%, 0.10%, 1.5%, 2%, 2.5% and 3% are 35.67MPa, 36.12MPa, 36.78MPa, 37.41MPa, 37.87MPa, 38.65MPa and 36.65MPa respectively at 28th day of curing. The Compressive Strength increases upto 2.5% use of nano- silica further it starts decreasing.

3. The Split Tensile strength of partially replaced cement by nano silica concrete of grade M 25 for proportions of 0%, 0.5%, 0.10%, 1.5%, 2%, 2.5% and 3% are 2.13MPa, 2.34MPa, 2.89MPa, 3.32MPa, 3.56MPa, 4.35MPa and 4.77MPa respectively at 28th day of curing. The Split tensile Strength increases upto 2.5% use of nano- silica further it starts decreasing.

4. With the use of 2.5% of Nano-Silica concrete gives the maximum result in compression as 24.86MPa, 32.87MPa and 38.65MPa at 7th day, 14th day and 28th day of curing respectively.

5. With the use of 2.5% of steel fibre gives the maximum result in Split Tensile Strength as 2.87MPa, 3.28MPa and 4.35MPa at 7th day, 14th day and 28th day of curing respectively.

6. Even a small amount of nano-silica particles can increase the strength of concrete.

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