Laboratory Experimental Analysis of The Physical Properties of Nano Silica Concrete

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Abstract- *The implementation of nano-technology in the making of cement concrete structures has added a new direction towards the improvement of its properties. The Nano-materials, due to its very small size particles it affects the cement concrete properties by altering the microstructure. This research considers with the employment of nano oxide of powder type to enhance the compressive strength of cement concrete mixture. 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 M-20 (1:1.5:3) grade of cement concrete with water cement ratio 0.42. The tests performed on samples shows a considerable increase in early-age compressive strength and the Split Tensile strength of concrete on 7th day, 14th day and 28th day of curing. The Workability and Strength increase was discovered with the rise within the proportion of nano oxide.*

Keywords- Nano silica, Concrete, Sand, Aggregate, Cement, Compressive Strength, Tensile Strength and Workability.

I. INTRODUCTION

1.1 GENERAL

Concrete is the substance of current scenario as well as future scenario. 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 these needs, there is an urgent need to improve the strength and durability of concrete. The various ingredients used in the manufacturing of concrete, cement acting as a key role due its size and bonding agent property. Thus to improved 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. Other materials are fly ash, stone dust, asphalt, blast furnace slag, rice husk, silica fumes, glass dust 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.

1.2 SCOPE

The bulk use of cement is vital in attaining a higher compressive strength. The use of nano- SiO2 materials by replacement of a percentage of binding material cement can lead to a rise in the compressive strength of the concrete as well as a check to pollution. The use of a very minute quantity of Nano SiO2 can influence the properties and character of concrete largely, a proper study of its microstructure is essential in understanding the reactions and the effect of the nano-particles. This experiment is effort to explain the impact of a nano- silica on the compressive strength character of concrete by explaining its microstructure.

The current experiment incorporates mix design based on Indian Standard code IS 10262- 2009. The nano-silica used is imported from a supplier. The admixture is strictly prohibited in the design of mix. The water content has been kept stable to facilitate a better assessment for different samples. The compressive strength measurements are carried out for 7-day, 14 day and 28-day.

1.3 METHODOLOGY

Concrete as a raw materials available almost everywhere by a very energy-efficient process By mixing this material with water, you get a construction material that is workable for many hours, that can be formed into any geometrical shape, and that hardens and develops high strength. It is used in a relatively crude way in the field.Silicon dioxide Nano particles (Nano silica, nano-SiO2) proved to be effective additive to polymers for improving strength, flexibility. It is also added to increase the cohesiveness of concrete. It reduces the segregation tendency. Nano silica fills the voids in the young and hardened state. It can improve the microstructure and reduce the water permeability of hardened concrete Nano silica application reduces the calcium leaching rate of cement pastes and therefore increases their durability. NS addition increases density, reduces porosity, and improves the bond between cement matrix and aggregates.

Material is the most commonly used material in the construction industry. Its significance to the basic infrastructure of modern civilization is immeasurable. However, concrete as a material has changed relatively little since its first usage in its current form one hundred years ago. Concrete as a construction material is unique because it is a commodity, fabricated on site by generally workers with a medium of quality control. Imagine a material made out of abundant.

The application of Nano silica particles in concrete saves the resources and energy as well as it protects the environment from the pollution with the reduction of waste material and reduction of $CO2$ emission. The research work concern with the use of Nano silica in concrete and to improve the compressive strength of concrete of M20 with water cement ratio 0.42. This paper shows the partial replacement of cement with the Nano silica with different dosses like 0%, 0.5%, 1%, 1.5%, 2%, 2.5% and 3% by weight of cement and increase the strength property of concrete and also shows that the comparative study between the concrete without addition of Nano silica and with addition of Nano silica. The result of this research paper is, the enhance in the strength of concrete by the application of Nano silica.

II. LITERATURE REVIEW

In this chapter the work of various authors on the use of nano materials in concrete and its effect has been discussed in brief. A number of Research & Development work dealing with the use of nano materials like Nano silica, colloidal Nano Silica (CNS), Al2O3, TiO2, ZrO2,Fe2O3, carbon nano tubes (CNT) in cement based materials are discussed in the literature. The Pozzolanic action of the binding material cement is essential in forming the C-S-H clot and hence the CH crystals are prevented from growing and their number reduces. Thus the early age strength of hardened cement paste is increased.

Habib H. Alqamish and **Adil K. Al-Tamimi (2021)**

In the last decade, nanomaterials made a major breakthrough in the concrete industry by providing the concrete with unique properties. Earlier studies have shown improvement in the early strength of concrete that can accelerate the construction process. In this study, 1% and 2% of nano-silica were added to concrete mixtures that contain 30% and 70% ground granulated blast-furnace slag (GGBS). Adding 1% of nano-silica to the 30% GGBS mixture showed an increase in the compressive strength by 13.5%, 7.8%, 8.1%, and 2.2% at one day, three days, seven days, and twenty-eight days, respectively. The 2% of nano-silica increased the 30% GGBS mixture's compressive strength less effectively by 4.3%, 7.6%, and 4.9% at three days, seven days, and 28 days, respectively, when compared to the 1%. On the other hand, adding 1% and 2% of nano-silica reduced the 70% GGBS mixtures' compressive strength. Moreover, nano-silica reduced the deformability of the mixtures significantly, which caused the increase in the Young's modulus. The flexural strength of the 30% GGBS mixtures had similar behavior as the 28-day compressive strength. On the other hand, the flexural strength of the 70% GGBS mixtures increased as the nano-silica increased. Nano-silica addition improved the microstructure and the interface structure of the mixtures due to its high pozzolanic activity and the nano-filler effect, which is confirmed by RCPT results and SEM images

Fei Zhou, Wenbin Sun, Jianli Shao, Lingjun Kong and Xueyu Geng (2020)

With the increasing number of underground projects, the problem of rock-water coupling catastrophe has increasingly become the focus of safety. Grouting reinforcement is gradually applied in subway, tunnel, bridge reinforcement, coal mine floor and other construction projects. At present, cement-based grouting materials are easy to shrink and have low strength after solidification. In order to overcome the special problems of high water pressure and high in-situ stress in deep part and improve the reinforcement effect. In view of the mining conditions of deep surrounding rock, a new type of cement-based reinforcement material was developed. We analyses the principle and main indexes of floor strengthening, and tests and optimizes the indexes and proportions of the two materials through laboratory tests. Then, observes and compares the microstructures of the optimized floor strengthening materials with those of the traditional strengthening materials through scanning electron microscopy. The test results show that 42.5 Portland cement-based grouting reinforcement material has the advantages of slight expansion, anti-dry-shrinkage, high compressive strength and high density when the water-cement ratio is 0.4, the content of bentonite is 4%, and the content of Nano Silica is 2.5%. The reinforcement effect is better than other traditional grouting reinforcement materials.

Ahad Amini Pishro **And Xiong Feng (2018):**

As per Author, for production of high performance concrete, Micro-silica is commonly used as an additive to cement. This matter is used to improve the efficiency of concrete and strength. As per author, due to the enlargement of advanced nano-technology, nano-silica has been created with particle sizes smaller than micro-silica and higher pozzolanic activity. In this research, author have numerically investigated the bond strength using numerical methods and calibration of the Abacus results in addition to its experimental study of ultra- high performance concrete and steel reinforcement. Comparison between numerical and experimental analysis results shows that numerical investigation with high correctness can predict the bond stress, bond load, and concrete specimen fracture mode.

Rutuja Mininath Sarade et.al.(2017) :

In this paper authors review the recent developments and current state of function of Nano silica in concrete technology. The use of Nano silica in concrete is save the energy, resources and also protect the atmosphere from the toxic waste with the diminution of waste material and reduction of CO2 emission. As per author the partial replacement of cement with the Nano silica with different doses like 1%, 1.5%, and 2% by weight, it increase the strength of concrete and also shows that the relative study between the concrete exclusive of addition of Nano silica. As per author Nano Sio2concrete gives the more valuable result than the ordinary concrete. The result of this paper gives the increase in compressive strength of concrete by the application of Nano.

Rakesh.K et.al (2017):

As per author method to reduce the cement (binding) content in concrete mixes is the replacement of silica fumes. Among the Nano materials presently used in concrete, The Strength tests results for Nano silica based concrete were found more than the normal concrete. As per author, the durability tests results for Nano SiO2 based concrete were initiate more than the normal concrete. Therefore this study of Nano silica based concrete is helpful and is more useful for the future concrete world.

Billa Mahender And B. Ashok (2017):

As per authors The problem defined are acute deficiency of construction materials, increase the output of waste and other products usually M30 concrete is used for most of the constructional works. 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 or SCMs 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, nanotechnology looks to be a promising approach in improving the properties of concrete. Nanomaterials are very small sized materials with particle size in nanometres. These materials are very effective in changing the properties of concrete at the ultrafine level by the virtue of their very small size. This experiment deals with Partial replacement of Waste Plastics and waste rubber as partial replacements in concrete at an addition of 5% each time. i.e; 0%, 5%, 10%, 15%, 20% with equal replacements in sand and coarse aggregates. Cubes and Cylinders were cast and tested at the age of 7 and 28 days. The results were compared with concrete specimens cast in 0% of Waste Plastics and Waste Rubber. The concrete with waste plastic and waste rubber can be used for construction of tennis courts, rigid pavements, sewers, and walker areas which leads to reduce in the overall depth of the pavement.

Dr. Somasekharaiah et al. (2017):

Concrete is a usually used construction material, consumes natural resources like lime, aggregates, water. In this present investigation there is replacement of composite concrete material with industrial wastes in the present investigation, a study has been made for the development of high performance concrete using mineral admixture such as Metakaolin and Nano-silica as feasibility made to know the strength on Concrete. The combine proportion is arrived from 0%, 10%, 20% and 30% of cement is interchanged with Metakaolin. Different water : cement ratio of 0.275, 0.325 and 0.375 and aggregate ratio of 2.0 is used In this experiment, In this connection series of concrete cubes of size 100 x 100 x 100, cylinders of 200 x 100 and beams of 100 x100 x 500 size were cast with various mix proportions and were cured for 7 and 28 days .The cured specimens are tested for getting strength characteristics of concrete.

Justin Montgomery et al. (2016):

This study investigated the compressive strength of hardened cement paste and the formation of Calcium Silicate Hydrate (C-S-H) with the addition of nano silica (SiO2). Compressive strength testing was performed using MTS and Forney testing machines to determine stress-strain curves and compressive strength of the materials. The hydration process and formation of C-S-H and Calcium Hydroxide (CH) was examined using Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). This study also incorporates the use of vacuum curing, in comparison to that of the traditional water curing method. Results indicate an increase in compressive strength using 1, 3 and 5% of nano silica to cement replacement by volume in comparison to the control mix (without nano silica). The optimum cement replacement to yield maximum strength was of the 1% nano silica content. The formation of CS- H increases significantly during the early testing days which correspond with the drastic increase in compressive strength. The hydration process continues to increase throughout the 56 day trails at a moderate rate. The traditional water curing method proves to be more efficient and beneficial than of the vacuum curing method. However, vacuum cured results showed only about a 5% reduction in compressive strength after 56 day tests in comparison to the water curing method.

Mohammadmehdi Choolaei et.al (2012):

In this research, the concert of nano SiO2 in cement-sand mortars was experimentally studied. In accumulation, there was no extra water used in the designed slurries. Results indicated that by using this nano SiO2, the setting time of concrete and the length of the dormant period were decreased. Also, studying the porosity of cements designed using nano SiO2 showed a decrease in cement porosity as the amount of nano SiO2 was increased in the investigated slurries.

Mounir Ltifia et.al (2011):

As per author the properties of cement mortars including nano-SiO2 were experimentally studied. The unstructured or glassy silica, which is the major ingredients of a pozzolan, action with calcium hydroxide formed by calcium silicate hydration. The nano scale-size of particles can result in dramatically improved properties from conventional grain-size materials of the same chemical composition. Thus, industries may be able to re-engineer many existing products and to design new and novel products that function at unprecedented levels. There are few reports on mixing nano-particles in cement-based building materials. Thus, the use of nano-particles has received particular attention in many fields of applications to fabricate materials with new functionalities. When ultra-fine particles are incorporated into Portlandcement paste, mortar or concrete, materials with different characteristics from conventional materials were obtained. The performance of these cementitious based materials is strongly dependent on nanosized solid particles, such as particles of calcium–silicate–hydrates (C–S–H), or nano-sized porosity at the interfacial transition zone between cement and aggregate particles. Typical properties affected by nano sized particles or voids are strength, durability, shrinkage and steel-bond. As per author the effects of the addition of nano-particles on the performance of pastes of cement mortars, nano-particles of silica amorphous were integrated at a rate of 3 and 10% by weight of binding material cement. The compressive strengths of other mortars increase with the increasing of the amount of nano-SiO2. The persuade of nano-SiO2 on setting time and consistency are different. Nano-SiO2 accelerates the cement hydration process and give cement paste thicker.

III. MATERIALS AND METHODOLOGY

3.1 GENERAL

This chapter is concerned with the details of the properties of the materials used, the method followed to design the experiment and the test procedures followed. The theory is supplemented with a number of pictures to have a clear idea on the methods.

The materials used to design the mix for M20 grade of concrete are cement, sand, coarse aggregate, water and Nano SiO2. The properties of these materials are presented below.

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.

3.1.1 CEMENT

Ordinary Portland cement (OPC) is by far the most important type of cement. Cement is manufactured through a closely controlled chemical combination of calcium, silicon, aluminium, iron and other ingredients. The OPC was classified into three grades namely, 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested as per IS 4031-1988.

3.1.2 PROPERTIES OF CEMENT

Portland slag cement of 43 grade conforming to IS: 455-1989 is used for preparing concrete specimens. The properties of cement used are given in the Table1.

Table 3.1: Properties of Portland slag cement

Specific Gravity	Fineness by sieve analysis	Normal consistency
3.014	2.01%	33%

3.2 FINE AND COARSE AGGREGATE

Aggregate

During crushing it is tried to maintain to produce the maximum size of aggregate in between 20mm to 4.75mm. It should have finess modulus 2.50-3.50 and silt contents should not be more than 4%. Coarse sand should be either river sand or pit sand; or combination of the two. In our region, fine aggregates can be found from bed of Tapi river. It confirms to IS 383-1970 which comes under Zone I.

A coarse aggregate which has the sizes of particles mainly belonging to a single sieve size is known as single size aggregate. For example 20 mm single size aggregate mean an aggregate most of which passes 20 mm IS sieve and its major portion is retained on 10 mm IS sieve.

Aggregate particle size distribution curve is presented in Fig. 3.1. The physical properties of both fine aggregate and coarse aggregate are evaluated as per IS: 2386 (Part III)-1963 and given in Table 3.2.

Table 3.2: Properties of coarse aggregate and fine aggregate

Property	Coarse Aggregate	Fine Aggregate
Specific Gravity	2.85	2.8
Bulk Density (kg/L)	1.586	-
Loose Bulk Density(kg/L)	-	-
Water Absorption (%)	0.5%	1.2
Impact Value	9%	-
Crushing Value	20.09	-
Fineness Modulus	2.67	-

3.3 WATER

In a concrete, after aggregate and cement, water is most important component. Water and cement are responsible for binding everything. Thus water/cement ratio plays a very vital role in any construction. For high strength concrete 0.4 w/c ratio is desired. For ordinary concrete w/c ratio between 0.6-0.7 is normal. A higher water cement ratio makes the concrete structure weaker.

3.3.1 PROPERTIES OF WATER

Tap water was used in this experiment. The properties are assumed to be same as that of normal water. Specific gravity is taken as 1.00.

3.4 NANO SILICA

Fig 3.1: Nano silica material

Nano-materials are very small sized materials with particle size in nanometres. The small size of the particles also means a greater surface area. Since the rate of a pozzolanic reaction is proportional to the surface area available, a faster reaction can be achieved . Only a small percentage of cement can be replaced to achieve the desired results.

Nanosilica is highly pozzolanic material. It contains very fine particles approximately 1000 times smaller than the cement particles. In the present study colloidal form of nanosilica has been used i.e. nanosilica in dispersion with water in 40:60 ratio (40% Nanosilica). Nanosilica used in the study was manufactured by Bee Chems HO: E-5, Panki Industrial Area, Site-1, Kanpur-208022, UP India. Nanosilica is being manufactured for a range of 15% to 40% Active Nano content with particle size in the range of 5-40 nm.

The construction industry uses concrete to a large extent. About 14 bln ton were used in 2007. Concrete is used in infrastructure and in building.

Granular materials of different sizes and the size range of the composed solid mix covers wide intervals. The overall grading of the mix, containing particles from 300 nm to 32 mm determines the mix properties of the concrete.

The properties in fresh state (flow properties and workability) are for instance governed by the particle size distribution (PSD), but also the properties of the concrete in hardened state, such as strength and durability, are affected by the mix grading and resulting particle packing. One way to further improve the packing is to increase the solid size range, e.g. by including particles with sizes below 300 nm. However, these products are synthesized in a rather complex way, resulting in high purity and complex processes that make them non-feasible for the construction industry. The aim of this research is to create a practical application method and a model to apply newly developed in concrete.

PRODUCTION METHOD OF NANO SILICA

Nowadays, there are different methods to produce nS products. One production method is based on a sol-gel process (organic or water route) at room temperature. An alternative production method is based on vaporization of silica between 1500 to 2000 °C by reducing quartz (SiO2) in an electric arc furnace.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). Estevez et al. developed a biological method to produce a narrow and bimodal distribution of nS from the digested humus of California red worms (between 55nm to 245nm depending of calcination temperature). By means of this method, nanoparticles having a spherical shape with 88% process efficiency can be obtained. In addition, nano-silica is being developed via an alternative production route.

Basically, olivine and sulphuric acid are combined, whereby precipitated silica with extreme fineness but agglomerate form is synthesized (nano-size with particles between 6 to 30 nm), and even cheaper than contemporary micro-silica.

EFFECT OF CSH ADDITION IN CONCRETE AND MORTARS

In concrete, the micro-silica works on two levels. The first one is that the chemical effect: the pozzolanic reaction of silicon oxide with hydrated lime forms additional CSH-gel at final stages. The second operate is physical one, as a result of micro-silica is concerning one hundred times smaller than cement. Micro-silica will fill the remaining voids within the young and partly hydrous cement paste, increasing its final density. Some researchers found that the addition of one weight unit of micro-silica permits a discount of concerning four weight unit of cement, and this may be higher if nS is employed.

The main mechanism of this regulation is expounded to the high area of nS, as a result of it works as nucleation web site for the precipitation of CSHgel. It has not however been determined whether or not the additional speedy association of cement within the presence of nS is thanks to its chemical reactivity upon dissolution (pozzolanic activity) or to their considerable surface activity. In the latter case, it is necessary to use a dispersing additive or plasticizer to minimize this effect The test results show that nS can improve the microstructure and reduce the water permeability of hardened concrete. Lin et al. demonstrated the impact of nS addition on porosity of eco-concrete. They have shown with a mercury porosimetry check that the relative porosity and pores sizes decrease with nS addition (1 and a couple of bwoc).

Fig 3.2 CSH powder

The nS particles fill the voids of the CSH-gel structure and act as nucleus to tightly bond with CSH-gel particles. This means that nS application reduces the atomic number 20 leach rate of cement pastes and so increasing their sturdiness. Even though the beneficial effect of nS addition is reported, its concentration will be controlled at a maximum level of 5% to 10% bwoc, depending on the author or reference. At high nS concentrations the autogenous shrinkage thanks to self-desiccation will increase, consequently resulting in higher cracking potential. To avoid this effect, high concentration of superplasticizer and water have to be added and appropriate curing methods have to be applied.

IV. TEST RESULTS AND ANALYSIS

4.1 GENERAL

This chapter is concerned with the presentation of results of the experiments carried out towards the objective of the project. It includes results from, materials, workability tests, compressive strength and Split tensile strength test. The results are supplemented with graphs in order to have a better analysis of the results.

4.2 TESTING AND RESULT OF MATERIALS:

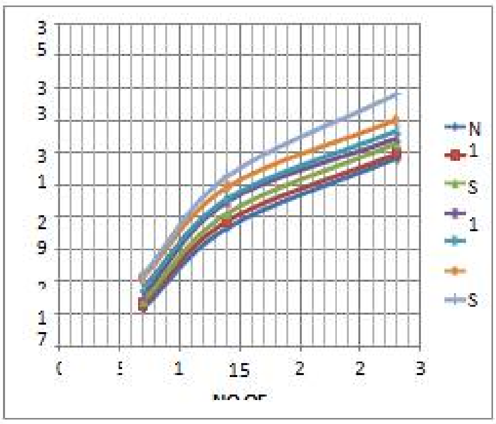
4.2.1 COMPRESSIVE STRENGTH TEST RESULTS

As it is evident from Table 4.1, an enhancement in 28 days compressive strength compared to control sample occurs for the nano silica particles. The use of nano- silica increases the compressive strength. This may be the due to fact that the quantity of pozzolana presence in the mix is higher than the amount required to combine with the lime during the processes of hydration. It leads to excess silica leaching out and causing a deficiency in strength as it replaces the certain amount of the cement material but does not contribute to the strength.

Table 4.1 Compressive Strength of Nano Silica Concrete

S. No.	Name	Quantity per cubic meter (g)					Average Compressive strength In N/mm sq		
		Cement	Sand	Aggregate	Nano- Silica		7 Days	14 Days	28 Days
					%	Amount			
1	N1	404	614	1333	0.0	-	17.34	22.34	26.67
2	S1	401.98	614	1333	0.5	2.02	17.59	22.76	26.92
3	S2	399.96	614	1333	1.0	4.04	17.79	23.24	27.58
4	S3	397.94	614	1333	1.5	6.06	18.18	23.97	27.91
5	S4	395.92	614	1333	2.0	8.08	18.63	24.14	28.37
6	S5	393.9	614	1333	2.5	10.1	19.26	24.87	29.05
7	S6	391.88	614	1333	3.0	12.12	19.43	25.54	30.65

COMBINED GRAPH OF COMPRESSIVE STRENGTH TEST

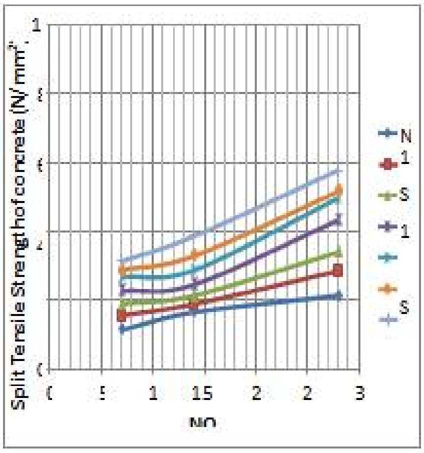


Graph 4.1 Combined Compressive Strength of Cement replaced by **Nano- Silica**

The combined Graph 4.1, 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%, 0.2%, 2.5% and 3.0% and compressive test result is 26.67N/mm^2, 26.92 N/mm^2 , 27.58 N/mm^2 , 27.91 N/mm^2, 28.37 N/mm^2,29.05 N/mm^2, 30.65 N/mm^2 respectively on 28th day of curing. The compressive strength of concrete using nano- silica increases as content of silica increases.. The maximum result is by replacing 3% of cement by nano-silica is 19.43N/mm^2, 25.54N/mm^2 and 30.65 N/mm^2 on 7th, 14th and 28th day of curing.

4.2 Combined Split Tensile Strength result

The combined Graph 16, 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 test result is 2.13N/mm^2, 2.84 N/mm^2 , 3.39 N/mm^2 , 4.32N/mm^2, 4.96N/mm^2, 5.15 N/mm^2, 5.77 N/mm^2 respectively on 28th day of curing. The Split Tensile strength of concrete using nano- silica increases upto use of 3% replacement of cement. The maximum result is by replacing 3% of cement by nano-silica is 3.12N/mm^2, 3.85N/mm^2 and 5.77 N/mm^2 on 7th, 14th and 28th day of curing.



Graph 4.2 Combined Split Tensile Strength

V. CONCLUSION AND DISCUSSION

5.1 CONCLUSION

From the above experiment it is observed that the Workability of concrete with use of nano-silica improve upto a limit than it decreases.

1. The Compressive Strength of partially replaced cement by nano silica concrete of grade M 20 for proportions of 0%, 0.5%, 0.10%, 1.5%, 2%, 2.5% and 3% are 26.67MPa, 26.92MPa, 27.58MPa, 27.91MPa, 28.37MPa, 29.05MPa and 30.65MPa respectively at 28th day of curing. The Compressive Strength increases upto 3%.
2. The Split Tensile strength of concrete with partially replaced cement by nano silica of grade M 20 for proportions of 0%, 0.5%, 0.10%, 1.5%, 2%, 2.5% and 3% are 2.13MPa, 2.84MPa, 3.39MPa, 4.32MPa, 4.96MPa, 5.15MPa and 5.77MPa respectively at 28th day of curing. The Split tensile Strength increases upto 3% use of nano-silica.
3. With the use of 3% of Nano-Silica concrete gives the maximum result in compression as 19.43MPa, 25.54MPa and 30.65MPa at 7th day, 14th day and 28th day of curing respectively.
4. With the use of 3% of nano silica gives the maximum result in Split Tensile Strength as 3.12MPa, 3.85MPa and 5.77MPa at 7th day, 14th day and 28th day of curing respectively.
5. Even a minute amount of nano-silica material can increase the overall strength of concrete.

5.2 LIMITATIONS OF THE WORK

- The percentage of nano silica is not restricted to 3% due to workability and strength issues thus it can be further used.
- Without the use of super plasticizers a appropriate compaction of the concrete was mired.

VI. SCOPE FOR FUTURE RESEARCH WORK

- The effect of addition of Super-plasticizer can also be checked on various proportions in the concrete mixes.
- In future, the effect of waste polymer can also be checked in the concrete mixtures for various physical characteristics.
- Although a lot of work has been carried out with nano silica particles in concrete, but a proper understanding has not been developed.
- In future, the effect of stone dust can also be checked in the concrete mixtures for various physical characteristics.
- In future, the size special effects of nano-silica can be premeditated in detail. Due to low cost of the nano silica many new methods can be designed.

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