

# A Microstructure analysis of Nano Material use in Concrete

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**Abstract**—This paper present microstructure analysis of the Nano material use in concrete. As there are various issues occurs due to environmental hazards. In which condition the Nano materials gives advanced results in various studies. Literature shows various durability checks like acid attack, sulphate attack, permeability parameters gives good result by the use of nano materials. It also shows that it required specific requirements for perform the durability tests. So, most of the problems created as the concrete is porous material and the pores reduced by using nano materials. This types of issues solved by using Nano materials using in the construction field.

**Keywords-** Nano Materials, Durability, SEM Analysis, Microstructure Analysis.

## I. INTRODUCTION

The development of construction materials technology, particularly concrete is growing very rapidly in the presence of nanotechnology. Nanotechnology is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. To obtain sustainable concrete, the mix is design to have high strength as well as low permeability using as much possible local sources. Determine permeability help to detect durability problems and allows timely and cost-effective protection of the concrete structure. The nano particles respond with Ca(OH)<sub>2</sub> crystals as a pozzolanic material. This makes the cement matrix extra homogeneous and compacted. Therefore the scuff and capillarity of water absorption fighting and strength are improved apparently. To authenticate the mechanism predicated through compressive SEM evaluations were performed.

Due to the nano-filler effect and the pozzolanic reaction, the microstructure became more homogeneous and less porous, which led to reduced permeability. The pore size distribution also indicated that the large capillary pores were refined by the nano-silica, due to the combined contribution of the nano-filler effect and the pozzolanic reaction. The strength and durability and other characteristics of concrete depend upon the properties of its ingredients, on the proportions of mix, the method of compaction and other controls during placing, compaction and curing. Significant improvement was observed in mixtures incorporating nanosilica in terms of workability, mechanical and durability properties.

In most of the studies nano silica increase the microstructure properties of concrete and make the concrete more dense and durable. The amount of nS also influenced on concrete durability properties. There are very few study has been carried out on durability of plain concrete.

The effectiveness of using nano-material to improve the impermeability and durability of concrete is also discussed.

## II. OBJECTIVES

To check utilization of the Nano Materials like Nano Silica as a solution as the Durable Structures. Use Nano Silica in Concrete make more sound and Homogeneous Material to improve the strength and durability. Cost Comparison with Normal Concrete. Recommend another Waste Material with use of nS to reduce or balance cost compare with Normal Concrete.

## III. MATERIALS AND METHODS

### Materials

- Cement: For preparation of samples, 43 grade ordinary Portland cement is used.
- Sand : Zone 1 (As Per IS:383-1970 Specification)
- Aggregate: Aggregates will be of Gandhinagar, Dist. Gandhinagar, Gujarat (As per IS: 383-1970 Specification) used.
- Water: As a constituent of matrix, simple tap water available in laboratory is used. Water quantity is taken with reference to cement content.
- Nano Silica : <100nm, [Sigma Aldrich Company (Germany)] OR Nano Fly Ash : <100nm, [Nanoshel Company]
- Fly Ash: GEB Power Plant, Gandhinagar (if required).
- Super plasticizer: various Super Plasticizers can be used.
- The properties of materials such as cement, fine aggregate, coarse aggregate and Nano Silica are determined and Calculation of M40 designed as per IS.

- The experimental investigation to be carried out on casting cubes. Nano Silica in Concrete added by varying the percentage of it.
- A set of nine samples of specimen will be casted with constant w/c ratio 0.38 and 0 % Nano Silica.
- After that with the use of Nano Silica will be used in various % method (i.e. 0.5%, 1%, 1.5%, 2% etc...), while Fly Ash used in increasing % method can be use.
- Check the Durability of the specimens with the use of Nano Silica which will be used in constant % method.
- Check the Durability Tests (i.e. Sea water attack test, Acid test, Sulphate test, Chloride test, Oxygen permeability test etc...) of that Specimen with the use of Nano Silica or Nano Fly Ash or Micro Fly Ash which will be used in increasing % method.
- Make the Cost Comparison of Compositions and if required than use waste materials (i.e. Fly Ash, Silica Fumes) in replacements to make it economical and Eco Friendly.
- The Engineering properties of the concrete like compressive strength and Durability are tested by using both Destructive and Non-Destructive testing methods.

#### IV. METHODOLOGY

##### *Microstructure Analysis*

##### *SEM (Scanning Electron Microscope) Principle:*

In this technique, an electron beam is focused onto the sample surface kept in a vacuum by electromagnetic lenses (since possesses dual nature with properties of both particle and wave an electron beam can be focused or condensed like an ordinary light) Further, the beam is scanned over the surface of the sample. The backscattered and secondary electrons from the sample are then fed to the detector and then to a cathode ray tube through an amplifier, where the images are formed, which gives the formation on the surface of the sample.

##### *Uses of SEM (Scanning Electron Microscope) :*

The Microstructure of the Nano Silica can be computed by the SEM (Scanning Electron Microscope) Test. By which the surface Examination of Surface morphology, Identification of metals and materials, powder morphology, particle size and analysis etc can be found out by it.

##### *Microstructure analysis of nS*



Fig.1 Specimen preparation for SEM



Fig.2 SEM Analysis of Nano Silica

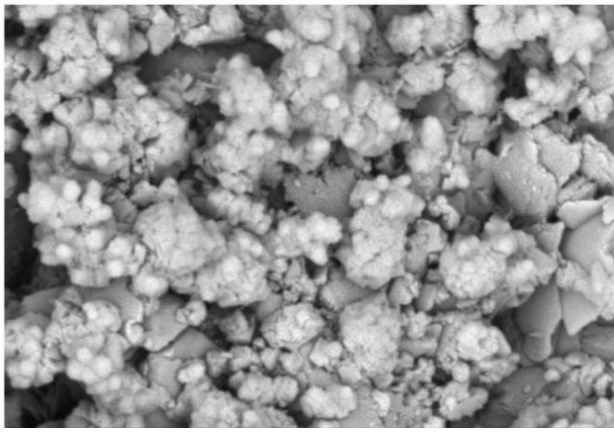


Fig.3 SEM Analysis of Concrete with nS

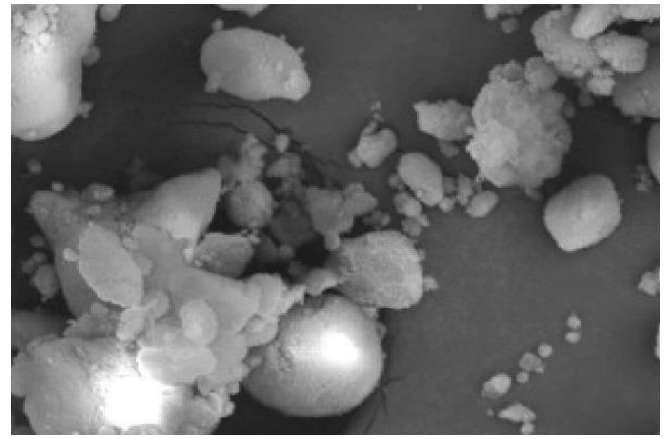


Fig.4 SEM Analysis of Concrete with nS

## V. RESULT AND DISCUSSION

### RESULT

- ✓ Use of nano silica in concrete can effectively increase the compressive strength of concrete.
- ✓ When the percentage by weight of nS exceeds 1.5% of the total weight of cement, it results in reduce the strength of concrete.
- ✓ From the Microstructure analysis it is observed that nS gives better homogeneity so it reduces voids in the concrete and make it sound.
- ✓ Up to certain accuracy it gives better result in Microstructure analysis, as the mechanism gives more micro result but its not indeed visible or useful.
- ✓ As the concrete durability maximum depends on its soundness and homogeneity, it is observed that concrete with the use of nS gives better result compare to nominal concrete.
- ✓ When the percentage by weight of nS exceeds 1.5% of the total weight of cement, it results in agglomeration. The results obtained from water absorption test suggest that nS concrete is more durable than conventional concrete. [7]
- ✓ The main objective of the present investigation was to study the effect of nanosilica on the mechanical and durability and flexural properties of concrete. [8]
- ✓ The compressive strength of concrete is increased by almost 40% by adding 2% nano silica in concrete. The durability of concrete containing 2% nano silica exhibits better resistance against sulphate attack, chloride attack and acid attack. [4]
- ✓ The SEM Analysis of Nano material shows the very fine particles and its bonding.
- ✓ The SEM Analysis of the nS used in Concrete shows the low permeability and low porosity with better homogeneity in the concrete which gives better resistance against any type of Environmental effects which generally affects when the concrete have higher porosity.
- ✓ Fig.1 shows the specimen with use of nS in it and foe performing SEM analysis on it.
- ✓ Fig.2 shows

### DISCUSSION

The properties and results of nano silica (nS) were studied and major conclusions are as follows:

- ✓ In all cases, the nS give more durability than normal concrete with the same mix proportion.
- ✓ The nS give better result if it is used limited to 1 or 1.5 % maximum.
- ✓ The nS decrease the permeability of concrete.
- ✓ As the permeability of the concrete decreases the durability increases.
- ✓ Micro and Nano fly ash also affected on the durability properties.
- ✓ nS is not greater responsible for strength but responsible for durability parameters.
- ✓ From the above results it shows better workability in concrete if used nS upto 1% in the conctere mix.
- ✓ Due to good workability concrete becomes better homogeneous material and gives higher durability.

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