

Comparative Study on Effect of Nanomaterials As Cement Replacement on Properties of Concrete

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Abstract-The present research work enables us to study the basic properties of concrete in which manufactured cement is used as a main component and full replacement for Nano material. To reduced cement production such as use Nano material to study basic strength and durability characteristics of concrete M50 and M55 grades were selected. In the strength study to find compressive strength and split tensile strength. In the durability study to acid attack test. In research work use of Nano silica and Nano ZrO₂ material. Ali nazari& shadi riahis research to find effect of Nano material replacement with cement properties so last conclusion to add 4% Nano SiO₂ and Nano ZrO₂ in concrete result in compressive strength and split tensile strength nearest twice to require strength. So this research going on to reduction of cement content 10% to 60% for use 4% Nano material in M50 and M55 grade.

Keywords-Nano SiO₂, Nano ZrO₂,compressive strength, splite tensile strength ,durability

I. INTRODUCTION

- Concrete is the most using material in all over world. Maximum use of it in structures, factories, buildings and bridge to airports. Make to most inspected materials of the 21st century so this material improvement is needed different admixture adds in concrete and improve concrete quality and retain concrete material cost. Cement material is main component of concrete so most investigation to replace cement properties in concrete and adds different materials to improve concrete strength and durability.
- Various materials known as complementary articulation materials are added to concrete and improve strength and durability also make high performance concrete. Some of these are blast furnace, silica fumes, rice husk slug, fly ash and etc. We also use various method for improved concrete physical and chemical properties use for Nano technology.

II. LITERATURE SURVEY

- As I studied many research papers and found that they all

used single Nano material replacement with cement and they found concrete compressive strength, split tensile strength, concrete permeability and durability. so I will choice two strong bonding Nano material Nano SiO₂ and Nano ZrO₂.^{[1][2]} The current study is concerned with the incorporation of Nano SiO₂+ Nano ZrO₂ and find out the minimum cement requirement in high performance concrete M50 and M55 grade.

III. OBJECTIVES OF THE STUDY

- To study the effect of Nano-SiO₂ and ZrO₂ on the compressive strength, split tensile strength and durability of concrete with reduce cement properties and made M50 and M55 grade concrete.
- Also study to mix both Nano materials in concrete and check the compressive, split tensile strength and durability of concrete.

IV. MATERIAL AND METHODS

1. Material:

The material used in present research were locally available in mehsana and check physical properties were found through laboratory test conducted in concrete lab form MIT,piludara.

▪ Fine aggregate:

Ordinary sand available in Sarasvati river, sidhapur having following properties has been used as fine aggregate. Physical properties as below table 1.

TABLE:1

Sr.No.	Parameter	Specification
1	Specific gravity	2.60
2	Finesse modulus	2.65
3	Water absorption	0.74 %
4	Sand zone after sieve analysis	Zone- II

▪ Course aggregate:

Locally available black crushed stone in mehsana with maximum nominal size of 20mm and 10mm have been used as course aggregate. Physical properties as below table 2.

TABLE:2

Sr.No.	Parameter	Specification
1	Aggregate crushing	24 %
2	Aggregate impact value	29%
3	Specific gravity	2.64 %
4	Water absorption	0.94 %
5	Fineness modulus	6.15

▪ Cement:

Commercially available ordinary Portland cement confirming to IS 455:1989 with coromandal king was used M50 and M55 grade of concrete. Physical properties as below table 3.

TABLE:3

Sr.No.	Parameter	Specification
1	Initial setting time	125 min
2	Final setting time	380 min
3	Soundness By Lee-Chatelier method	max 10mm 1.0 mm

▪ Water:

Tap water was used throughout the test procedure which is available in concrete laboratory.

▪ Nano SiO₂:

We collect Nano SiO₂ from the Kanpur becheem chemical production pvt. Ltd. The physical properties check through autus laboratory Ahmedabad. Physical properties as below Table 3.

TABLE:4

Sr.No.	Parameter	Specification
1	Molecular weight	60.08 g/mole
2	Color	Hazy white
3	Average particle	20nm
4	Viscosity	15 CPS
5	Specific gravity	1.31
6	Surface area	140 m ² /g

▪ Nano ZrO₂:

We collect Nano ZrO₂ from the Kanpur Becheems chemical production pvt. Ltd. The physical properties check

through autus laboratory Ahmedabad. Physical properties as below table 5.

TABLE:5

Sr.No.	Parameter	Specification
1	Molecular weight	123.33 g/mole
2	Color	white
3	Average particle	45nm

▪ Superplasticizer (polycarboxylate ether):

We collect polycarboxylate ether from the durga bondchem pvt Ltd, manjalpur Vadodara. The physical properties check from autus lab Ahmedabad show the properties below table 6.

TABLE:6

Sr.No.	Parameter	Specification
1	Appearance	Yellow-brown Liquid
2	pH	5.1-5.5
3	Specific gravity	1.12
4	Viscosity	76-80

Methodology:

▪ Compressive Strength Test:

The compressive strength of specimens is determined after 28 days of curing with surface dried condition as per Indian Standard IS: 516-1959. Three specimens are tested for typical category and the mean compressive strength of three specimens is considered as the compressive strength of the specified category.

▪ Split Tensile Test Results:

The split tensile test strength of specimens is determined after 28 days curing with surface dried condition as per Indian standard IS 5816:1999. Three specimens are tested for typical category and the mean split tensile strength of three specimens is considered as the compressive strength of the specified category.

▪ Durability Test:

Many test is available to find out durability of concrete. So that my research use acid attack for concrete cubes. Use sulfuric acid tank to put concrete cubes after curing 28 days. Then check concrete weight loss and also find compressive strength loss of concrete.

cubes are immersed in acid solution (5 % H₂SO₄) for 28 days after weighing. After 28-day compressive strength is measured in compressive machine. And find strength loss and compared to the original results for reduction cement content 10% to 60% compressive strength results.

Mix Design of concrete:

Using Indian standard guidelines for mix design of concrete grade M50 and M55 as per IS 10262:2009. The mix proportion is calculated and the value of different ingredients for one cubic meter concrete by mass is given below table 7.

TABLE:7

Grade	Water	Cement	F.A	C.A	Nano SiO ₂	Nano ZrO ₂	PE
M50	152.52	462.27	610	1260	18.49	18.49	115.5
M55	152.52	476.62	606	1252	19.06	19.06	119.1

V. EXPERIMENTAL ANALYSIS

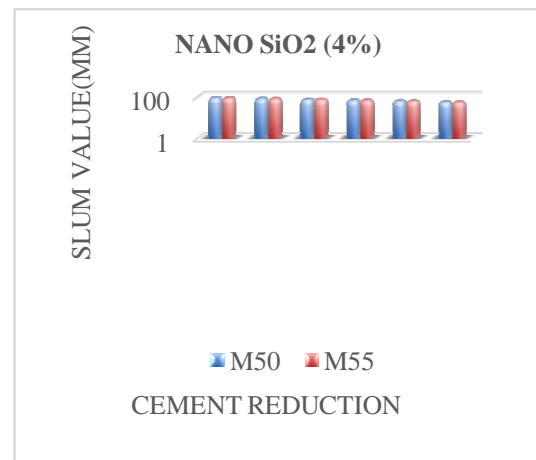
This Section is Worried with the performance of results of the trials Carried out Towards the objective of the project. It comprises results from compressive strength test and split tensile test results. Also incense durability test. The results are Accompanied with Graphs in order to have a better Analysis of the Results.

Experimental Results

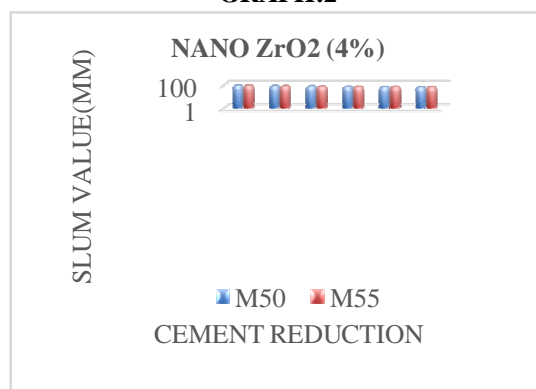
▪ **Slum Test Results:**

Show the result of slum test for M50 and M55 grade concrete to cement reduction 10% to 60% and add Nano SiO₂ and Nano ZrO₂ in concrete 4%.

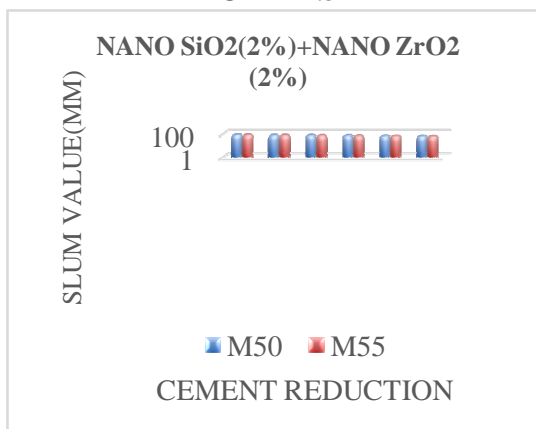
GRAPH:1



GRAPH:2



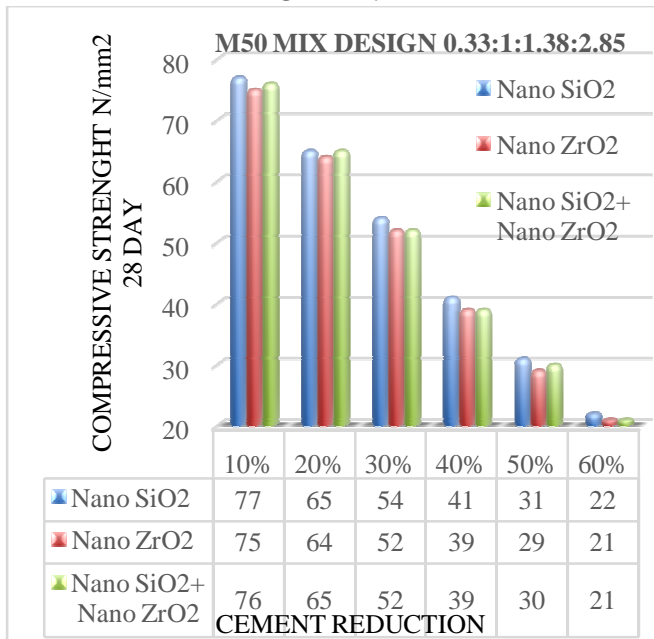
GRAPH:3



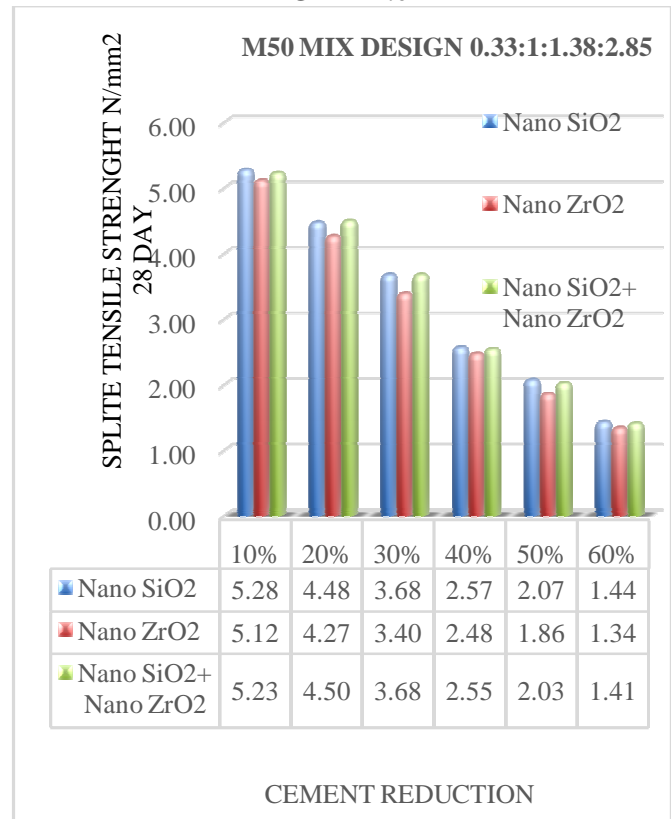
▪ **Compressive Test Results:**

After 28-day curing Show the results of compressive strength test in graph.

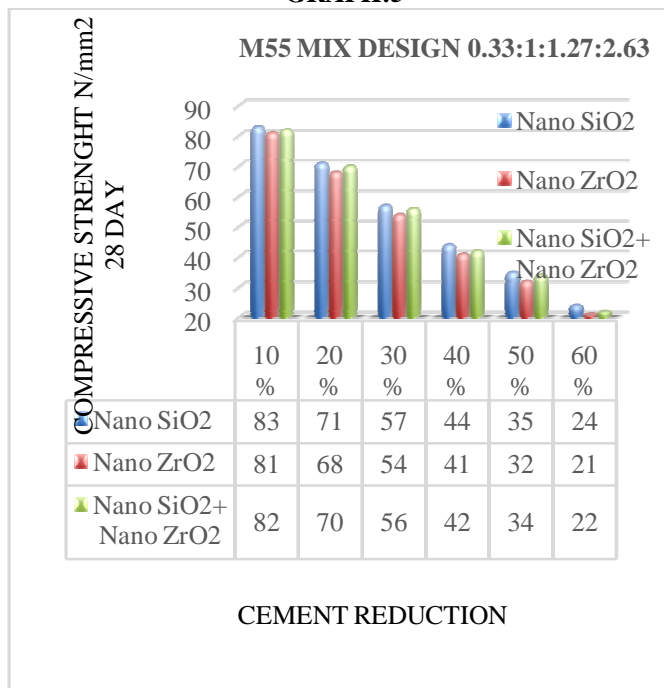
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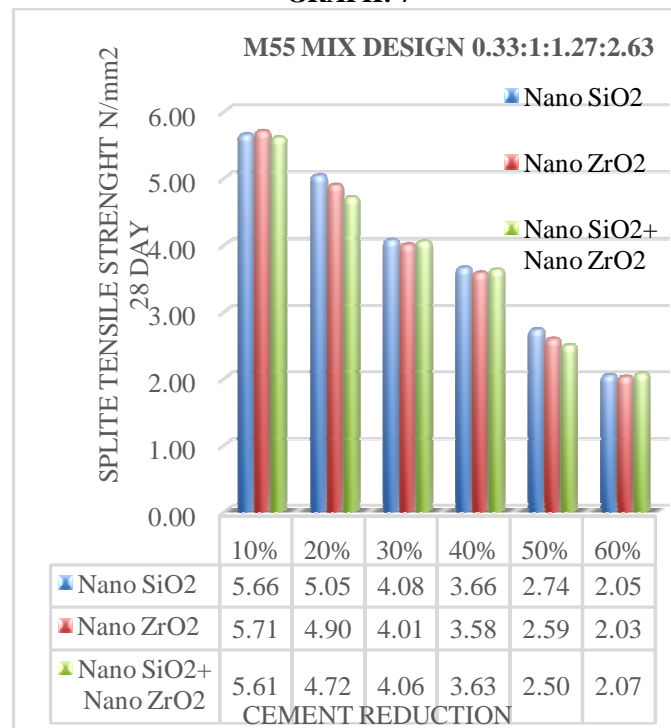
GRAPH:6



GRAPH:5



GRAPH: 7



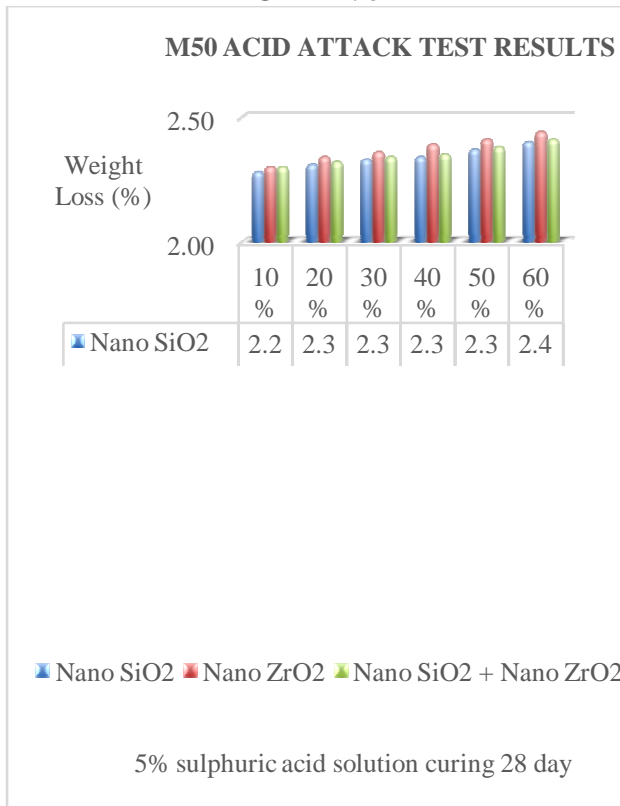
▪ **Split Tensile Test Results:**

After 28-day curing Show the results of split tensile strength test in graph.

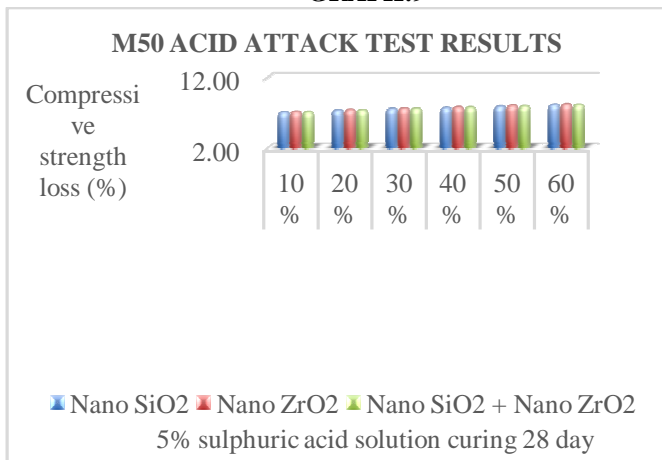
▪ **Durability Test Results:**

After 28-day acid curing to find out the weight loss of concrete and also check compressive strength loss.

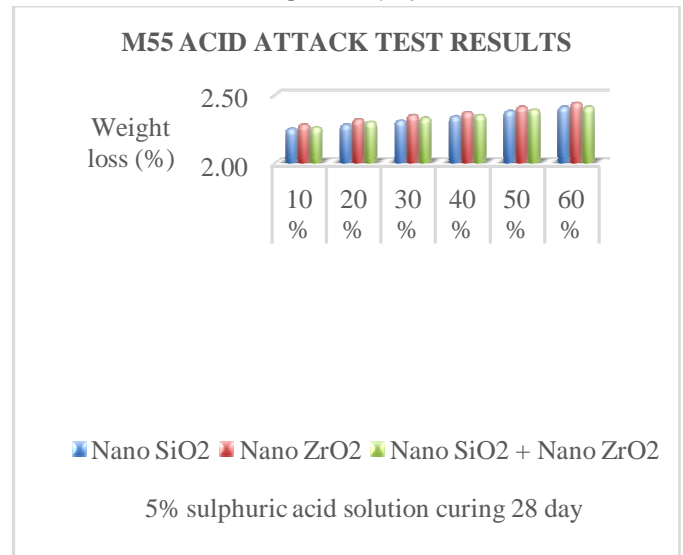
GRAPH: 8



GRAPH:9



GRAPH: 10



GRAPH:11

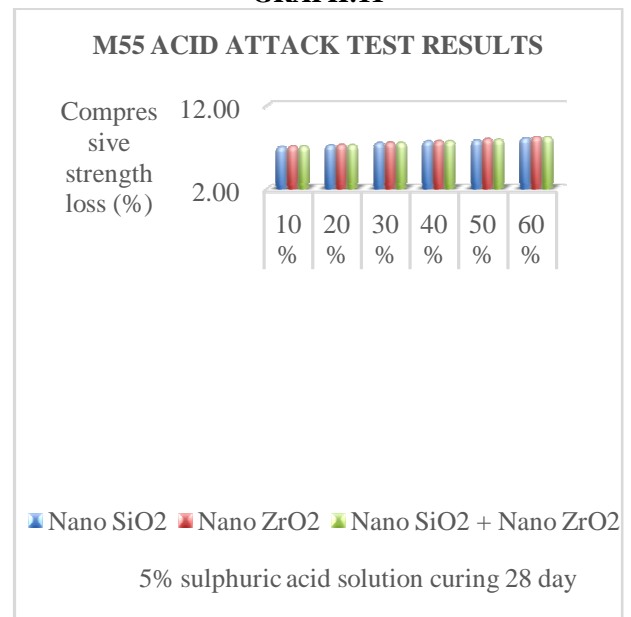


Figure 1: Concrete Cubes Strength Test

VI. CONCLUSION

- On addition of 4% of Nano SiO₂ & 30% reduction of cement, as compressive strength of mix is 54 N/mm² and 57 N/mm² this value is nearest M50 and M55. And workability of fresh concrete is average usefully in site work.
- On addition of 4% of Nano ZrO₂ & 30% reduction of cement, as compressive strength of mix is 52 N/mm² and 54 N/mm² this value is nearest M50 and M55. And workability of fresh concrete is average usefully in site work.
- On addition of 2% of Nano SiO₂ and 2% of Nano ZrO₂ & 30% reduction of cement, as compressive strength of mix is 52 N/mm² and 56 N/mm² this value is nearest M50 and M55. And workability of fresh concrete is average usefully in filed.
- On addition of 4% of Nano SiO₂ & 30% reduction of cement, as split tensile strength of mix is 3.68 N/mm² and 4.08 N/mm² this value is nearest M50 and M55.
- On addition of 4% of Nano ZrO₂ & 30% reduction of cement, as split tensile strength of mix is 3.40 N/mm² and 4.01 N/mm² this value is nearest M50 and M55.
- On addition of 2% of Nano SiO₂ and 2% of Nano ZrO₂ & 30% reduction of cement, as split tensil strength of mix is 3.68 N/mm² and 4.06 N/mm² this value is nearest M50 and M55. And workability of fresh concrete is average usefully in filed.
- As M50 and M55 grade of concrete was examined by addition of 4% of Nano SiO₂, 4% of Nano ZrO₂ and 2% of Nano SiO₂ & Nano ZrO₂ one after the other and 10% to 60% reduction of cement parallel as sulphuric acid attack test conducted for durability and found that weight loss of concrete increased by reduction of cement content loss of compressive strength of concrete also increased.

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