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Study Of Mechanical Properties Of Concrete With Nano Zirconia

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ABSTRACT: Concrete is the one of the powerful ingredient for construction field , this concrete can improved by adding some extra additives like nano powders which helps to increases the strength in the concrete, but nano powder of zirconia is very advantageous in reducing temperature effects and high hardness property, so it used in highly temperature condition as a coatings and paints, the requirement of journals by using nano zirconia powder in concrete is minimum,

In this present work nano zirconia used as energy booster to increase the strength of the concrete, nano zirconia powder is added into the concrete with different percentage of 0%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.2%, which are mixed separately for each specimen with water and 1% of conaplast SP430 is mixed by using mixer for 2 min in order to get the uniform dispersion of nano powder in the concrete, the specimens with nano zirconia gives the high compressive, tensile, impact strength when compared to normal concrete at each different percentage of nano zirconia and it increases the strength after 28 days.

1.0 INTRODUCTION

Concrete is a important ingredient used in construction, now a days need of concrete is increased very high in construction field, because of increasing population and life style of people in the society. The demands of construction of school buildings, residential buildings and office buildings etc. where expectations are more from engineers in the design and strength factors. Strength and design are the two important consideration in the construction, but irregular alignment of beams and columns for design purpose does not give the expected strength. In that case some alteration should be done for strength, so in order to increase the strength of the elements of the structure some materials are introduced in the concrete to develop the quality and mechanical properties of the concrete. The materials are of various types they are rubber, fiber, synthesized fly ash aggregates, polymerized materials, super plasticizers and nano materials, etc. These materials are good in some mechanical properties of concrete and they are helpful for increasing the strength of concrete.

1.1 Concrete

Concrete is one of the world wide using common construction material, which is manufactured by mixing locally available aggregates, water and cement in a specified proportion. The concrete is brittle in nature having good compressive strength when compared to tensile strength and it produces a homogeneous mix, which will help to improve the workability of concrete. Workability means easy to batching, mixing, transporting, placing and compacting of concrete, it is achieved by maintaining the water content in concrete otherwise it become stiff and unworkable. If water content increases the workability of concrete decreases due to more liquidity in concrete causes the flow of concrete, so water content is the main factor to alter the workability of concrete.

The concrete becomes stiff and hard when it losses water content and attains the strength to resist the compressive forces in harden state. It becomes impermeable and free from segregation and bleeding. Segregation is the process of separation of aggregates from the cement paste and bleeding is separation of cement paste from the mass. It causes the dry shrinkage due to movement of water through the pores which leads to volume changes in the concrete causing shrinkage problems. The main factor for shrinkage problem is water variation in the concrete, because of temperature variation, water movement and entry of alkalies in to the surface of concrete. In order to avoid the shrinkage problems the pores ratio and void ratio should be minimized with proper compaction and by taking safety measurements to avoid entry of alkalies materials in the concrete.

In present situation construction is changing it's way of construction by adding new techniques, machines, tools and materials. Materials are the life of the structure, so concrete should be improved by adding different materials like smart materials, composite materials and nano materials

2. Materials and methodology

Materials required in this experiment are shown below:

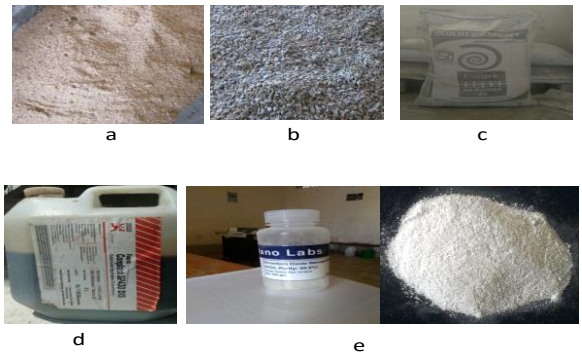

Fig 2.1Materials required in this work

a. Fine aggregates:

Table 2.1 Properties Of Fine Aggregates

S.l.no	Test	Result
1	Specific gravity	2.72
2	Fines modulus	2.60
3	Zone	II

a. Coarse aggregates:

Table 2.2 Properties Of Coarse Aggregates

S.l.no.	Test	Result
1	Specific gravity	2.74
2	Bulk density	1448.69 g/ cm^3

b. Cement: in this work ordinary Portland cement OPC 43 used

c. Conaplast SP430:

Table 2.3 physical properties of conaplast SP430

S.l.no.	Properties	Description
1	Specific gravity	1.2 to 1.21
2	Chloride content	Nil. To IS:9103-1999 and BSS:5075
3	Air interment	Approx. 1.5% addition air over control
4	color	brown

d. Nano zirconia powder:

Table 2.4 Physical Properties Of Zirconium Oxide

S.l no	Physical Properties	Zirconium oxide
1	Purity	99.9%
2	APS	30-50nm
3	SSA	40-45 m^2/g
4	Appearance	White
5	True density	5.89 kg/m^3
6	Morphology	Spherical
7	Melting point	2715^0 C

Table 2.5 chemical composition of zirconium oxide

S.l. no	Zro_2	Al	Fe	Pb
1	>99.9%	<0.09%	<0.02%	<0.02%

3. METHODOLOGY

In this methodology, concrete is designed for M30 grade of ratio 1:1.52:2.62 with the addition of zirconium oxide at (0%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.2%) with the use conaplast SP430 superplasticizer amount, by using moulds of size 150 x 150 x 150 mm for compressive strength test, $\frac{\pi}{4} \times r^2 \times l$ for flextural strength test, $\frac{\pi}{4} \times d^2 \times 6$ mm for impact strength test and test the specimemens were casted and tested after 28 days

3.1 Priliminary Test Methods

In starting stage the find out specific gravity of fine aggregates by using pycnometer, specific gravity of coarse aggregates by wire basket and confirming the zone of sand by seive analysis method were carried out as per Indian code as per IS 383.

3.2 Secondary Test Methods

- First step is cleaning the moulds and applying oil before filling the concrete mixtutre into the moulds
- Weight the aggregates (15.96 kg), sand(27.37 kg) and cement (10.43 kg) according to design, are mixed well in dry condition
- Then weigh 1% of conaplast SP430 weigth (104.3 ml solution) poured in the jar and then weigh the 0.2% of nano zirconia of (weight 20.86 g) with water mixed well in the mixer.
- The mix is done for around 10 second, after mixing spread the solution on the dry mix concrete and spread uniformly throughout the mix.

- The above procedure is done for each % of (0%, 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.2%). Nano zirconia sepeartly.
- Moulds are filled with prepared concrete mix.
- The moulds are in room temperature for one day, then they are demoulded.
- Keep the mould in water tank for 28 days for curing
- Remove the moulds after 28 days keep it for surface drying.
- Tests the moulds to check the mechanical properties.

Fig 2.2 demoulded nano zirconia specimens

3. RESULTS AND DISCUSSIONS

Workability results

Table 3.1 workability test results

S.l. no	% of nano zirconia	Slump in mm	Vee bee test in seconds	Compaction factor test in %	Flow table test in %
1	0%	105	3	0.95	52
2	0.2%	100	8.69	0.92	20
3	0.4%	95	9.30	0.85	14
4	0.6%	92	27	0.85	12.8
5	0.8%	84	28	0.85	10
6	1%	81	29	0.84	8.8
7	1.2%	70	30	0.81	6

Table 3.2 water absorption and soroptivity results

S.l.no	% of nano zirconia	Water absorption test in %	Soroptivity test
1	0%	0.35	6.6
2	0.2%	0.11	6.5
3	0.4%	0.23	8.1
4	0.6%	0.23	8.9
5	0.8%	0.23	9.8
6	1%	0.23	9.8
7	1.2%	0.35	9.8

Table3.3 compressive strength test results

S.l.no.	% of nano zirconia	Compressive strength in Mpa
1	0%	33
2	0.2%	43.2
3	0.4%	41.4
4	0.6%	41.3
5	0.8%	38.4
6	1%	38.3
7	1.2%	28.1

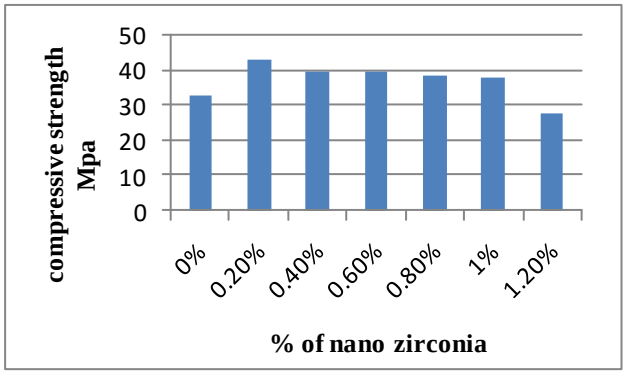

Fig 3.1 compresion test results

Table 3.4 Splitting tensile strength test

S.l.no.	% of nano zirconia	Spliting tensile strength test
1	0%	3.2
2	0.2%	3.4
3	0.4%	2.8
4	0.6%	2.7
5	0.8%	2.7
6	1%	2.5
7	1.2%	2.6

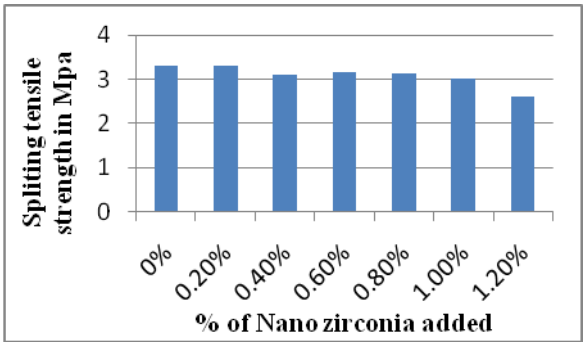

Fig 3.2 spliting tensile strength test results

Table 3.5 Impact strength test results

S.l.no	% of nano zirconia	Impact strength test
1	0%	4990
2	0.2%	32430
3	0.4%	1829
4	0.6%	1823
5	0.8%	1466
6	1%	1343
7	1.2%	1035

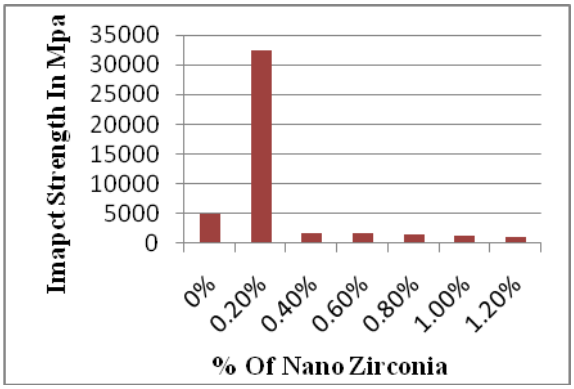

Fig 3.3 impact strength results

CONCLUSIONS

The works on these experiments are conducted to know the better results when compared with reference concrete.

In workability results, the 0.2% of nano zirconia gives the good flow percent, reduced permeability and better compaction ratio when compared to other percentage of nano concrete at 0.2% of nano zirconia specimen.

Compressive strength is maximum in 0.2% of nano zirconia specimen when compared with all other percentage of nano zirconia specimens, it gives good result when compared to reference concrete and also split tensile, impact strength are checked with reference concrete gives the high result when compared with reference concrete at 0.2% of nano zirconia specimen.

The numbers of pores are reduced by good compaction and addition of nano zirconia at 0.2% in the specimen

By knowing overall results of experiment, it conclude that 0.2% of nano zirconia in concrete is very advantageous for improving the mechanical properties and also reducing in temperstural effects on the concrete with porosity.

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