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Experimental Study on Behaviour of Nano Concrete

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ABSTRACT:The application of nanotechnology in concrete has added a new dimension to the efforts to improve its properties. Nanomaterial,by virtue of their very small particles size can affect the concrete properties by altering the microstructure. This study concern with the use of titanium dioxide(Tio_2) to increase the strength of concrete. An experimental investigation has been carried out by replacing the cement with titanium dioxide(Tio2) of 0.5%,1%,1.5% by water binder ratio. This test conducted on it shows a considerable increase in early age compressive strength and also improves the overall compressive strength of concrete. Thestrength increase was observed with the increase in the percentage of nano silica.

KEYWORDS: Titanium dioxide, Super plasticizer, Hydration.

I. INTRODUCTION

Concrete is one of the most widely used construction materials. It is usually associated with Ordinary Portland cement as the main component for making concrete. The demand for concrete as a construction material is on the increase. The development of concrete modified using Titanium dioxide is in the response for the need of a greener concrete in order to reduce carbon dioxide emission from the cement production. It offers a significant opportunity to materialize green concrete as it is possible to utilize a by-product such as titanium dioxide to replace the use of ordinary Portland cement in concrete, and hence to reduce the emission of carbon dioxide to the atmosphere. The first part of this project studied the development of mixture proportions of the four concrete samples, followed by the manufacture of the samples and the study of effect of main parameters on the short-term and the long-term engineering properties of fresh and hardened concrete. In this investigation, the properties of concrete modified with Titanium dioxide in M45 and M50 grades are determined. In the first sample cement is replaced by 0.5% of tio2. In the second sample cement is replaced by 1% of tio2. In the third sample cement is replaced by 1.5% of tio2. And the fourth sample is normal concrete. These samples are casted and water cured for 21 and 28 days. The tests conducted in this work are compressive test, Split tensile test, Flexural test etc.

II. EXPERIMENTAL WORKS

MATERIALS:

Titanium dioxide:TIO_2Nano particle are manufacture worldwide in large quantities for use in a wide range of applications. Titanium dioxide is a white pigment and because of its brightness and very high refractive index it is most widely used. The use of Nano titanium dioxide particles has higher strength and faster chemical reaction (eg: hydration reaction). Nano cement particles can accelerate cement hydration due to their high activity. Similarly the incorporation of Nano particles can fill the pores more effectively to enhance overall strength and durability. Thus Nano particles can lead to production of a new generation of cement composites to enhance strength and durability.

Super plasticizers: Super plasticizers, also known as high range water reducers, are the chemical used as admixtures where well-dispersed particle suspensions are required. These are used as dispersants to avoid particle aggregation and to improve the flow characteristics of suspensions such as in concrete applications. Their addition to concrete or mortar allows the reduction of the water to cement ratio, not affecting the workability of the mixture, and enables the production of self-consolidating concrete and high performance concrete.

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Proportioning of ingredients:

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of required strength, durability and workability as economically as possible is termed as the concrete mix design. The proportioning of the ingredients of concrete is governed by the required performance of the concrete in two states, namely the plastic and the hardened states.

Mix design:

The mixture proportions of three concrete sample. In sample 1 concrete modified using TIO2 of 0.5% of weight of cement. In sample 2 concrete is modified using TIO2 of 1% of weight of cement. And in sample 3 concrete is modifies using TIO2 of 1.5% of weight of cement.

CEMENT	FINE AGGREGATE	COURSE AGGREGATE	WATER
1	1.5	2.08	0.4

Materials required for concrete containing 0.5%,1% and 1.5% of TIO2 for 3 cubes of M50 grade

MIX 1

MATERIALS	QUANTITY
Cement	5.88kg
Fine aggregate	11.84kg
Coarse aggregate	12.23kg
TIO2	5 (gms)
Super Plasticizer	1.3% of cement
Water	2.2 litres

MIX 2

MATERIALS	QUANTITY
Cement	5.83kg
Fine aggregate	11.84kg
Coarse aggregate	12.23kg
TIO2	10 (gms)
Super Plasticizer	1.3% of cement
Water	2.2 litres

MIX 3

MATERIALS	QUANTITY
Cement	5.78kg
Fine aggregate	11.84kg
Coarse aggregate	12.23kg
TIO2	15 (gms)
Super Plasticizer	1.3% of cement
Water	2.2 litres

III.TESTING OF SPECIMEN

Slump test: "The concrete **slump test** measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concreteflows. It can be also used as an indicator of an improperly batch."

Compression test: A compression test is any test in which a material experiences opposing forces that push inward upon the specimen from opposite sides or is otherwise compressed, "squashed", crushed, or flattened.

Split tensile strengthtest: The tensile strength of concrete is one of the basis important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete.

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Flexural strength test: Flexural strength also known as modules of rupture bend strength or fracture strength a mechanical parameter for brittle material is defined as a materials ability to resist deformation under load the transverse bending test is most frequently employed in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress here given the symbol σ.

Water absorption test: Water absorption is the amount of water taken by the flour to achive the desired consistency or optimal end result usually defined based on flour weight for example,60% water absorption would mean 60Ibs of water is required for every 100Ibs of flour.

X-ray diffraction: X-ray diffraction is based on constructive inference of monochromatic X-rays and a crystalline sample. X-rays are generated by cathode ray tube, filtered to produce monochromatic radiation, collimated to concentrate, and directed towards the sample. The interaction of the incident rays with the sample produces constructive inference (and a diffracted ray) when conditions satisfy Bragg's law,

$$N\lambda=2d\sin\Theta$$

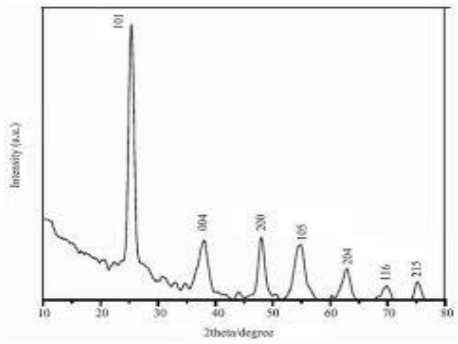

Fig :1X- Ray diffraction of Titanium dioxide

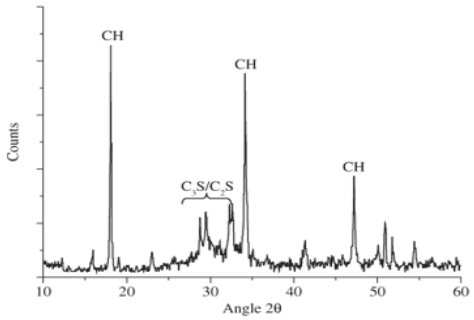

Fig:2X- Ray diffraction of cement

Scanning electron microscope test

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron- sample interactions reveal information about the sample including external morphology (texture) and elemental composition of materials making up the sample. In most applications, data are collected over a selected area of the surface and 2- dimensional images generated that displays spatial variations in these properties, Areas ranging from approximately 1cm to 5microns in width can be imagined in a scanning mode using conventional SEM techniques (magnification ranging from 20X to approximately 30,000X, spatial resolution of 50 to 100nm).

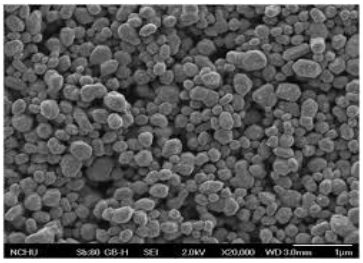

Fig3 : SEM image of Titanium dioxide

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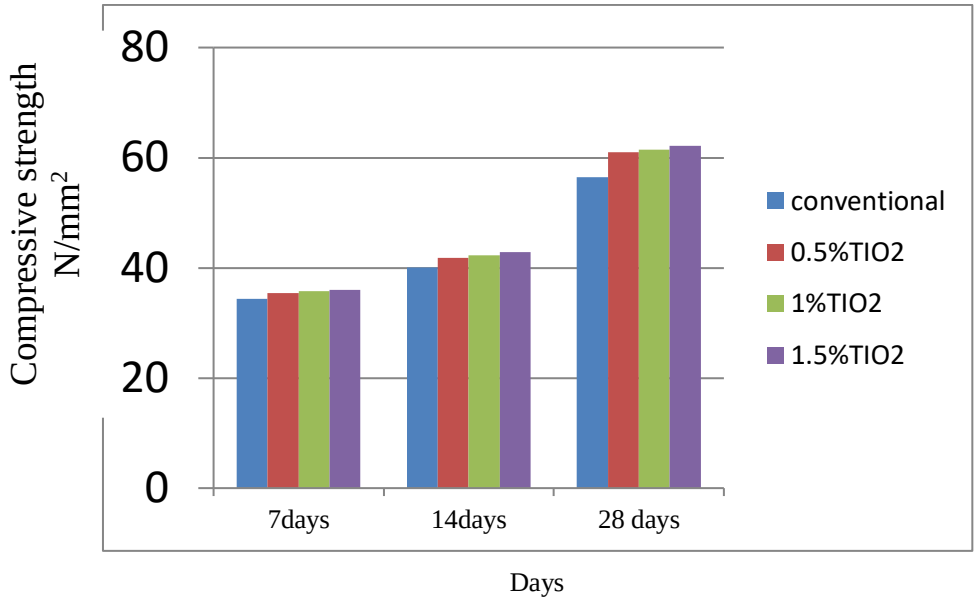
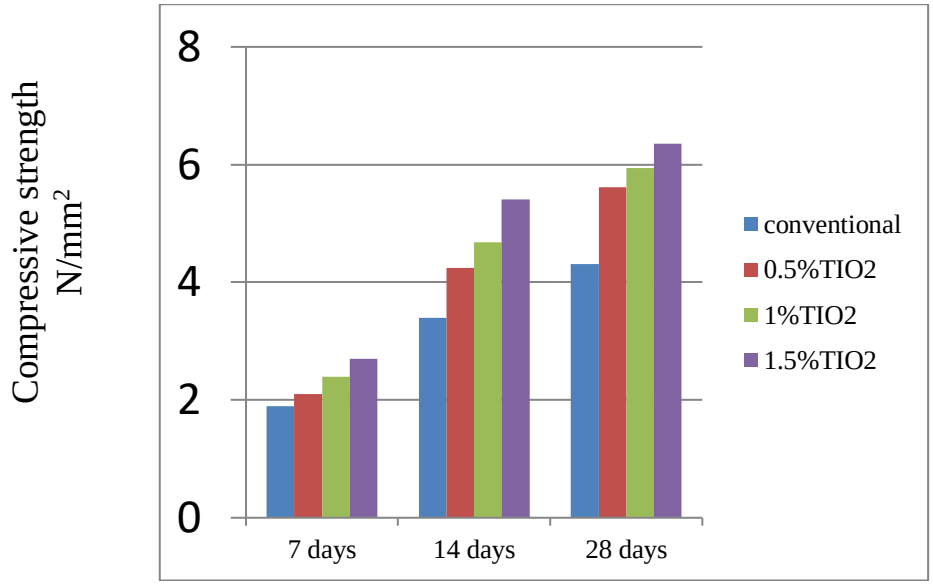
IV.RESULT AND DISCUSSION

Compression strength test



Split tensile test



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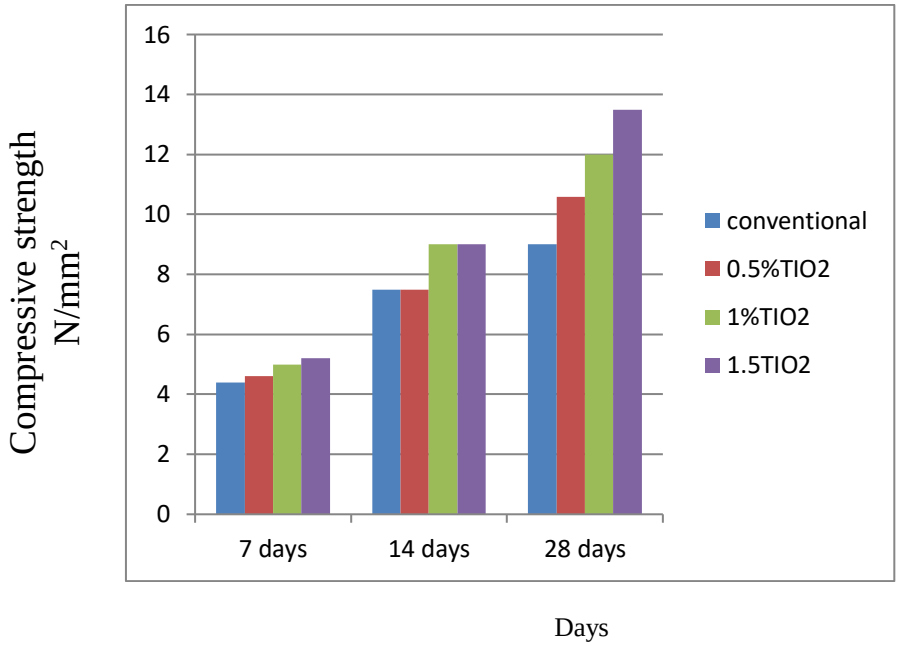
Flexural strength test:



V.RESULTS AND DISCUSSION

- The readings obtained from the cube compressive strength after a curing of 7,14 and 28 days for M50 grade of concrete shows that concrete containing Titanium dioxide exhibits higher strength than the normal cement based concrete.

- The readings obtained from the split tensile strength test after a curing of 7, 14 and 28 days for M50 grade of concrete shows that concrete containing Titanium dioxide exhibits higher strength than the normal cement based concrete.

- The readings obtained from the flexural strength test after a curing of 7, 14 and 28 days for M50 grade of concrete shows that concrete containing Titanium dioxide exhibits higher strength than the normal cement based concrete.

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