EIA FOR REDUCTION IN GLOBAL WARMING A NEW ERA IN CONSTRUCTION INDUSTRY – NANO CONCRETE

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Abstract - *The increase in the greenhouse effect causes ecological imbalance contributing to global warming which is at alarming rate. Concrete usage around the world is second only to water. According to the recent study as of 2015, 280 tons of cement is manufactured in India and 4180 tons of cement is manufactured over all in the world which means 4180 tons of CO_2 is emitted as pollution in the environment which leads to global warming. An important ingredient in the conventional concrete is the Portland cement. The cement industry is responsible for 6% of all CO_2 emission, because the production of one tone of Portland cement emits approximately one tone of CO_2 into the atmosphere. In order to overcome the global warming effect caused by the manufacturing of the ordinary Portland cement there is an immediate need to find a suitable substitute. In this investigation, the property of concrete modified with titanium di oxide in M45 grade is determined. As per IS-10262 – 2009 - concrete Mix design, two types of samples are prepared for the experimental work. In the first sample titanium di oxide replaces about 0.5%, 1%, and 1.5% of cement in M45 grade of concrete and the second sample is the conventional concrete. These samples are casted and cured up to 28 days for carrying out the related tests. Compressive test, split tensile test and flexural test are the tests conducted on this cured samples. Using titanium di oxide (Tio_2), it is observed that compressive strength, split tensile strength, flexural strength is higher in the first sample which is a nano concrete compared to the conventional concrete.*

***Key words:* Greenhouse effect, Nano Particles, Titanium di oxide, M45 concrete, compressive strength, split tensile strength, flexural strength**

1.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 [1]. 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 [2]. 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 [3]. Some of the common properties of Nano-Particles are - Well-dispersed nano-particles increase the viscosity of the liquid phase helping to retain the cement grains and aggregates which improves the segregation Resistance and workability of the system [4]. Nano-Particles fill the voids between cement grains which results in the Immobilization of ''free'' water (''filler effect'') [5]. Well-dispersed nano particles acts as centers of crystallization of cement hydrates, therefore accelerating the hydration [6]. Nano-Particles favor the formation of small-sized uniform clusters of C-S-H. Nano-Particles participates in the pozzolonic reactions, resulting in the consumption of Ca(OH)2 formation of an ''additional'' C-S-H.Nano-Particles improve the structure of the aggregates contact zone, resulting in a better bond between aggregates and cement paste[7].Crack arrest and interlocking effects between the slip planes provided by nano-particles improve the overall mechanical properties like toughness, shear, tensile and flexural strength of cement based materials[8].This research involved partial replacement of cement by TIO_2 and thereby making concrete more affordable to common man.

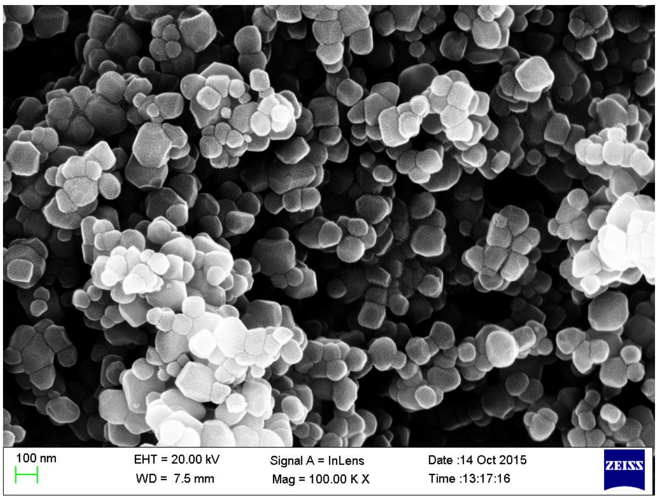

Fig - 1: Titanium di-oxide(TiO_2) when viewed under Scanning electron microscope at mag = 100.00 K X.

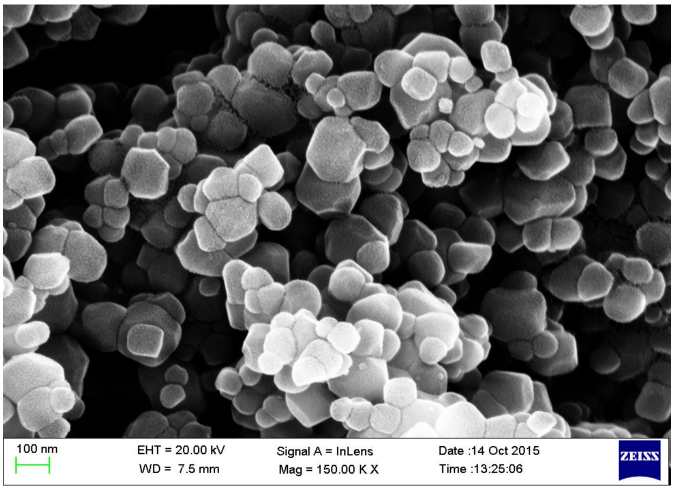

Fig - 2: Titanium di-oxide(TiO_2) when viewed under Scanning electron microscope at mag = 150.00 K X.

1.1. Literature Review

Nano particles can improve the durability and mechanical properties of concrete. The contribution of nano Tio_2 on improvement of mechanical properties and durability of concrete was more than the other nano particles. Generally, nano material added in small percentage in the range of 1 to 3% will improve the strength, permeability and shrinkage of concrete. Anwar M.Mohamed (2014) explained the influence of nano materials on flexural behavior and compressive strength of concrete. The results showed that nano particles can be very effective in improving mechanical properties of concrete, nano silica is more effective than nano clay in mechanical properties and wet mix gives higher efficiency than dry mix. A.M. Said (2012) explained the properties of concrete incorporating nano silica and investigated effect of colloidal nano-silica on concrete incorporating single (ordinary cement) and binary (ordinary cement + class fly ash) binders. The results concluded that the overall performance of concrete, with or without fly ash, was significantly improved with addition of variable dosages of nano-silica. Ali Nazari (2011) studied the TIO_2 nano particle effects on physical, thermal and mechanical properties of concrete with ground granulated blast furnace slag as binder. The result found that the content of TIO_2 nano particles is increased up to 3.0 weights the compressive strength, split tensile strength and flexural strength of specimens is increased. Ali Nazari (2010) explained the compressive strength and workability of concrete by partial replacement of cement with nano-phase TIO_2 nano particle. The results showed that the partial replacement of cement with nano phase TIO_2 particles improves the compressive strength of concrete but decreases its workability

2. EXPERIMENTAL INVESTIGATION

2.1 Compression test

Cubical moulds of size 150×150×150mm are taken. It is made of non-absorbent material and substantial enough to hold their form during the moulding of test specimens. After unmoulding the sample is kept for water curing. The sample is tested after 28 days of curing.

Table -1: Compressive strength test for 0.5% of TiO_2

S.NO	Grade of concrete	Type of sample	Sample name	Load (KN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)
1	M45	Conventional concrete	A	1020	55.333	55.250
			B	1060	57.111	
			C	980	53.556	
2	M45	TiO_2	A	990	44.000	45.965
			B	870	48.667	
			C	950	42.222	

Table -2: Compressive strength test for 1% of TiO_2

S.NO	Grade of concrete	Type of sample	Sample name	Load (KN)	Compressive Strength (N/mm^2)	Average Strength (N/mm^2)
1	M45	Conventional concrete	A	1030	55.778	55.926
			B	1080	58.000	
			C	990	54.000	
2	M45	TiO_2	A	950	46.222	45.814
			B	860	45.222	
			C	900	46.000	

Table -3: Compressive strength test for 1.5% of TiO_2

S..NO	Grade of concrete	Type of sample	Sample name	Load (KN)	Compressive Strength (N/mm²)	Average Strength (N/mm²)
1	M45	Conventional concrete	A	1050	56.667	56.667
			B	1100	58.889	
			C	1000	54.444	
2	M45	TiO_2	A	850	47.778	47.663
			B	890	49.556	
			C	960	45.667	

2.2. Split tensile test

Cylindrical moulds of size 150×300mm are taken. It is made of non-absorbent material and substantial enough to hold their form during the moulding of test specimens. After unmoulding the sample is kept for water curing. The sample is tested after 28 days of curing

Table -4: Split tensile result for 0.5% of TiO_2

S.NO	Grade of Concrete	Type of concrete	Specimen Name	Load (KN)	Split tensile Strength (N/mm²)
1.	M 45	TIO_2	A	260	5.517
2.	M 45	Conventional concrete	A	155	3.289

Table -5: Split tensile result for 1% of TiO_2

S.NO	Grade of Concrete	Type of concrete	Specimen Name	Load (KN)	Split tensile Strength (N/mm²)
1.	M 45	TIO_2	A	275	5.835
2.	M 45	Conventional concrete	A	170	3.607

Table -6: Split tensile result for 1.5% of TiO_2

S.NO	Grade of Concrete	Type of concrete	Specimen Name	Load (KN)	Split tensile Strength (N/mm²)
1.	M 45	TIO_2	A	290	6.150
2.	M 45	Conventional concrete	A	155	3.289

2.3. Flexural Strength test

Prism moulds of dimension 100×100×500mm are taken. It is made of non-absorbent material and substantial enough to hold their form during the moulding of test specimens. After unmoulding the sample is kept for water curing. The sample is tested after 28 days of curing.

Table -7: Flexural strength result for 0.5% of TiO_2

S.NO	Grade of Concrete	Type of Concrete	Specimen Name	Loa (KN)	Flexural Strength (N/mm²)
1.	M 45	TIO_2	A	14	10.5
2.	M 45	conventional concrete	A	12	7.5

Table -8: Flexural strength result for 1% of TiO_2

S.NO	Grade of Concrete	Type of Specimen	Specimen Name	Load (KN)	Flexural Strength (N/mm²)
1.	M 45	TIO_2	A	12	9
2.	M 45	conventional concrete	A	12	7.5

Table -9: Flexural strength result for 1.5% of TiO_2

S.NO	Grade of Concrete	Type of Concrete	Specimen Name	Load (KN)	Flexural Strength (N/mm^2)
1.	M 45	TIO_2	A	16	12
2.	M 45	conventional concrete	A	12	7.5

3. CONCLUSIONS

Therefore, with the use of titanium di oxide (TiO_2) increases the overall strength of the concrete by 30% and manufacturing of cement can be reduced thus avoiding the greenhouse effect. Manufacturing of one tone of cement emits equal amount of carbon emission into the environment. By using the nano-materials in the concrete we can pave way for sustainable development.

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