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EFFECT OF NANO TITANIUM DIOXIDE AND GGBS ON FLEXURAL BEHAVIOUR OF CONCRETE BEAM

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ABSTRACT

Because of the rise in global urbanization, the product made by man has become easily available all over the world. The concentration of carbon dioxide (CO2) released during the production of ordinary Portland cement (OPC) is approximately one ton. The carbon dioxide (CO2) ejection is estimated 8% of the global total. Now in order to reduce carbon dioxide emissions and create a sustainable environment, we need to produce green building materials. For this Nona Titanium Dioxide and Ground Granulated Blast furnace slag are used in cement at the concrete mixing stage. By use of nano titanium dioxide in concrete helps in reducing smoke, self-cleaning, the consistency of indoor air, the biotic limit due to its photo-catalytic properties, and the use of GGBS in concrete decreases the high amount of CO2 produced during cement processing. The present study is aimed at determining the flexural behavior of plane concrete beams, where cement has been replaced by Nano TiO2 and GGBS in various proportions.

Keywords: TiO_2, GGBS, Flexural Behaviour, Green Building Material.

I. INTRODUCTION

Nanotechnology is among the most involved branches of study that is commonly applicable in nearly all scientific fields. Since concrete is the most usable material in the building industry, its quality needs to be improved. Improving the concrete properties of nano particles such as nano-silica, nano-titanium dioxide and carbon by incorporating them. In comparison to standard concrete, nanotubes etc have demonstrated substantial enhancement.

Nanotechnology is the science of atomic and molecular-scale modification of matter. In specific, nanotechnology deals with the creation of materials, devices or other structures with a minimum dimensional size of < 100 nm. Increased urbanization in the present period also contributes to an impact on air quality, where air pollution is a big contribution from manufacturing, thermal power plants, vehicles and aircraft, etc., since we know that air pollution not only impacts the wellbeing of living binges, but also leads to improvements in biological biodiversity and the environment.

II. METHODOLOGY

MATERIALS

1. **Cement:** Cement used in this present experimental work is Ordinary Portland Cement (OPC) 43 grade and obtained from JK Cement Ltd. Confirmed to IS 8112- 2013. The properties are given below.

Table-1: Properties of Cement

S. No.	Particulars	Results
1	Specific Gravity	3.14
2	Initial Setting Time	32 min
3	Final setting Time	445 min
4	Fineness modulus	3.12

2. **Fine Aggregates** Fine aggregates were obtained from locally available river and sieve analysis was done. Various test has been done to find properties of sand for required application which includes sieve analysis, specific gravity, fineness modulus and moisture content as per IS:383-2Table 3: Properties of Coarse Aggregate.

Table-2: Properties of Fine Aggregate

S. No	Particulars	Results
1.	Type	River Sand
2.	Specific Gravity	2.82
3.	Fineness Modulus	2.9
4	Water Absorption	1.2%
5.	Grade of Sand	Zone II

3. **Coarse Aggregates**: Crushed stone is used to make concrete, the size of coarse aggregate which is used to carry out experiment investigation lies in the range of 10 mm to 20 mm. The Properties are given blow.

Table-3: Properties of Coarse Aggregate

S. No.	Particulars	Results
1	Type	Crushed
2	Specific Gravity	2.60
3	Size	10-20 mm
4	Water absorption	1 %

4. **Titanium Dioxide** It is naturally occurring oxide of titanium. The utilization of this material started as a white shade power in the mid twentieth century because of its high refractive list, supplanting poisonous lead oxides. TiO_2 having photo-catalytic properties that can break down any organic compound in the presence of sun light. The properties of TiO_2 are given below.

Table-4: Properties of titanium Dioxide

S. No	Particulars	Results
1.	Particle Size	15nm
2.	Appearance	White Power
3.	PH	6.5
4.	Specific Gravity	3.7

5. **GGBS:** Ground granulated blast furnace slag, is a mineral admixture which have the chemical components similar to that of Portland cement. Due to hydraulicity, therefore, it contributes not only improvement of concrete performance, but also in resource and energy savings. The specific gravity of GGBS is 2.85.

Table-5: Properties of GGBS

S.NO.	Compound	Content by % wt.
1	SiO_2	39
2	Al_2O_3	10.2
3	Fe_2O_3	3.25
4	CaO	35.36
5	MgO	7.0
6	K_2O	0.4

6. Water

Tap water having PH range of 6 to 8 is used for casting and curing. Water should be clean and fit for drinking, and should meet the requirement as specified by IS code 456-2000.

III. RESULTS AND DISCUSSION

M25 grade concrete is prepared in present investigation, with water cement ratio of 0.5. Mixes are prepared by different proportions of cement replacing with TiO_2 (1%, 1.5% and 2%0 with GGBS (0%, 10%, 20% and 30%) The mix design for M25 grade was done in accordance with a specification of code IS: 10262-2019. The mix designation are given below.

a) 0 % TiO_2 + 0 to 30 % of GGBS I.e. (T_0 % G $_{(0, 10, 20, 30)}$ %)

b) 1 % TiO_2 + 0 to 30 % of GGBS I.e. (T_1 % G $_{(0, 10, 20, 30)}$ %)

c) 1.5 % TiO_2 + 0 to 30 % of GGBS I.e. ($T_{1.5}$ % G $_{(0, 10, 20, 30)}$ %)

a) 2 % TiO_2 + 0 to 30 % of GGBS I.e. (T_2% G $_{(0, 10, 20, 30)}$ %)

CASTING OF SPECIMENS

Beam of size 500×100×100mm were casted for conducting flexural strength. Flexural strength of concrete which is also known as modulus of rupture was determined by casting a beam of size discussed above and then demoulded after 24 hours and kept for curing for 28 days and after 28 days beam was kept under normal atmosphere and then testing was done under universal testing machine. For flexural strength beam was placed under 3 point loading such that beam is supported from 20mm edge to the boundaries and third load was placed at the center of beam. The condition used to decide the flexural quality according to IS 516-1959.

Fig.-1: Flexural Test on UTM

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Fig.-2: Casting of Beam

5 EXPERMENTAL RESULTS

The flexural Strength of M25 grade of concrete mixes replacing OPC by TiO_2 and GGBS is investigated. The below given tables represents the flexural strength after 28 days of curing.

Flexural Strength of 0% of TiO_2 with different proportion of GGBS

S. No	SAMPLE %age	FLEXURAL STRENGTH MPa
1.	T_0G_0	5.84
2.	T_0G_{10}	7.12
3.	T_0G_{20}	6.12
4.	T_0G_{30}	5.84

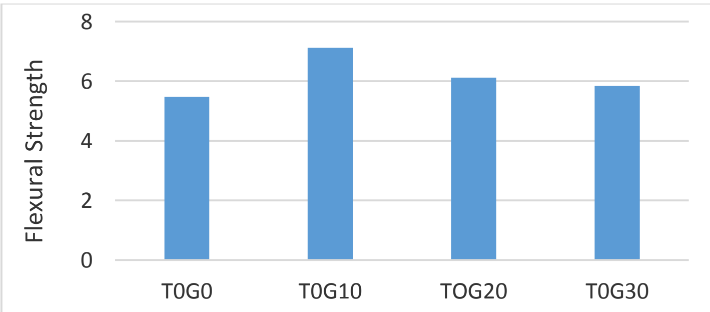

Fig.-3: Flexural test results of TiO_2 with different proportions of GGBS

Flexural Strength of 1% of TiO_2 with different proportion of GGBS

S.NO.	SAMPLE %age	FLEXURAL STRENGTH MPa
1.	T_0G_0	5.84
2.	T_1G_0	4.48
3.	T_1G_{10}	6.2
4.	T_1G_{20}	3.34
5.	T_1G_{30}	6.72

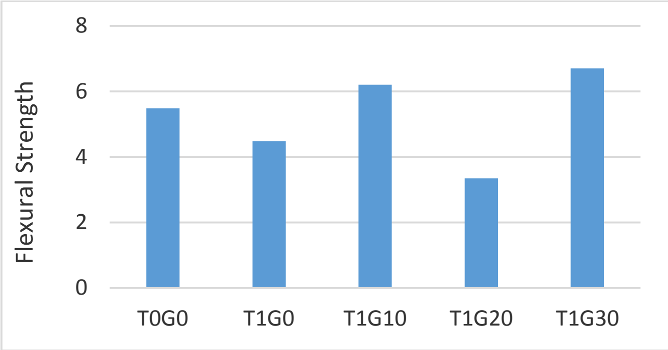

Fig.-4: Flexural test results of TiO_2 with different proportions of GGBS

Flexural Strength of 1.5% of TiO_2 with different proportion of GGBS

S.NO.	SAMPLE %age	FLEXURAL STRENGTH MPa
1.	T_0G_0	5.84
2.	$T_{1.5}G_0$	4.2
3.	$T_{1.5}G_{10}$	4.06
4.	$T_{1.5}G_{20}$	6.26
5.	$T_{1.5}G_{30}$	6.0

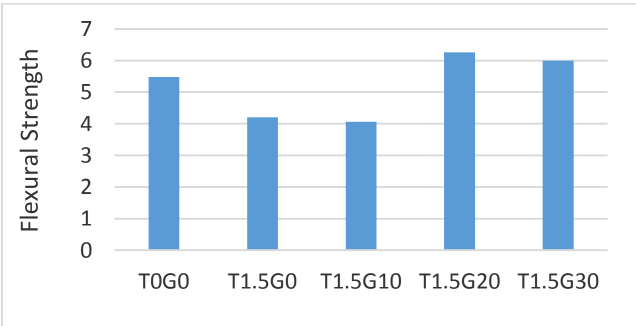

Fig.-5: Flexural test results of TiO_2 with different proportions of GGBS

Flexural Strength of 2% of TiO_2 with different proportion of GGBS

S.NO.	SAMPLE %age	FLEXURAL STRENGTH MPa
1.	T_0G_0	5.84
2.	T_2G_0	6.62
3.	T_2G_{10}	5.07
4.	T_2G_{20}	5.4
5.	T_2G_{30}	2.5

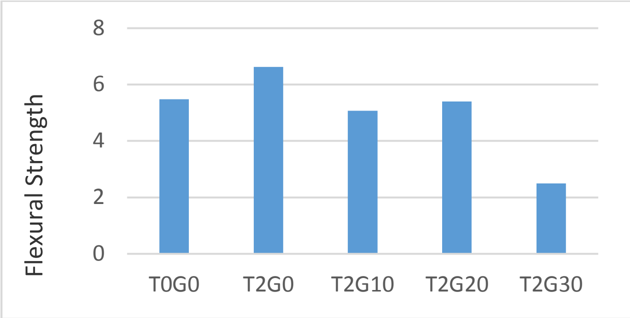

Fig.-6: Flexural test results of TiO_2 with different proportions of GGBS

Based upon the above experimental work following conclusions are drawn.

- From the results obtained during the flexural test on UTM it is observed that there is increase in flexural strength after replacing cement 1%, 1.5%and 2% with 10%, 20%, and 30% of GGBS.
- But the optimum percentage of increase in flexural strength is obtained at T_0G_{10}.
- Following optimum results are found with different combinations of TiO_2 and GGBS

S. No	Combination	Result (Mpa)
1	T_0G_{10}	7.12
2	T_1G_{30}	6.7
3	$T_{1.5}G_{20}$	6.26
4.	T_0G0	6.62

IV. CONCLUSION

Based upon the above experimental work following conclusions are drawn.

- From the results obtained during the flexural test on UTM it is observed that there is increase in flexural strength after replacing cement 1%, 1.5%and 2% with 10%, 20%, and 30% of GGBS.
- But the optimum percentage of increase in flexural strength is obtained at T_0G_{10}.
- Following optimum results are found with different combinations of TiO_2 and GGBS

S. No	Combination	Result (Mpa)
1	T_0G_{10}	7.12
2	T_1G_{30}	6.7
3	$T_{1.5}G_{20}$	6.26
4.	T_0G0	6.62

V. REFERENCE

[1] M. Kalaivani, G. Shyamala, S. Ramesh, K. Angusenthil, and R. Jagadeesan, "Performance evaluation of fly ash/slag based geopolymer concrete beams with addition of lime," 2020, doi: 10.1016/j.matpr.2020.01.596.

[2] P. R. Deepa and J. Anup, "Experimental Study on the Effect of Recycled Aggregate and GGBS on Flexural Behaviour of Reinforced Concrete Beam," Appl. Mech. Mater., 2016, doi: 10.4028/www.scientific.net/amm.857.101.

[3] C. K. Madheswaran and P. merlin Philip, "Experimental and Analytical Investigations on Flexural Behaviour of Retrofitted Reinforced Concrete Beams with Geopolymer Concrete Composites," Int. J. Mater. Mech. Eng., 2014, doi: 10.14355/ijmme.2014.0303.02.

[4] C. H. Rajesh, C. Rajamallu, and S. S. Asadi, "Experimental investigation of self compacting concrete (scc) with confinement by partial replacement of cement with ggbs, lime stone and fine aggregate with pond ash," Int. J. Civ. Eng. Technol., 2018.

[5] M. Kalaivani, G. Shyamala, S. Ramesh, K. Angusenthil, and R. Jagadeesan, "Performance evaluation of fly ash/slag based geopolymer concrete beams with addition of lime," 2020, doi: 10.1016/j.matpr.2020.01.596.

[6] P. R. Deepa and J. Anup, "Experimental Study on the Effect of Recycled Aggregate and GGBS on Flexural Behaviour of Reinforced Concrete Beam," Appl. Mech. Mater., 2016, doi: 10.4028/www.scientific.net/amm.857.101.

[7] C. K. Madheswaran and P. merlin Philip, "Experimental and Analytical Investigations on Flexural Behaviour of Retrofitted Reinforced Concrete Beams with Geopolymer Concrete Composites," Int. J. Mater. Mech. Eng., 2014, doi: 10.14355/ijmme.2014.0303.02.

[8] C. H. Rajesh, C. Rajamallu, and S. S. Asadi, "Experimental investigation of self compacting concrete (scc) with confinement by partial replacement of cement with ggbs, lime stone and fine aggregate with pond ash," Int. J. Civ. Eng. Technol., 2018.