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An Experimental Investigation on Properties of Concrete by Partial Replacement of Cement with Ggbs and Tio2

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Abstract: *Concrete is most suitable construction material. And it will adapt very well with the situations in the site. This concrete is considered as a homogeneous material but it is mixture of cement and fine aggregate and coarse aggregate and water. There are various methods in-order for concrete to gain strength, replacing the contents of concrete is also a way but partially is considered optimum. Now main binding agent in the concrete is the cement content so by partially replacing the cement by various cementitious materials like GGBS and tio2 will give optimum results in raised strength values of concrete. In this study a small trial is done to modify the properties of concrete by partial replacement of cement with GGBS of a percentage 10%, 20%, 30% and 40% and TIO_2 of percentages of 0.6%, 0.8%, 1.0% and 1.25%. Different tests are done to determine Compressive Strength and split tensile strength All the cubes are used for 7 & 28 days.*

Keywords: Ground Granulated Blast Furnace Slag, Titanium Dioxide, Compressive Strength, Split Tensile Strength.

I. INTRODUCTION

Concrete is the widely known constructional material in this world, it is used for the structural development of any kind. There are a variety of techniques to achieve various required conditions may be of a higher strength than the conventional, concrete will also support the methods like post & pre tensioning to achieve a higher strength at a time with the reduction of concrete. The concrete is a combination of material like cement, coarse aggregate, fine aggregate and water in which the cement is binding agent. When cement comes contact to water there will be an exothermic reaction takes place such that the contents of the concrete are being hardened. There are various types of concrete used for specific criteria of the environment and strength purposes and in order to produce cement there will a lot of co2 emitted around 120 million metric tons per year , so a partial replacements like GGBS(ground granulated blast furnace slag) and TIO2 (titanium dioxide) and they will aid in strength to concrete.

II. OBJECTIVES

1. To study the strength properties of ggbs as a partial replacement for cement in concrete.
2. To study the optimize of Titanium dioxide.

III. MATERIALS

3.1 Cement

Cement is a binding agent, a material used for construction for the purpose of holding the building materials together. Concrete consists of coarse aggregate as main content and fine aggregate is used to fill the voids between the coarse aggregates. Plain cement mixed with fine aggregate and water called as mortar, and coarse aggregate with mortar called as concrete.

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3.2 Aggregate

Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete.

3.3 Water

Water is one of the most important elements in construction and is required for the preparation of mortar, mixing of cement concrete and for curing work etc. The quality of water used has a direct impact on the strength of the motor and cement concrete in the construction work.

3.4 GGBS

GGBS (ground granulated blast furnace slag) is a white colored furnace slag produced from the iron ore refining furnaces. The main content of GGBS is oxides of calcium, silica, aluminum, and magnesium. Calcium oxide is typically of 40% in GGBS.

3.4 Titanium Dioxide (TIO2)

The titanium dioxide is a naturally occurring chemical which is of a composition of titanium and oxygen. It is an inorganic compound. This material gives great flexural strength and it also gives white color to the concrete.

IV. EXPERIMENTAL RESULTS

4.1 Compressive Strength

The cube specimens of 150mm x 150mm x150mmwere cast and tested in compression testing machine for 7 and 28days of curing period for different proportions of concrete mix and presented in table below.

S.No.	% of GGBS	Compressive Strength, N/mm^2		
		28Days	56Days	90Days
1	0%	49.82	54.08	57.81
2	10%	50.27	54.53	58.74
3	20%	50.80	55.35	59.16
4	30%	51.12	55.50	59.80
5	40%	53.93	58.60	62.86
6	50%	51.37	55.66	59.75

Table 1.1: Compressive strength of concrete with GGBS as partial replacement of cement in concrete

S.No.	% of Tio2	Compressive Strength, N/mm^2		
		28 Days	56Days	90 Days
1	0%	49.82	54.08	57.81
2	0.6%	56.67	61.46	65.87
3	0.8%	57.33	61.98	66.74
4	1%	59.10	63.96	68.78
5	1.2%	56.53	61.70	65.99

Table 1.2: Compressive strength of concrete with tio2 as partial replacement of cement in concrete

Sl. No	GGBS+Tio_2	Compressive Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0%	49.82	54.08	57.81
2	40%GGBS+1% Tio_2	61.15	66.64	70.99

Table 1.3: Compressive strength of Concrete with GGBS and TiO2

4.2 Split Tensile Strength Results

At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength.

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Table 1.4: Split tensile strength of concrete with GGBS as partial replacement of cement in concrete

S. No	% of GGBS	Split tensile strength, N/mm^2		
		28Days	56Days	90Days
1	0%	4.83	5.25	5.65
2	10 %	4.93	5.34	5.76
3	20%	5.05	5.48	5.89
4	30%	5.10	5.55	5.95
5	40%	5.50	5.97	6.44
6	50%	5.09	5.54	5.93

Table 1.5: Split tensile strength of concrete with tio2 as partial replacement of cement in concrete

Sl. No	TiO_2	Split tensile strength, N/mm^2		
		28 days	56 days	90 days
1	0%	4.83	5.25	5.65
2	0.6%	5.47	5.95	6.36
3	0.8%	5.60	6.09	6.51
4	1%	5.96	6.48	6.98
5	1.2%	5.59	6.06	6.53

Table 1.6: Split tensile strength of concrete with GGBS and to2 as partial replacement of cement in concrete

Sl. No	GGBS and Tio_2	Split tensile strength, N/mm^2		
		28 days	56 days	90 days
1	0%	4.83	5.25	5.65
2	10%	6.29	6.85	7.38

V. CONCLUSION

In this study, the concrete ingredients like cement are partially replaced by GGBS and TIO2 respectively. GGBS varied different percentages of 10%, 20%,30%,40%, 50%.and TIO2 is varied with different percentages like 0.6%, 0.8%, 1.0%, 1.2%

1. At 40% partial replacement of GGBS with cement the compressive strength of concrete at 7 and 28 days are 38.39 and 53.93 N/mm^2.
2. At 40% partial replacement of GGBS with cement the split tensile strength of concrete at 7 and 28 days are 3.87 and 5.50 N/mm^2.
3. At 1% partial replacement of titanium dioxide with cement the compressive strength of concrete at 7 and 28 days are 41.60 and 59.10 N/mm^2.
4. At 1% partial replacement of titanium dioxide with cement the split tensile strength of concrete at 7 and 28 days are4.06 and 5.96 N/mm^2.
5. By the combination of 40% GGBS +1% Tio_2 with cement the compressive strength of concrete at 7 and 28 days are 42.07 and 61.15 N/mm^2.
6. By the combination of 40% GGBS +1% Tio_2 with cement the split tensile strength of concrete at 7 and 28 days are 4.39 and 6.29 N/mm^2.

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