



INVESTIGATION ON CONCRETE BY USING TITANIUMDIOXIDE AND GGBS

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ABSTRACT

Concrete is the best material for construction. Additionally, it will efficiently adapt to the site's conditions. This concrete is regarded as a homogeneous substance even though it is made up of a mixture of cement, fine aggregate, coarse aggregate, and water. In this study, a brief experiment is carried out to modify the properties of concrete by partially substituting the cement with GGBS at percentages of 10%, 20%, 30%, and 40% and TIO₂ at percentages of 0.6%, 0.8%, 1.0%, and 1.250%. Several tests are used to determine the compressive strength and split tensile strength. Every cube is tested for M30 Grade concrete for 28,56 and 90 days.

Keywords: Ground granulated blast furnace slag, Titanium dioxide, compressive strength, split tensile strength.

1. INTRODUCTION

The most popular building material in use today is concrete, which is used for all kinds of structural development. With less concrete, techniques like post and pre tensioning can be used to provide better strength over time. There are numerous ways to fulfil certain requirements, some of which may have stronger effects than usual. Concrete, a combination of water, coarse aggregate, and fine aggregate, uses cement as a binding agent. The components of concrete harden as a result of an exothermic process that takes place when cement and water are combined. For various environmental and strength needs, various types of concrete are employed. Partial substitutes like GGBS and TIO₂ can help reduce CO₂ emissions while still boosting the strength of concrete because the production of cement generates a lot of CO₂—around 120 million metric tonnes per year.

2. OBJECTIVES

1. Aiming the strength properties of GGBS as a partial replacement for cement in concrete.
2. Aiming of Titanium dioxide.

3. MATERIALS

3.1 Cement:

Cement is a substance used in construction as a binding agent to hold the other building materials together. The primary ingredient in concrete is coarse aggregate, whereas fine aggregate is used to fill up any gaps that the coarse aggregates leave behind. Contrary to concrete, which is only cement combined with coarse aggregate, mortar is nothing more than plain cement mixed with fine aggregate and water.

3.2 GGBS:

A byproduct of the furnaces used to process iron ore is the white furnace slag known as GGBS (ground granulated blast furnace slag). The majority of GGBS is composed of calcium, silica, aluminum, magnesium, and aluminum oxides. Calcium oxide typically accounts for 40% of GGBS.

3.3 Titanium dioxide (TIO₂):

Titanium dioxide is a naturally occurring substance composed of titanium and oxygen. It is an inorganic material. This material provides concrete a white colour and high flexural strength.

4. EXPERIMENTAL RESULTS

4.1 COMPRESSIVE STRENGTH

The 150mm x 150mm x 150mm cube specimens were cast, tested in a compression testing machine for 28,56 and 90 days of curing time, and the results are shown in the table below for various quantities of concrete.

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

Sl. no	GGBS	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	39.25	42.76	45.91
2	10%	39.60	43.15	46.28
3	20%	39.97	43.55	46.74
4	30%	40.05	43.61	46.83
5	40%	42.03	45.79	49.17
6	50%	38.11	41.52	44.52

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

Sl.no	TIO ₂	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	39.25	42.76	45.91
2	0.6%	44.17	48.13	51.62
3	0.8%	45.07	49.11	52.67
4	1%	46.17	50.31	53.93
5	1.2%	44.14	48.09	51.57

Table1.3: Compressive strength of Concrete with GGBS and Tio₂

Sl.no	GGBS +TIO ₂	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	39.25	42.76	45.91
2	40%GGBS+1%TIO ₂	47.74	52.01	55.84

4.2 Split tensile strength results

The cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength for 28,56 and 90 days.

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

Sl.no	GGBS	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	3.85	4.19	4.51
2	10%	3.89	4.23	4.54
3	20%	3.99	4.38	4.67
4	30%	4.04	4.42	4.73
5	40%	4.58	5.01	5.35
6	50%	3.80	4.14	4.49

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

Sl. no	TiO ₂	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	3.85	4.19	4.51
2	0.6%	4.26	4.64	4.98
3	0.8%	4.40	4.79	5.14
4	1%	4.66	5.07	5.47
5	1.2%	4.36	4.75	5.09

Table 1.6: Split tensile strength of concrete with GGBS and tio2 as partial replacement of cement in concrete

Sl.no	GGBS +TiO ₂	28 days (N/mm ²)	56 days (N/mm ²)	90 days (N/mm ²)
1	0%	3.85	4.19	4.51
2	40%GGBS+1%TiO ₂	5.02	5.48	5.86

5. 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. The normal concrete Compressive strength result for 28, 56 and 90 days is 39.25 N/mm², 42.76 N/mm² and 45.91 N/mm².
2. The normal concrete Split tensile strength result for 28, 56 and 90 days is 3.85 N/mm², 4.19 N/mm² and 4.51 N/mm².
3. At 40% partial replacement of GGBS with cement the compressive strength of concrete at 28, 56 and 90 days are 42.03 N/mm², 45.79 N/mm² and 49.17 N/mm².
4. At 40% partial replacement of GGBS with cement the split tensile strength of concrete at 28, 56 and 90 days are 4.58 N/mm², 5.01 N/mm² and 5.35 N/mm².
5. At 1% partial replacement of titanium dioxide with cement the compressive strength of concrete at 28, 56 and 90 days are 46.17 N/mm², 50.31 N/mm² and 53.93 N/mm².
6. At 1% partial replacement of titanium dioxide with cement the split tensile strength of concrete at 28, 56 and 90 days are 4.66 N/mm², 5.07 N/mm² and 5.47 N/mm².
7. By the combination of 40% GGBS + 1% TiO₂ with cement the compressive strength of concrete at 28, 56 and 90 days are 47.74 N/mm², 52.01 N/mm² and 55.84 N/mm².

8. By the combination of 40% GGBS +1% TiO₂ with cement the split tensile strength of concrete at 28,56 and 90 days are 5.02 N/mm², 5.48 N/mm² and 5.86N/mm².

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