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Investigation on Concrete by Partial Replacement of Fine Aggregate with Groundnut Shell Ash and cement With Titanium Dioxide

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ABSTRACT

The main aim of this project is to make concrete stronger by substituting some of the cement with titanium dioxide. For high-performance constructions, cement concrete has significant practical challenges in achieving high compressive strength and durability. However, keeping the fundamentally desirable characteristics of concrete and boosting the compressive strength and durability of some cement-based composites are both becoming more difficult. These problems are addressed by this project's addition of titanium dioxide. Titanium dioxide was substituted for cement in experimental investigations in amounts of 0 %, 0.5 %, 1 %, 1.5%, 2 %, and 2.5 % based on cement weight. In this experimental investigation, the viability of using peanut husk ash in place of fine aggregate was assessed. Instead of 0 %, 2.5 %, 5 %, 7.5 %, or 12.5% fine aggregate, six different concrete compositions were used.

Keywords: Titanium dioxide, Groundnut shell ash, compressive strength, split tensile strength.

INTRODUCTION

Concrete is a composite material made of cement paste, fine and coarse aggregate, and water that dries over time. The majority of the concrete that is utilised is either lime-based or made of another hydraulic cement. Road surfaces frequently employ asphalt concrete, a kind of concrete. Asphalt concrete uses bitumen as the cement ingredient, while polymer concrete can be used if the polymer is a cement material. Titanium dioxide is a kind of titanium oxide that occurs naturally. TiO2 is its chemical name. Natural forms of the well-known mineral titanium dioxide include rutile, anatase, and brookite. Ilmenite ore is the principal source of titanium dioxide extraction. This is the type of titanium dioxide ore that is found most frequently worldwide. By filling up tiny gaps, titanium dioxide significantly increases the permeability and strength of concrete.

OBJECTIVES

The objectives of this study are as follows

1) To use cement containing titanium dioxide as efficiently as possible.
2) To use ground nut shell ash and fine aggregate as efficiently as possible.
3) To assess the concrete's compressive and split tensile strength.

MATERIALS

The properties of cement are presented in Table 1.

Table-1: Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.139
2	Fineness	9.39%

3.1 GROUNDNUT SHELL ASH

It is a nutrient-rich leguminous crop that is primarily used for the production of seeds and oils across the world. The by-product of removing the groundnut seed from its pod is groundnut shells. This is a plentiful agricultural waste product that degrades slowly under natural circumstances. 2013; Zheng et al. Contrarily, groundnut shells have a wide range of beneficial bio-active and functional elements for people. In the business world, it is used as a food, fertilizer filler, and even as a biofilter carrier. The majority of these abandoned groundnut shells, however, are either burned or buried, which pollutes the environment. Therefore, in order to attain zero waste generation and to transform this otherwise useless product into valuable materials, new technologies must be developed.

3.2 TITANIUM DIOXIDE

When utilised in concrete, titanium dioxide, a white-colored naturally occurring mineral, acts as a cleaning agent and absorbs hazardous pollution. Porcelain enamels have been given brightness, hardness, and acid resistance thanks to the employment of titanium dioxide as a bleaching and opacifying agent. Thin coatings with titanium dioxide photocatalytic activity have the ability to self-clean and be sterile when exposed to UV light. Titanium dioxide has special qualities that make it useful and well-known in nanoscience and nanotechnology.

EXPERIMENTAL INVESTIGATIONS

4.1 Compressive strength results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2 to 4.

Table 2: Compressive strength of concrete with Groundnut shell ash as partial replacement of cement in concrete

Sl. No	GSA	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	34.23	49.01
2	2.5%	35.21	50.32
3	5%	35.64	50.99
4	7.5%	35.89	51.50
5	10%	36.87	53.44
6	12.5%	36.71	52.55

Table 3: Compressive strength of concrete with Tio_2 as partial replacement of cement in concrete:

SL. NO	Tio_2	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	34.23	49.01
2	0.5%	39.18	57.45
4	1%	41.88	59.83
5	1.5%	37.09	55.45

Table 4: Compressive strength of Concrete with Ground nut shell ash and Tio2

Sl. No	Tio_2+GSA	7 days (N/mm^2)	28 days N/mm^2)
1	0%	34.23	49.01
2	10%+1%	42.50	61.78

4.2 Split Tensile strength results

The cylindrical specimens (150mm diameter x 300mm height) were examined for assessing the split tensile strength at ages 7 and 28 days. A cylindrical sample is placed horizontally between a compression testing machine loading surface, and a load is applied until the cylinder fails along the vertical diameter.

Table 5: Split tensile strength of concrete with GSA as partial replacement of fine aggregate in concrete

Sl. No	GSA	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	3.83	4.84
2	2.5%	3.92	4.98
3	5%	4.14	5.25
4	7.5%	4.19	5.32
5	10%	4.24	5.38
6	12.5%	3.53	5.20

Table 6: split tensile strength of concrete with tio_2 as partial replacement of cement in concrete: -

Sl. No	Tio_2	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	3.83	4.84
2	0.5%	3.89	5.68
4	1%	4.04	5.80
5	1.5%	3.61	5.42

Table 7: Split tensile strength of Concrete with Ground nut shell ashandTio2

Sl. No	Tio_2 + GSA	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	2.67	3.83
2	10%+1%	3.37	4.81

CONCLUSION

In this study, the concrete ingredients like cement are partially replaced by Gsa and TIO2 respectively. Gsa varied different percentages of 2.5%, 5%, 7.5%,10%, 12.5%.andTIO2isvariedwith differentpercentageslike0%,0.5%,1.0%,1.5%.

- At 10% partial replacement of GSA with cement the compressive strength of concrete at 7 and 28 days are 36.87 and 53.44N/mm^2.
- At 10% partial replacement of GSA with cement the split tensile strength of concrete at 7 and 28 days are4.24 and 5.38 N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the compressive strength of concrete at 7 and 28 days are 41.88 and 59.83N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the split tensile strength of concrete at 7 and 28 days are4.04 and 5.80 N/mm^2.
- By the combination of 10% GSA +1% Tio_2 with cement the compressive strength of concrete at 7 and 28 days are 42.50 and61.78 N/mm^2.
- By the combination of 10% GSA +1% Tio_2 with cement the split tensile strength of concrete at 7 and 28 days are 3.37 and 4.81 N/mm^2.

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