STRENGTH STUDIES ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH TITANIUM DIOXIDE AND FINE AGGREGATE WITH GROUNDNUT SHELL ASH

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***Abstract*: This study is primarily aimed to increasing the compressive strength of concrete by partially replacing cement with titanium dioxide. Cement concrete has major practical difficulties in achieving high compressive strength and durability of high-performance structures. However, increasing the compressive strength and durability of certain cement-based composites and maintaining the basic desirable properties of concrete are also becoming a challenge. This project addresses these issues by the adding titanium dioxide. Experimental studies were carried out by replacing cement with titanium dioxide in the proportions of 0%, 0.5%, 1%,1.5, 2% and 2.5% based on cement weight. This experimental study evaluated the feasibility of peanut husk ash as an alternative to fine aggregate. Six different concrete mixtures containing crushed ash instead of 0%, 2.5%, 5%, 7.5%, 12.5% fine aggregate for M20 concrete with a water to binder ratio of 0.50 Manufactured in. The properties of these concrete mixtures were analyzed in both fresh and hardened concrete conditions. The mixing design used in this study was M20 and the mixing ratio of M20 concrete was achieved using IS 10262:2009 and IS 456:2000. Cube samples were caste, cured and tested after 7 days and 28 days to determine the compressive strength of the cube samples.**

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

I. INTRODUCTION

Concrete is a composite material consisting of fine and coarse aggregate combined with cement paste that hardens over time. Most of the concert used is lime-based concrete or concrete made of other hydraulic cement. Asphalt concrete is concrete commonly used for road surfaces. In asphalt concrete, the cement material is bitumen, and if the polymer is a cement material, polymer concrete may be used. Titanium dioxide is a naturally occurring titanium oxide. Its chemical formula is TiO2. Titanium dioxide naturally occurs as the well-known mineral's rutile, anatase and brookite. Titanium dioxide is mainly extracted from ilmenite ore. This is the most common form of titanium dioxide-containing ore in the world. Titanium dioxide radically improves the strength and permeability of concrete by filling small voids and pores in the microstructure. The peanut industry produces waste such as peanut shell ash. It is usually dumped outdoors without the economic benefits of impacting the environment. The purpose is to prepare for the efficient use locally available materials. In this study, the compressive strength, split tensile strength, water absorption rate and partial substitution of fine particles by crushed nut shell ash was experimentally examined and the suitability of crushed nut shell ash as a building material was examined.

II. OBJECTIVES

The objectives of this study are as follows

I. To optimize the usage of cement with titanium dioxide.
II. To optimize the usage of fine aggregate with ground nut shell ash .
III. To evaluate the compressive and spilt tensile strength of concrete.

III. 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	3.14
2	Fineness	9.45%

3.1 GROUNDNUT SHELL ASH: -

It is a nutrient-dense leguminous crop that is mostly produced for seed and oil production around the world. Groundnut shells are the by-product of the extraction of the groundnut seed from its pod. This is an abundant agro-industrial waste product that degrades very slowly in natural conditions Zheng et al., 2013. Groundnut shells, on the other hand, contain a variety of bioactive and functional components that are helpful to humans. Commercially, it is utilized as a feedstock, food, fertilizer filler, and even as a carrier for bio-filters. However, most of the abandoned groundnut shells are burned or buried, polluting the environment. As a result, new technologies must be created in order to achieve zero waste production and to redirect this otherwise waste product into useful applications such as food, feed, paper, and bioenergy.

3.2 TITANIUM DIOXIDE

Titanium dioxide is of a white colored naturally occurring mineral and when used in concrete act as a cleaning agent which absorbs harmful smog. Titanium dioxide has been used as a bleaching and opacifying agent in porcelain enamels, giving them brightness, hardness, and acid resistance.The photocatalytic activity of titanium dioxide results in thin coatings exhibiting self-cleaning and disinfecting properties under exposure to ultraviolet radiation. Because of its unique properties, titanium dioxide is widely used and is well known in nano science and nanotechnology

IV. 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.

Table2: Compressive strength of concrete with Groundnut shell ash as partial replacement of cement in concrete.

Sl.no	Ground nut shell ash	7 days N/mm^2	28days N/mm^2
1	0%	18.93	27.12
2	2.5%	19.21	27.49
3	5.0%	19.39	27.89
4	7.5%	19.43	27.96
5	10%	20.22	28.59
6	12.5%	19.33	28.44

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	28days N/mm^2
1	0%	18.93	27.12
2	0.5%	20.91	30.94
3	1.0%	22.84	32.45
4	1.5%	20.04	30.14

Table 4: Compressive strength of Concrete with Ground nut shell ashandTio2

Sl.no	Ground shell ash +Tio_2	7 days N/mm^2	28days N/mm^2
1	0%	18.93	27.12
2	10%Gsa+1%Tio_2	22.83	33.19

4.2Split 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. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machine loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table5: Split tensile strength of concrete with Gsa as partial replacement of fine aggregate in concrete

Sl.no	Ground nut shell ash	7 days N/mm^2	28days(N/mm^2)
1	0%	1.88	4.83
2	2.5%	1.89	4.93
3	5.0%	1.90	5.05
4	7.5%	1.91	5.10
5	10%	2.15	5.50
6	12.5%	1.92	5.09

Table6: split tensile strength of concrete with tio_2 as partial replacement of cement in concrete

Sl.no	Tio2	7days N/mm^2	28days N/mm^2
1	0%	1.88	2.70
2	0.5%	2.06	3.05
3	1%	2.25	3.21
4	1.5%	1.93	2.91

Table7: Split tensile strength of Concrete with Ground nut shell ash and Tio2

Sl.no	Ground shell ash +Tio_2	7 days N/mm^2	28days N/mm^2
1	0%	1.88	2.70
2	10%Gsa+1%Tio_2	2.35	3.38

V. 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%.and TIO2 is varied with different percentages like0%,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 20.22 and 28.59 N/mm^2.
- At 10% partial replacement of Gsa with cement the split tensile strength of concrete at 7 and 28 days are 2.15 and 3.05 N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the compressive strength of concrete at 7 and 28 days are 22.84 and 32.45 N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the split tensile strength of concrete at 7 and 28 days are2.25 and 3.21 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 22.83 and 33.19 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 2.35 and 3.38 N/mm^2.

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