

EXPERIMENTAL STUDY ON PHOTOCATALYTIC CONCRETE

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Abstract— This project titled “EXPERIMENTAL STUDY ON PHOTOCATALYTIC CONCRETE ” the recent discovery of the photo catalytic pollution reduction capabilities of titanium dioxide (TiO₂),It is fabricated by adding photocatalyst into convention concrete, and the most appropriate photocatalyst to fabricate photocatalytic is TiO₂ are eco-friendly and contribute towards the required target strength of the concrete.. Replacement of cement as TiO₂ acts as pigment and binder it is partially replaced in the ratio of 5% 10% and 15% by weight of the cement. The final element of this study focused on identifying practical and cost-effective methods of adding TiO₂ . The properties of fresh concrete are tests are slump cone test and for hardened concrete is compressive strength test at 28 days of age. This study investigated both practical application techniques and the effects of the climatic environment around the specimens. When concrete specimens were exposed to the weather for 10-days, the specimen’s photocatalytic efficiency decreased significantly.

Keywords — Photocatalytic, environmental friendly, TiO₂

I. INTRODUCTION

Concrete is quite strong mechanically , it suffer from several drawbacks, such as low tensile strength, permeability to liquid and consequent corrosion of steel reinforcement , susceptibility to chemical attack and low durability.

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Since concrete is a heterogeneous materials, its properties vary widely from point to point due to the random presence of high strength aggregates, medium strength mortar and weak aggregates mortar interfaces even after proper mixing procedure is adopted. Further, voids are also present again at random places which act as stress raisers. Thus the current study investigates on the use of Nano technology to improve the mechanical and durability properties of concrete is carried out. Photocatalytic concrete has the capability to realize air depollution, self-cleaning, and self-disinfecting. It is fabricated by adding photocatalyst into conventional concrete is TiO₂ .The photocatalytic reaction can occur under the light when energy is higher than the photocatalyst band gap. The formed highly oxidizing hydroxyl radicals can react which contaminants and produce carbon dioxide, water or other harmless substance. The decomposed pollutants can be taken away by wind or rain to achieve the function of air depollutants can be taken away by wind or rain to achieve the function of air depollution and self-cleaning.

II. OBJECTIVE

1. To study the fresh concrete property in conventional concrete and photocatalytic concrete.
2. To study the strength characteristics of photocatalytic hardened concrete by compressive strength and photofilm test.
3. To study the durability characteristics of photocatalytic in hardened concrete
4. To satisfy general aspects of people in concrete (i.e) quality, control, reliability, efficiency.

III. EXPERIMENTAL STUDY

1) Cement

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used as a component in the production of mortar in masonry, and of concrete, which is a combination of cement and an aggregate to form a strong building material.

TABLE 1 CEMENT PROPERTIES

Sl. No	Particulars	Result
1	Specific Gravity	3.05
2	Normal Consistency	31 %
3	Fineness Of Cement	1.2 %
4	Initial Setting Time	35 minutes
5	Final Setting Time	10 hours

2) Fine Aggregate

Generally river sand is used as a fine aggregate. Due to increase in the utilization of concrete in construction sector, the need for river sand has been increased enormously. Limitations have been laid on the large scale mining of river sand from river beds. The fine aggregate used in this study was clean river sand purchased from traders at Chennai.

3) Coarse aggregate

Aggregates are the components of composite materials such as concrete and asphalt concrete. The aggregate serves as reinforcement to add strength to the overall composite material. Mining of mineral aggregate deposits, including sand, gravel and stone us of waste slag from the manufacture of iron and steel, and recycling of concrete. They form the major portion of the concrete and impact great strength to the matrix. The coarse aggregate used in this study is 20mm aggregates and gradation conforms to IS 383.

TABLE 2 PROPERTIES OF AGGREGATE

Properties	River sand	Coarse Aggregate
Fineness modulus	2.1	4.76
Specific gravity	2.86	2.8
Bulk density	33%	-
% of voids	37.4	-
Density	-	-
Young's modulus	-	-
Thermal Properties	-	-
Organic impurities	Nil	Nil

4) Titanium dioxide

Titanium dioxide, also known as titanium(IV) oxide or titania, is the naturally occurring oxide of titanium formula TiO_2 When used as a pigment, it is called titanium white, Pigment White 6 (PW6), or CI 77891. Generally it is sourced from ilmenite, rutile and anatase. It has a wide range of applications, from paint to sunscreen to food colouring.

TABLE 3: PROPERTIES OF TITANIUM DI-OXIDE

Properties	
Chemical formula	TiO_2
Molar mass	79.866 g/mol
Appearance	White solid
Odour	Odourless
Density	4.23 g/cm ³ (Rutile) 3.78 g/cm ³ (Anatase)
Melting point	1,843 °C (3,349 °F; 2,116 K)
Boiling point	2,972 °C (5,382 °F; 3,245 K)
Solubility in water	Insoluble
Flash-point	Non-Flammable
Description	White Powder
Oil absorption(ml)	22max

5) Mix Design

TABLE 4: MIX PROPORTION

WATER	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
186Kg	372Kg/m ³	554kg/m ³	1203kg/m ³
0.50	1	1.49	3.2

IV. RESULT AND DISSCUSSION

1) Compressive strength test

Compressive strength test was conducted for 3, 7 and 28 days.

TABLE 5: COMPRESSIVE STRENGTH TEST

S.no	Sample	3 th day [N/mm ²]	7 th day [N/mm ²]	28 th day [N/mm ²]
1.	Convention Concrete	8.12	14.82	20.32
2.	TiO ₂ 5% (replacement)	7.13	12.98	19.78
3.	TiO ₂ 10% (replacement)	7.45	13.59	19.93
4.	TiO ₂ 15% (replacement)	7.09	12.73	19.12

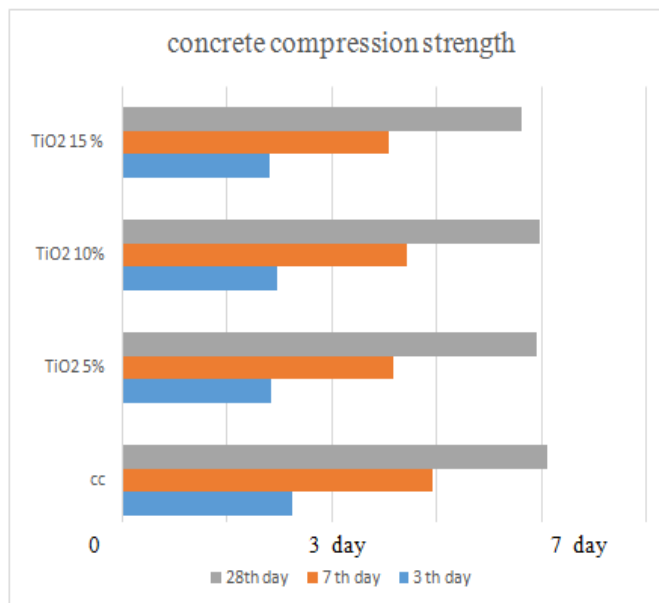


Figure 1: Compressive Strength graph

2) Photo catalytic test result

TABLE 6 : METHYLENE BLUE REACTION TEST

S.no	Sample	3 th day [sec]	7 th day [sec]	28 th day [sec]
1.	Convention Concrete	Nil	Scatred Not dis coloration	Mild discoloration
2.	TiO ₂ 5% (replacement)	30	26	15.7
3.	TiO ₂ 10% (replacement)	19.3	12.1	8
4.	TiO ₂ 15% (replacement)	11.5	8	5

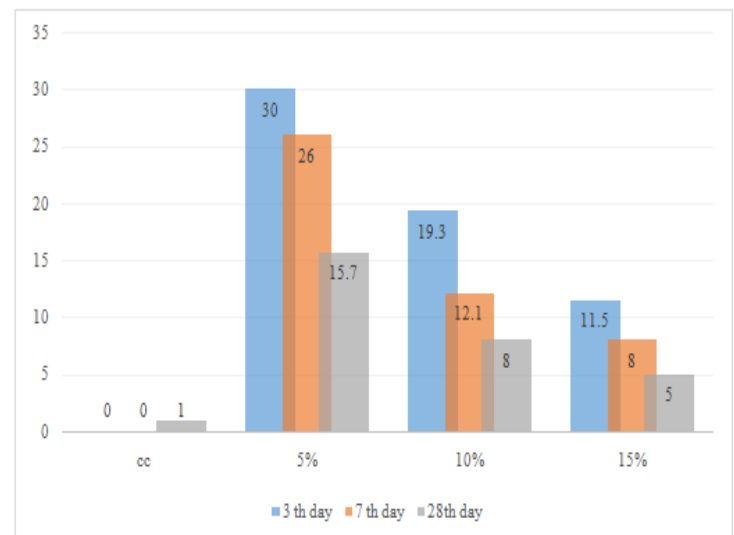


Figure 2 Methylene Blue reaction test

V. CONCLUSION

- From the experimental study we conclude that when TiO₂ is added to the ordinary concrete there will be increase in its compressive.
- The higher the quantity of TiO₂ particles per unit area, the higher the photocatalytic efficiency.
- The fineness of the TiO₂ particles makes the concrete mixture stickier, which may require changes to the mixture design to maintain workability.
- UV irradiance is a dominating variable, with higher UV irradiances leading to higher photocatalytic efficiencies.

- The rate of chemical reaction, rate of diffusion, and the area of the sample all play a role in the kinetics leading to the apparent photocatalytic efficiency of a specimen.
- Apparent photocatalytic efficiency increases when the NO_x pollutant concentration decreased and when the flow rate decreases.
- Our experimental result, increased strength when TiO₂ added to concrete is upto certain limit.
- At the same time when is TiO₂ added beyond optimum level, the concrete strength will be decreased.

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