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# Experimental Investigation of Eco-Friendly Paver Block using Titanium Dioxide

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**ABSTRACT:** Today is the era of industrialization, globalization and modernization. Due to this the nature in 21st century is turning towards devastation. The green cover of earth is reducing hence the problems like global warming arising. This project provides base for future eco-friendly environment in urban area. In upcoming years due to rapid growth of industries as well as vehicular pollution that can harm environment. So this can be minimized or controlled by this pavement block made with TiO<sub>2</sub> up to some extent.

**KEYWORDS:** Air pollution, Titanium dioxide, photocatalysis, NCM(normal concrete mix).

## I. INTRODUCTION

Today is the era of industrialization, globalization and modernization. Due to this the nature in 21st century is turning towards devastation. The green cover of earth is reducing hence the problems like global warming arising. But it is not a harmful yet. However in upcoming years this problems may arise more, hence proper steps need to be taken today. Some ecological and social problems in any metropolitan cities are as follows:

1. Increasing population.
2. Traffic and industrial pollution.
3. Storm water and drainage problems.
4. Road accident and health condition.
5. Living standard.

This are just the highlighted problems which are creating negative impact on urban cities. This problems are arising due to vehicular pollution and ineffective storm water disposal. For that reason the road system is partially responsible for pollution because the road surface does not contribute to control the pollution. That's why the exhaust system of vehicle directly emits the pollution into the atmosphere. To reduce such a problems, applying photo catalytic coating to the pavement on a large scale to reduce air pollution in urban areas. The photo catalyst, titanium dioxide (TiO<sub>2</sub>), is a naturally occurring compound that can decompose gaseous pollutants with the presence of sunlight. Use of TiO<sub>2</sub> in pavement blocks can helps to remove emission pollutants right next to the source, near the vehicles that drive on the pavement itself. When TiO<sub>2</sub> is applied to pavement, this provides sustainable benefit that the air will be purified.

## II. TITANIUM DIOXIDE (TiO<sub>2</sub>)

Titanium is the world's fourth most abundant metal, ninth most abundant element, and was first discovered in England by Reverend William Gregor in 1791. TiO<sub>2</sub> is a naturally occurring oxide in titanium metal and can have three different crystal structures: anatase, rutile and brookite. The crystal structures can be identified by their octahedral chain configurations. Based on octahedral design and thermodynamic calculations rutile is found to be the most stable phase at all temperatures. TiO<sub>2</sub> has been used as a white pigment since ancient times because of its white color and availability. It first became a common industrial product in the 20th century replacing toxic lead oxides as pigments for white paint. Now the world's production of TiO<sub>2</sub> exceeds 4 million tons per year, and approximately 98% is used to make white pigments. It is used as a white pigment in paints, plastics, paper, toothpaste, sunscreen, and many other products. The primary reason it is used in products like sunscreen is because TiO<sub>2</sub> can absorb UV light without being consumed in the reaction. Also, because of the high refractive index of TiO<sub>2</sub> it is being used as anti-reflection coatings in silicon solar cells, roofing materials, and many other commercial products. TiO<sub>2</sub> in these applications has proven to increase light reflectance, reduce heat buildup, and help mitigate the urban heat island effect. Since the 1980's there has been a lot of interest in the photocatalytic properties of TiO<sub>2</sub>. It has been shown that titanium dioxide (TiO<sub>2</sub>) has photo



catalytic properties, and that it can effectively be used to reduce VOCs and NOx .In this photo catalyst process TiO2 traps and absorbs pollutant molecules from the air and converts them to harmless inorganic anions in the presence of UV sunlight.

### III. METHODOLOGY

#### 3.1 Cement

- Test on cement: 1. Field test  
2. Laboratory test- Fineness test

#### 3.2 Aggregate

- Fine aggregate -Test on fine Aggregate Specific gravity test (IS 2386 Part-III 1963)  
Coarse Aggregate- Test on coarse Aggregate-Sieve Analysis (IS2386 Part I-1963  
Impact value Test (IS 2386 Part IV-1963)

#### 3.3 Titanium dioxide (TiO2)

- 3.4 Concrete mix design of M20 grade of concrete (IS 10260-2009)  
MIX PROPORTION IS 1: 1.82: 2.36

WATER (lit)	CEMENT (kg)	FA (kg)	CA (kg)
0.50	1.00	1.82	2.36
220.48	416	757.52	982.83

Table 1: Mix proportion

#### 3.5 Properties of fresh concrete-Slump Cone Test (IS 1199-1959)

#### 3.6 Properties of harden concrete- Compressive strength (IS 516-1959)

#### 3.7 Pollution under control test (PUC)

### IV. EXPERIMENTAL RESULTS

#### 4.1 Field test on cement-

The color of cement is uniform. When hand is inserted into a cement bag, it feels cool. It indicates that no chemical reaction has started. It is free from lumps.

#### 4.2 Laboratory test on cement-

Fineness test-

%weight of residue =

Weight of sample retained on sieve/ Total weight of sample %weight of residue = 6.95%

#### 4.3 Test on fine aggregate-

Specific gravity of sand = 2.61

#### 4.4 Test on coarse aggregate

1.	Dry bulk density kg/lit	1.52
2.	Specific gravity	2.87

Table 2: Test on coarse aggregate

#### 4.5 Slump cone test-

Sr.no	Name of sample	Slump value obtained
1.	NCM	98
2.	NCM+ 0.5% TiO2	97
3.	NCM+ 1.0% TiO2	95

Table 3: Slump cone test



4.6 Compression test-

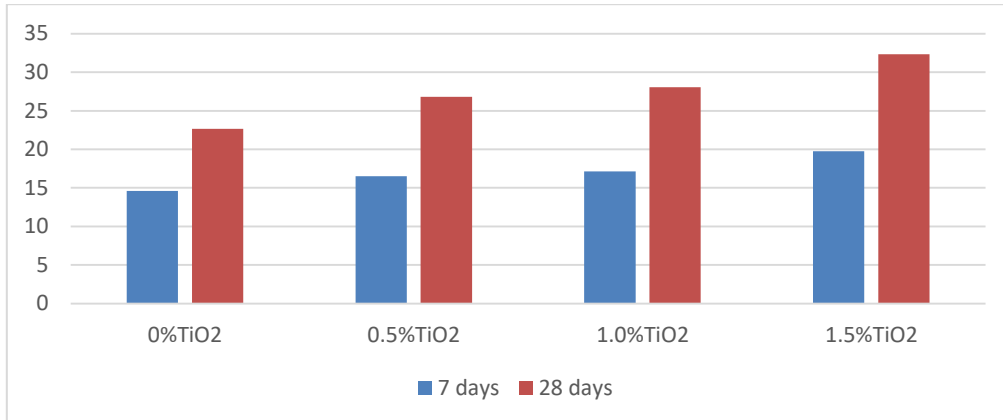


Figure 1: Compression test graph

4.7 PUC Test-

Sr. No.	Concrete blocks	Type of pollutant	PUC before test	PUC after test
1.	NCM	CO% vol.	1.9	1.5
		HC ppm	280	90
2.	NCM+0.5% TiO2	CO% vol.	1.68	0.84
		HC ppm	270	65
3.	NCM+1.0% TiO2	CO% vol.	1.7	1.1
		HC ppm	240	90
4.	NCM+1.5% TiO2	CO% vol.	1.75	1.3
		HC ppm	270	80

Table 4: 7 PUC Test

V. CONCLUSION

The test conclude that the concrete cube specimen of M20 grade of concrete with 1.5% TiO2 provides higher Compressive strength.Hence, using small percentage of titanium dioxide in concrete gives valuable results.The concrete blocks are prepared with different percentages of titanium dioxide such as 0%, 0.5%, 1.0% and 1.5% and each block is used for testing pollution under control test. This test conclude that there is significant amount of CO and HC removal.This project provides base for future eco-friendly environment in urban area. In upcoming years due to rapid growth of industries as well as vehicular pollution that can harm environment. So this can be minimized or controlled by this pavement block made with TiO2 up to some extent.

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