

Future Air Purification by Using TiO₂

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Abstract –

Our project aims to develop an 'Air Pollution Absorbing Material' by integrating titanium dioxide with conventional components. Titanium dioxide, commonly found in toothpastes and cosmetic products, acts as a self-cleaning agent. This property allows the material to break down algae and dirt, ensuring a cleaner surface over time. The core of the material is a mixture of traditional cement and titanium dioxide, forming a unique composition that permits airflow while trapping nitrogen oxide particles—a key contributor to smog. When exposed to UV light, titanium dioxide acts as a catalyst, triggering a chemical reaction that neutralizes pollutants. The resulting smog residue is easily removed by light rain, maintaining the material's effectiveness and appearance. This innovative and environmentally friendly solution leverages titanium dioxide's properties to combat air pollution safely and contribute to public health.

Key Words: Air Pollution, Titanium Dioxide (TiO₂), Photocatalysis, Self-Cleaning Material, Pollution Control, Smoke Reduction.

1. INTRODUCTION

Air pollution is one of the biggest problems in modern cities. According to the World Health Organization, a large percentage of urban populations breathe polluted air, and millions of people die every year due to diseases linked to air pollution. Rapid urban growth, vehicles, industries, and construction activities have increased the level of harmful gases in the atmosphere. Cement production, which is essential for making concrete, releases a high amount of carbon dioxide, contributing to climate change. Pollutants such as particulate matter (PM_{2.5}), nitrogen oxides (NO_x), and sulphur dioxide (SO₂) can cause respiratory problems, heart diseases, weak immunity, and other serious health issues.

To address this problem, researchers have developed smog-absorbing concrete mixed with titanium dioxide (TiO₂). TiO₂ is a photocatalyst that becomes active in the presence of sunlight. When ultraviolet light falls on the

surface, it triggers a chemical reaction that breaks down harmful gases into less harmful compounds. This innovative material can be used in pavements, building facades, and roads to help reduce air pollution and improve air quality in urban areas.

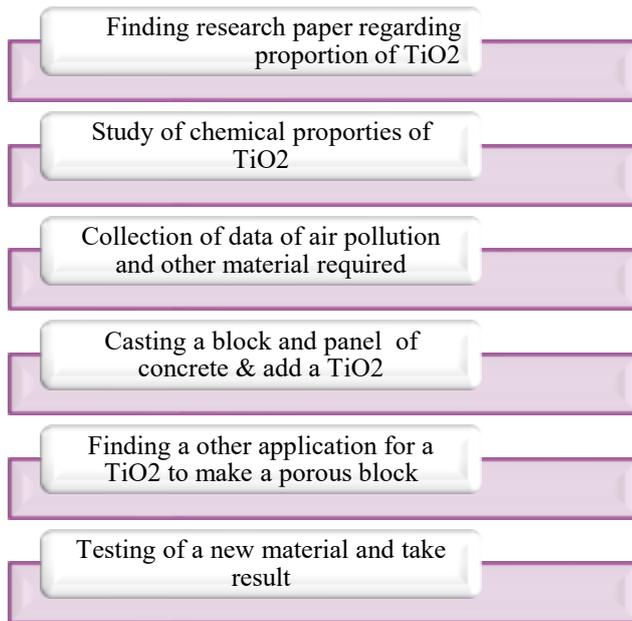
KEY OBJECTIVE:

- Reduce air pollution effectively and economically
- Reduce Diseases caused by air pollution.
- Use of TiO₂ in Constructions
- Trying to help the Government
- Produce clean and sustainable fuel.
- To reduce air pollution caused by industries and vehicles.

2. LITERATURE REVIEW

Titanium Dioxide (TiO₂) is widely studied for its photocatalytic properties, which help in reducing air pollution. When exposed to sunlight, especially ultraviolet rays, TiO₂ reacts with harmful gases such as nitrogen oxides (NO_x), sulphur oxides (SO_x), carbon monoxide (CO), and other pollutants, and converts them into less harmful substances. Many research studies explain that when TiO₂ is added to construction materials like cement and concrete, it does not significantly affect strength but provides self-cleaning and air-purifying properties. Cement acts as a binding material, while TiO₂ works as an active component that absorbs pollutants from the atmosphere. Researchers have also studied different proportions of TiO₂ mixed with cement to achieve effective pollution reduction without reducing durability. Therefore, studying previous research papers is important to understand material properties, chemical reactions between construction materials, and the suitable mix proportion for developing a new eco-friendly material that helps reduce air pollution.

3. METHODOLOGY



FLOW CHART OF METHODOLOGY

Titanium Dioxide (TiO₂) is widely studied for its photocatalytic properties, which help in reducing air pollution. When exposed to sunlight, especially ultraviolet (UV) rays, TiO₂ reacts with harmful gases such as nitrogen oxides (NO_x), sulphur-oxides (SO_x), carbon monoxide (CO), and other pollutants, and converts them into less harmful substances like nitrates and sulphate.

Many research studies explain that when TiO₂ is added to construction materials such as cement and concrete, it does not significantly reduce the mechanical strength if used in proper proportions. Instead, it provides additional benefits like self-cleaning surfaces and air-purifying properties. In this combination, cement acts as a binding material that gives strength, while TiO₂ works as an active photocatalyst that helps break down pollutants present in the atmosphere.

However, some additional issues must also be considered. The effectiveness of TiO₂ depends on sunlight availability, surface exposure, and proper dispersion in the mix. If TiO₂ particles are not evenly distributed, the photocatalytic efficiency may decrease. Long-term durability, cost of material, and maintenance requirements are also important factors. Researchers have therefore studied different percentages of TiO₂ in cement to find the optimum mix proportion that ensures pollution reduction without affecting durability and strength.

4. RESULT

POLLUTION ABSORBING TEST

Final Results of Overall 2 test

The TiO₂ Block:

The block coated with Titanium Dioxide (TiO₂) demonstrated active air-purifying properties. When exposed to light, TiO₂ initiated a photocatalytic reaction that helped break down organic pollutants present in the smoke. As a result, the smoke inside the container gradually reduced and became clear within about 2.5 hours.

The Normal Block:

The block coated with normal paint showed no interaction with the polluted air. Even after 2 hours, the smoke particles remained suspended in the container because ordinary paint does not have the chemical properties required to neutralize or decompose air pollutants.

The results confirm that adding TiO₂ to paint can convert a standard surface into an eco-friendly, pollution-reducing material. Therefore, TiO₂-based coatings have strong potential as a practical solution for reducing smog and improving air quality in indoor and outdoor environments.



Fig No. 1 -Before TiO₂ paint block



Fig No. – 2 After TiO₂ paint block

COMPRESSIVE STRENGTH RESULT

S R. N O	PRODU CT	MATERIA L	WEIG HT	STRENG TH
1	NORMA L BLOCK M20 (GRADE)	WATER	650 ml	19 N/mm2
		CEMENT	1.360 kg	
		SAND	2.260 kg	
		AGGREGA TE	4.250 kg	
		LIME	300 gm	

Table No 1: Normal Block

S R. N O.	PRODU CT	MATERIA L	WEIG HT	STRENG TH
2	TiO2 BLOCK M20 (GRADE)	WATER	68 gm	23 N/mm2
		CEMENT	1.360 kg	
		SAND	2.260 kg	
		AGGREGA TE	4.250 kg	
		LIME	300 gm	

Table No 2: TiO2 Block

5. CONCLUSIONS

Titanium dioxide (TiO₂) can play an important role in reducing air pollution when used in construction materials. When it is mixed with concrete or applied as a coating in paints, it reacts under sunlight and initiates a photocatalytic reaction that breaks down harmful air pollutants such as nitrogen oxides (NO_x). Experimental observations on TiO₂-coated surfaces showed a measurable reduction in surrounding pollutants. The lime water test was used to detect carbon dioxide (CO₂), as lime water turns milky in the presence of CO₂, confirming gas interaction during the process. Compressive strength tests were also conducted, and the results showed a slight

increase in strength after the addition of TiO₂. Overall, TiO₂ not only contributes to pollution control but also maintains or improves the mechanical properties of concrete, supporting cleaner and more sustainable urban development.

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