Introduction to New Façade Material

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Abstract:- *What meets the eye is what attracts us towards it and façade being the first thing we see in a building it draws us to it. With the foresight to come up with new and aesthetic facades, there is also a need to find ways that reduce the harmful impact of it on the surroundings. There needs to be a balance between the façade and its surroundings. Materials that are not only aesthetically pleasing but are also beneficial with respect to the surroundings should be approached. This paper reflects how we can opt for an eco-friendly material to achieve a balance between aesthetics and healthy environment.*

Key Words: Façade, Aesthetic, Healthy Environment, Materials, Surroundings.

1.INTRODUCTION

In today's scenario, the environment around the building is as important as the environment inside it. And façades play a pivotal role in achieving a healthy and efficient surrounding. They also add up to the unique architectural aesthetic of the building. With the increase in requirement of spaces the expectations to come up with something exquisite has also risen. Façades also provide us with visual quality and it has become important to find ways to make the environment "livable" and more engaging through aesthetic approaches. One such material in today's time that has given not only aesthetic but also a life to its surroundings is Titanium Di Oxide (TiO2).

2. MATERIAL: TITANIUM DIOXIDE

Titanium dioxide or Titanium (IV) Oxide is a naturally occurring oxide of titanium. When used in pigment form, it is also called titanium white. It is resistant to environmental and marine pollution as well and can perform in aggressive environmental conditions as well. In addition to it, it is odourless material and is insoluble in water. It has a self-cleaning property which makes it a material which requires low maintenance for a long period of time.

The material takes an active stance and attacks the problem of dirty air by aiming to help purify it. Therefore, it acts as a major separating as well as linking element between the inside and outside turf.

3. HISTORICAL BACKGROUND

The element Titanium is named after the "Titans" earth giants in ancient Greek mythology. It was discovered by Rev. William Gregor in the year 1791. Later, a German chemist, M. H. Klaproth confirmed that rutile ore consisted of the same Oxide in the year 1795 and assigned the name "Titanium" to it. It was nearly a hundred years later (1887) when impure titanium was first prepared by Nilson and Patterson. And about 20 years later Hunter heated titanium chloride with sodium in a steel bomb and isolated 99.6% pure titanium.

It is the ninth most abundant element in the earth's crust and is also found in the ash of coal, in plants and even in the human body. It also occurs in minerals rutile, ilmenite, anatase, etc. In the year 1946 it was produced at large scale as a major industrial product in the form of sponge made with the process of reducing titanium tetrachloride with magnesium developed by W.J. Kroll who as a renowned chemist from Luxemburg. Later it was used in the aerospace, chemical, electric power and other industries as well as in architectural, civil-engineering and general-purpose applications. Renowned architect Frank O. Gehry used Titanium as faced material in the Guggenheim Museum (Spain) in 1990, which made titanium the favourite material having exceptional aesthetical appeal (Fig.1).


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Fig.1. Guggenheim museum Bilbao, Spain

4. PROPERTIES

Chemical Properties

Titanium is a Block D, Group 4, Period 4 element. The number of electrons in each of Titanium's shells is 2, 8, 10, 2 and its electron configuration is [Ar] 3d2 4s2. Fig 2. The titanium atom has a radius of 144.8.pm and its Van der Waals radius is 200.pm. In its elemental form, CAS 7440-32-6, titanium has a silvery grey-white appearance. Titanium has five naturally occurring isotopes: 46Ti through 50Ti, with 48Ti being the most abundant (73.8%). And, its metallic form, titanium is both strong and lightweight, and it's highly resistant to corrosion. Thus it can be found in numerous aerospace and military applications. In its oxide form, it is used in low grades to produce a white pigment.

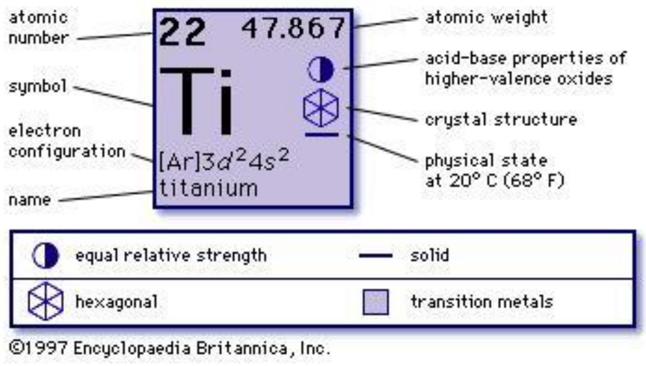

Fig. 2.

Physical Properties

Titanium highly compatible with steel, copper and aluminium as it possesses lowest thermal expansion. Titanium's coefficient of thermal expansion is half that of stainless steel and copper and one-third that of aluminium and equal to that of glass and concrete.

The specific gravity of titanium is 4.51 g/cm3 - about 60% that of steel, half that of copper and 1.7 times that of aluminium. It is a lightweight metal which can be easily fabricated and installed with ease as well as it has a less dead load. Because of its relative inertness in most atmospheres, titanium is considered environmentally friendly. It is 100% recyclable and the product of a renewable resource. It is durable and shock resistant having durable and shock resistant mechanical strength to steel. It is shock resistant and flexible than other architectural metals which perform well during earthquakes and other periods of violent movement. It is considered a sustainable material.

5. WORKING MECHANISM

TiO2 or Titanium Di Oxide works on the principle of photo-catalysis. Where, a typical semiconductor like TiO2, creates holes and electrons by irradiating light with higher energy than TiO2's band gap energy (wavelength < 380nm). The holes and electrons react with oxygen and hydroxyl ions, producing hydroxyl radicals and superoxide anions. Oxidation power of the chemicals is so strong that the chemicals decompose and eliminate organic compounds and NOx. Fig. 3.

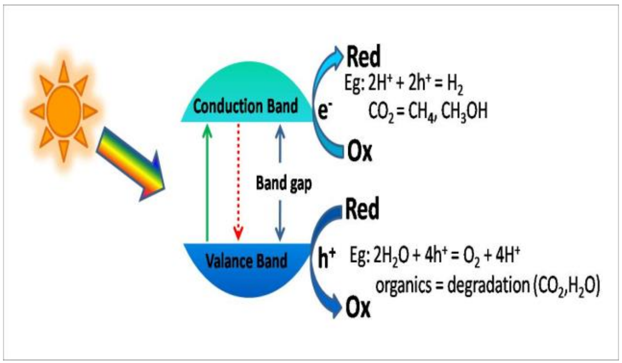

Fig. 3.

When light energy is radiated on the surface of Titanium Di Oxide (TiO2), electrons are released. Which then bind with oxygen to become superoxide anion and the surface of TiO2 becomes positively charged. The positively charged surface takes electrons from the moisture in the air. The moisture that has lost electrons becomes a hydroxyl radical which then, by the power of oxidation, decompose organic compounds such as oils, unwanted bacteria, hazardous scientific gases, fungus and offensive odours that cause staining, and turn them into the water and other harmless substances and disperse them into the atmosphere. Fig. 4.

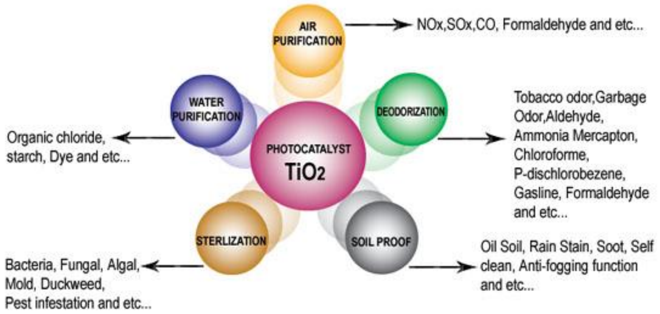

Fig. 4.

6. ADVANTAGES

Façade maintenance has become an indispensable aspect of building management. A timely maintenance of façade has become difficult over time. Cleaning operations are often delayed by owner or facility managers as they concern relevant and frequent investments. They require effort, in terms of water, use of detergents, operation cost and time. If not paid attention it may also result in reduced performance levels of the building. Undertaking this framework, the application of TiO2 and its sol-gel products on façade elements offer a wide range of fortuity to ensure proper functionality maintenance over time.

The self-cleaning facades utilize daylight to activate the TiO2 nanoparticles, bringing about high oxidation force and super hydrophilic impact. It allows for a more brawn/robust and sustainable façade. In times of downpour, the rainwater cleans the TiO2 surfaces effectively. There are various ways in which the material is beneficial for a longer run.

Low Maintenance

With a timely interval of every 5 years, a TiO2 façade becomes a tremendous investment for almost every type of structure.

Retro-fit

TiO2 can also be a retro-fit for various ends. When used in spray, paint, cladding, plaster, transparent coatings, etc. forms, it can escalate the life or condition of any surface that is in need.

Heritage Preservation

Today, with increasing urban scenarios, when it comes to preserving the structures which hold a heritage value, TiO2 proves to be immensely helpful.

Reduces Pollution

By the virtue of its nature, TiO2 eliminates the harmful hazardous gases from the environment and turns them into organic outcomes which cause no harm to the environment.

There are various other advantages of TiO2, which includes its self-cleaning properties; it is also helpful in water treatment, etc. Fig. 5.

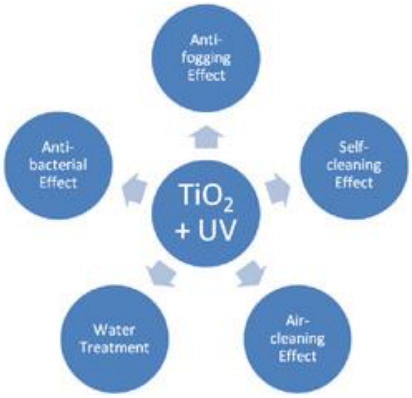

Fig. 5.

7. IT'S NEED FOR IMPLEMENTATION

Looking at its benefits, it can be concluded that TiO2 is the new- generation material which adds up to the architectural and environmental aspect of the façade. Not only it helps in improving the air quality but also has good shading capability. With the increase in demand for construction of new spaces, the need for sustainable materials is also arising. TiO2 being a new-generation sustainable material has the potential to lead us to a healthy and enduring future.

8. CONCLUSION

The newfangled trend towards a more sustainable management of the built environment suggests the amalgamation of self-cleaning materials on facades to enhance the cleaning capabilities of external facades. TiO2 with its splendid finish can easily become the favourite material used for architectural applications. Well-researched designs that capitalize on its unique attributes and long-term savings from durability and low maintenance make TiO2 one of today's most cost-effective building materials on a lifecycle basis. It is supposed to be a sustainable solution for architectural applications in abutting generation buildings.

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