Influence of Antimicrobial & Super Hydrophobic on Flooring Tiles

Ganesh Vijay Tapkire[1]

[1]*Assistant Professor, Civil Engineering Department, R. C. Patel Institute of Technology, Shirpur, Maharashtra, India*

Abstract:- *In the world of microbiology and health care, bacteria and fungi last on a surface for a long time in residential building, commercial buildings, hospitals, etc. This lead to unhealthy environment, foul smell, and health issues. Super hydrophobic and antimicrobial tiles and coating is a great solution to these problems. No water = No bacteria generation. Thus super hydrophobic tiles/coating will prevent the bacteria generation in toilet/sink and antimicrobial tiles / coating will prevent the harmful bacteria in hospitals.*

A new step towards healthy environment such a combination will solve the health issue all over. Super hydrophobic coating contact angle (CAS) is greater than 150degree and sliding angle (CAS) is less than 10degree has become the focus of research and industrial development studies for water repellency application. Super hydrophobicity is a combination of chemistry and roughness of surface, inspired by combining lotus leaf composition and structure. Antimicrobial substances are by dentition and design, substances that are toxic to certain organisms-bacteria, viruses, fungi or protozoa collectively known as microbes. Certain substances, Nano particles and metals can all be used as antimicrobials in everyday products. However, because their purpose is to hill and control target organism

KEYWORDS*: Microbiology, Super hydrophobic, Antimicrobial, Repellence, Dentition, Microbes*

1. INTRODUCTION

1.1 Antimicrobial Surface

An antimicrobial surface contains an antimicrobial agent that inhibits the ability of microorganisms to grow on the surface of a material. Such surfaces are becoming more widely investigated for possible use in various settings including clinics, industry, and even the home. The most common and most important use of antimicrobial coatings has been in the healthcare setting for sterilization of medical devices to prevent hospital associated infections, which have accounted for almost 100,000 deaths in the United States. In addition to medical devices, linens and clothing can provide a suitable environment for many bacteria, fungi, and viruses to grow when in contact with the human body which allows for the transmission of Infectious disease. Such surfaces can be provided in two types:

a) For existing building – Coating

b) For new construction – Tiles.

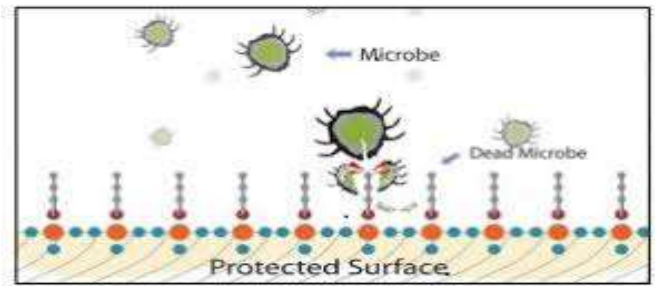

Fig-1 (Protected Surface)

1.2 super hydrophobic Surface

A super hydrophobic surface is a low energy, generally rough surface on which water has a contact angle of >150. Nonpolar materials such as hydrocarbons traditionally have relatively low surface energies; however this property alone is not sufficient to achieve super hydrophobicity. Super hydrophobic surfaces can be created in a number of ways; however most of the synthesis strategies are inspired by natural design. The Cassie-Baxter model provides and explanation for superhydropbicity air trapped in microgrooves of a rough surface create a composite surface consisting of air and the tops of micro protrusions. This structure is maintained as the scale of the features decreases, thus many approaches to the synthesis of super hydrophobic surfaces have focused on the fractal contribution. Wax solicitation, lithography, vapor deposition, template methods, polymer reformation, sublimation, plasma, electro spinning, sol-gel processing, electrochemical methods, hydrothermal synthesis, layer-by-layer deposition, and one-pot reactions are approaches to the creation of super hydrophobic surfaces that have been suggested.

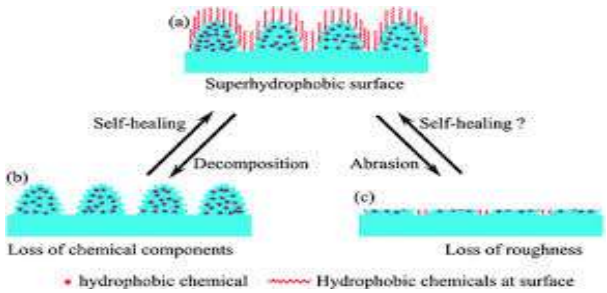

Fig-2 (super hydrophobic Surface)

1.3 A Combination of Both

The core part of this project is to use both super hydrophobic and antimicrobial surfaces in a combination which will satisfy both the purpose of antimicrobial

resistant and water-resistant i.e. the concept of No water=No bacteria generation Thus a super hydrophobic tiles or coating will prevent the bacteria, algae, fungi generation in tiles, kitchen, bath, etc. and a antimicrobial tiles or coating will prevent the hazardous bacteria in toilet, hospitals, etc.

2. LITRATURE REVIEW

Jukka Verho, Chris Bower) Development of durable non-wetting surfaces in hindered by the fragility of microscopic roughness features that are necessary super hydrophobicity. Additionally, self-healing hydrophobic layers and roughness pattern have been suggested and demonstrated. Nevertheless, mechanical contact not only causes damage to roughness pattern but also surface contamination, which shortens the lifetime of super hydrophobic surfaces inspite of the self-cleaning effect. The use of photocatalic effect and reduce electric resistance have been suggested to prevent the accumulation surface contaminants. Limited application - due to fragility - mechanically durable surface - better option

N.Cohen, A.Dotan) super hydrophobic contact angle (CAS)>150 degree and sliding angle (SAS)<10 degree have become the focus of research and industrial development studies for water repellency applications. Furthermore, super hydrophobic coatings have shown to reduce adhesion by means of their low surface energy chemistry and Nano-micro roughness. Super hydrophobicity achieved by combining chemistry and roughness of surface, inspired by combining lotus leaf composition and structure.

(Fed Schettler MD, MPH) Healthcare associated infections have always been a formidable challenge in hospitals are major causes of morbidity and mortality today. In furnishing the material must have undergone U.S. environmental protection agency (EPA). Manfactures of health care furnishing developing new products to protect material degradation and for decreasing diseases and for aesthetic use.

3. Identification of Flooring Detoration of Buildings.

Fig-3 (Problem-1)

Fig-4 (Problem-2)

Methods to Solve Problem
Material to Be Used
1. Titanium dioxide (Tio2)
2. Teflon
3. Silica Nano coating

In 1972, Honda-Fujishima re-discovered the power of TiO2, which has been known since 1921 as a photo-catalyser element. However, it is only relatively recently that it has been used in environmental cleaning such as self-cleaning tiles, glasses and windows. Theoretically, photo catalysis is based on the production of activated species at the surface of an irradiated semi-conductor with photons having energy higher than the one of their band gap, TiO2 has varied band gaps ranging between three and 3.2eV, which means it can only be activated with UV-light . The antimicrobial activity of TiO2 is activated when irradiated with UV radiation (wavelength <385nm). This prevents the initial adhesion of microbes, or inactivates microorganisms that adhere to a surface due to production of different reactive oxygen species (ROS). However, the half-life of most ROS is short, and they probably exist only in the region near 60 the catalyst surface because they can be readily suppressed in aqueous environments due to a high recombination rate. Using photoelectron-catalytic system with an external potential bias can suppress the charge recombination.

TiO2 is one of the most studied materials due to its stability and photosensitivity in both powder and thin film forms. In fact, TiO2 surfaces are considered as promising material in future medicine, because it is not poisonous and does not cause environmental pollution. There are three different forms of TiO2: anatase, rutile, and brookite. Rutile has a smaller band gap (3.0eV) than anatase (3.2eV), and with excitation wavelengths extends into the visible light range (410nm). Despite this, anatase is generally considered the most photo-chemically active phase of Titania, due to the higher surface adsorptive capacity of anatase and its higher rate of whole trapping.

4. Methodology

1. Place a plastic tarp down over the work area & set the moulds a top it.

2. Working on ground outdoors is ideal, so any spills beyond the tarp won't be as problematic as they would other surfaces.
3. Spray a mould release (oil) inside the moulds to ensure the tiles comes out easily once it has hardened.

Sample Preparation-

1. Take 1:3 cement sand proportion
(Cement =400 gm.; sand=1600 gm.)
2. Add the Antimicrobial material and super hydrophobic material in 5%, 10%, 20% of the total cement used.
3. Pour the mortar into each mould. Fill the moulds to the top.
4. Wiggle the moulds back & forth a bit to help remove bubbles and air pockets.
5. Allow the mortar to set for 24 hours.
6. Take out the tiles and keep them for 28 days curing.

Sr No.	Tile Type	Size (mm)	Chemical Used (%)
01	Traditional	220x220x15	-
02	TiO2	220x220x15	5%
03	Silica	220x220x15	5%
04	Traditional	220x100x15	-
05	TiO2	220x100x15	10%
06	Silica	220x100x15	10%
07	Combination	220x100x15	10% TiO2 +10%
08	TiO2	220x100x15	20%
09	Silica	220x100x15	20%

Fig-5 (Tile-1 Tio2)

Fig-6 (Tile-2 Silica)

Fig-7 (Tile-3 Traditional)

5. Experimental results

Civil Tests on Tiles

5.1 Abrasion test on tiles- as per IS

Tiles	Size In mm	W1 (gm)	W2 (gm)	Volume (mm^3)	Thickness T= (W1-W2)XV1/(W1XA)
Traditional	220x	275	273.5	72600	0.082
TiO2	220x	280	278.5	72600	0.080
Silica	220x	290	288	72600	0.103
Traditional	220x	190	188	33000	0.158
TiO2	220x	195	192	33000	0.231
Silica	220x	190	188	33000	0.158
Combinatio	220x	200	193	33000	0.525
TiO2	220x	195	191	33000	0.308
Silica	220x	190	188	33000	0.158

5.2Flexural test on tiles-

Tiles	Size in (mm)	Breaking		Flexural
Traditiona	220x220x15	529.74	150	2.408
TiO2	220x220x15	588.60	150	2.675
Silica	220x220x15	647.46	150	2.943
Traditiona	220x100x15	282.53	150	2.825
TiO2	220x100x15	317.84	150	3.178
Silica	220x100x15	311.96	150	3.120
Combinati	220x100x15	317.84	150	3.178
TiO2	220x100x15	282.53	150	2.825
Silica	220x100x15	270.76	150	2.708

6. conclusion

Newly made supply & antimicrobial tiles kills the weak bacteria & stops growth of strong enough bacteria. Such tiles in hospitals make the environment clean & hygiene by reducing the speed of infections & threat to patients whose immune system is weak As per above observation technical specification there is no measure changes in abrasion and flexural strength of tiles Family health which starts from kitchen is improved & maintained if such tiles are used. These tiles shows photocatalyic effect i.e. self-cleaning

property The concept of No Water = No Bacteria generation is fully satisfied by making Tio2 super hydrophobic surface & Antimicrobial property leads to no bacteria.
Both existing building & newly constructed building can be applied with this concept. Environment friendly, hygienic & efficient tiles.

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