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# Review: Corrosion Preventive Technique on Concrete Surfaces

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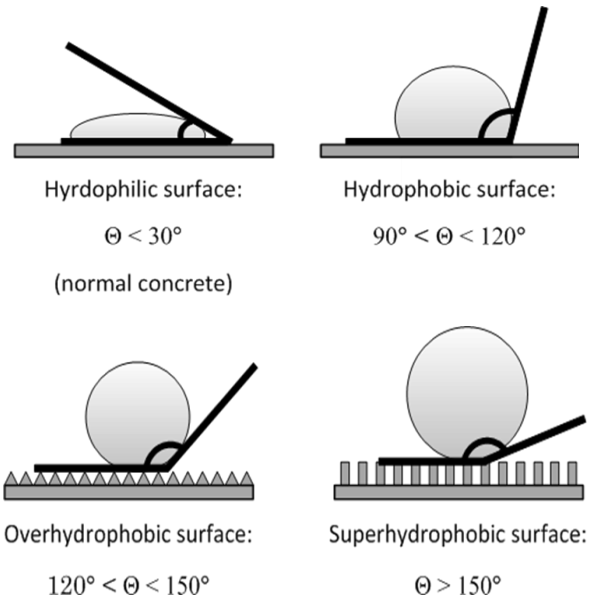
***Abstract* - Concrete is important materials in civil engineering constructions. It is being used in every part of the construction field. Durability of this important material is still a matter of great concern among civil engineers all over the world. Durability of concrete is affected mostly by intrusion of aggressive species from the immediate environment. Therefore, it is an absolute necessary to block the pores, voids, capillaries, interconnecting pores and other surface defects of concrete surfaces. This can be achieved by proper coatings, particularly by superhydrophobic coatings (lotus leaf coating). In this study superhydrophobicity is achieved by using Silane, Siloxane, Silicone as binder with Nano silica, Silica fume, Micro silica, $TiO_2$, etc. Nearly thirty different coatings were formulated and applied on concrete surfaces to study the hydrophobicity and superhydrophobicity. The best coatings were selected based on contact angles and roll on of water droplets and they never stick to the concrete surface. These coated surfaces are photo and video graphed and well established and discussed in detail.**

***Keywords:*** Hydrophobic, Superhydrophobic, Durability, Coatings, superficial protection, water resistant.

## I. INTRODUCTION

Concrete surface is usually hydrophilic porous and contain many capillaries, fissures, microcracks and other defects. Water or any other aggressive liquids and gases can easily penetrate through these surface defects and will lead to undesirable consequences. The penetrated chemicals or other aggressive species will react with concrete and form new chemical compounds. The Durability of concrete depends on its own overall absorption and permeability of aqueous solutions. The cumulative effect of such penetration, permeation, absorption and capillary sorption eventually cause expansion, cracking, scaling and crumbling of concrete.

Therefore, it is important to synthesize water-repellent hydrophobic or superhydrophobic coating to concrete surface in order to make the concrete more durable and in particular to produce ultra-durable concrete. It can be noted thathydrophobic concrete surfaces prevent discolouration and staining of concrete by chemical contacts.




Hydrophobic and superhydrophobic material are surface protection materials and capable of increasing the angle of contact between thewater droplet and the surface of concrete. Among various methods to protect concrete surface, impregnation of hydrophobic material is least harmful and highly efficient to inhibit capillary water absorption. It has been proved that hydrophobic agents could be effective for more than 10 years when applied as 6 months old concrete surfaces.

### 1.1 History

In the recent years, the hydrophobic coatings and admixtures for construction materials received a lot of attention since they offer anti-fouling, anti-corrosion and anti-icing properties. Besides introducing the hydrophobicagents as mentioned earlier, the nanoparticles are commonly used to create the required roughness for hydrophobic surface. The air captured on the rough surface can reduce the contact between solid-water, which is classified as the Cassie-Baxter state. For instance, the commercial metakaolin and silica nanoparticles were further blended into the polymethyl hydrogen siloxane solution to form the cementitious composites with hydrophobicity. In Malaysia, about two million tons of rice husk are produced annually and the combustion of rice husk are widely practiced for energy generation. The major by-

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product, rice husk ash contains more than 90% of amorphous silica which serves as the ideal substituent of commercial nanoparticles in the superhydrophobic coating. These hydrophobic materials and coatings are in use for bridges in UK, USA and Germany since 1986, to avoid chloride ion penetration.

### 1.2 Objectives

- To provides scratch free concrete surface.
- To protect materials and capable of increasing the angle of contact between the water droplet and the surface of concrete.
- To improve the freeze-thaw resistance of cement-based materials.
- To prevent the corrosion of steel in concrete.

### 1.3 Advantages

In nature, we found a lot of examples of motivation for researchers to generate or mimic natural things in a scientific way. In this legacy we saw property in nature like self-cleaning of lotus leaf, hydrophobicity of rose petal, self-cleaning of cicada wings, the anti-biofouling property of fish scale etc. So, in all these examples one thing is common that is hydrophobic property. In general words, we can say that hydrophobicity is a property of a surface that repels water on an extreme level and left the surface unwetted. On these surfaces, liquid or mainly water gets an almost spherical shape and doesn't get flat. Actually, lotus leaf or rose petal or cicada wings are covered with some kind of waxy nanocrystal coating; this coating can be described by two different aspects that are surface chemistry and surface structure. This waxy coating has nanostructured bumps in these nanostructured bumps air get trapped and due to this the water droplet doesn't get penetrate the crusts. so, as a result, it minimizes the contact area of the water droplet and water contact angle increases. Due to increased contact angle water drop get the shape of a sphere. If this contact angle can become more than 900 then it comes under hydrophobicity. This hydrophobic behaviour of lotus leaf led them to obtain properties like self-cleaning, anti-icing etc. So, if researchers could make these types of coating on surfaces, we can get surface with the property of self-cleaning windshields, anti-icing panels, corrosion-resistant surface, and wear resistance surfaces. According to constructed contact angle on the surface, we can categorize the surface into hydrophilic, hydrophobic or super hydrophobic. So, if the water contact angle is less than 900 then it will be categorized as a hydrophilic surface. If the contact angle is greater than 900 then it is hydrophobic but when the water contact angle becomes greater than 1500 and water sliding angle (i.e., tilted angle of the surface on which water slides down is less than 10 degrees) can be referred to as super hydrophobic surface.

## II. LITERATURE REVIEW

DY Kwok, AW Neumann., (1999): In Recent progress the correlation of contact angles with solid surface tensions is summarized. The measurements of meaningful contact angles in terms of surface energetics are also discussed. It is shown that the controversy with respect to measurement and interpretation of contact angles are due to the fact that some (or all) of the assumptions made all energetic approaches are violated when contact angles are measured and processed. For many polar and non-polar liquids on different solid surfaces, the liquid.

J. Z. and Buenfeld. N.R., (2000): "Chloride profiles in surface treated mortar specimens" measured chloride profiles of specimens applied with six different surface treatments such as acrylic sealer, polyurethane sealer, alkyl alkoxysilane, acrylic coating, polyurethane coating and polymer modified cementitious coating and immersed solution. They calculated interfacial chloride content between surface treatment layer and the substrate and pseudo diffusion coefficient. They found that all the surface treatments reduced below than that of the untreated specimens.

Han Young Moon. et. al., (2005): "Evaluation of the durability of mortar and concrete applied with inorganic coating material and surface treatment systems" assessed diffusivity of chloride by using mortar specimens and durability performance related to inorganic coating materials by using concrete specimens viacarbonation and resistance tests. Their results revealed that all the resistances were improved than that of the control ones, especially in-organic Top Coating (0.15 - 0.25 l/m2) exhibited remarkable performances.

Mustafa Sahmanan. et. al., (2007): "Transport properties of engineered cementitious composition underchloride exposure" investigated chlorine ion transport properties of Engineered Cementitious Composites by using immersion and salt ponding tests. Their results showed that ECC was-effective in slowing down the diffusion of chlorine ion under combined mechanical and environmental loading by its ability of self-controlled tight crack width.

Srinivasan, GH McKinley, RE Cohen., (2011): Gravity-induced sagging can amplify variations in goniometric measurements of the contact angles of sessile drops on super liquid-repellent surfaces. The very large value of the effective contact angle leads to increased optical noise in drop profile near solid-liquid free surface, and the progressive failure of simple geometric approximations. We demonstrate a

 

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systematic approach to determining the effective contact angle of drops on super-repellent surfaces. We use a perturbation solution of the Bashforth-Adams equation to estimate the contact angles of sessile drops of water, ethylene glycol and diiodomethane on an omniphobic surface using direct measurements of the maximum drop width and height. The results and analysis can be represented in terms of a dimensionless Bond number, that depends on the drop width and the capillary length of the liquid, to quantify the extent of gravity induced sagging.

Zuhua Zhang. et. al., (2012): "Potential application of geopolymers as protection coatings for marine concrete III – Field experiment" experimented in the in-situ application of geopolymer coating in coastal area. They observed that the geopolymer coat with a thickness of 5 mm was ideal and set within 4 hours, had a strong bond with concrete and able to resist the wave shock in the first tide rise. Despite addition of MgO based expansion agent and polypropylene, large shrinkage was observed and they suggested that to counteract these problem, appropriate shrinkage reducing agents could be used.

Chu-Chia Yang. et. al., (2012): "The relationship between migration time in ACMT and ponding time in ponding test for cementitious materials" carried observed and they suggested that to out diffusion test and migration test with ponding test AASHTO T259 and accelerated chlorine migration test ACMT respectively with different times (60, 90, 120 & 180 days) for fly ash, slag and fly ash plus slag samples. They calculated interfacial chloride content between surface treatment layer and the substrate and pseudo diffusion coefficient. They suggested that the relationship between the ponding time and migration time would not be affected by different mixes of different w/b ratio and 90 days salt ponding test was a long-term test for measuring penetration of chloride into specimen.

Neha Sharma and Prashant Sharma., (2021): Hydrophobic agents have been used in cement and concrete to reduce water penetration in concrete since many years. Hydrophobic agents are the materials that are employed in cement for enhancing the contact angle between the water and the concrete surface. Fatty acids and their fractions have been introduced in the cement as either phase change materials or as an admixture to minimize water ingress into concrete. Many alkenes, oils, fats, and greasy substances come under the category of hydrophobic molecule. Due to reduction in water permeability, hydrophobic agent enhances the durability and aesthetic appearance of the concrete. Since the mid-20th century, hydrophobic concrete found much popularity in building and construction. Hydrophobic are non-polar and lipophilic substances exhibits high contact angle thereby minimizes the rate of detrimental reactions. This article presents an overview of the work that has been carried out on the application of hydrophobic agents in cement mortar and concrete.

## III. CONCLUSION

This paper reviewed about Corrosion prevention and control (CPC) entails the characteristics of a system design to preclude or reduce corrosion, materials selection, non-destructive inspections for corrosion detection, coatings, finishes, cleaning materials and washings, repairs, and other maintenance activities. This research paper is deals about the reducing the expensive replacement processes required when corrosion occurs.

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