# FAQ

WATERPROOFING BY ZYCOSIL FREQUENTLY ASKED QUESTIONS

- What is Nano Technology of Waterproofing?

  *The size nanometer (ηm) is 1 X $10^{-9}$ meter i.e.1 meter is cut into 1,000,000,000 peaces, each peace is one nanometer. Any technology based on particles size less than 10 ηm is considered Nano Technology. Zycosil molecule when dissolved in solvent has estimated size of 5-6 ηm. Therefore Zycosil waterproofing technology is the Nano Technology.*

- How come Zycosil is UV stable and other polymeric materials are not?

  *Polymers contain many thousands of monomers attached with each other and form a long chain molecule. These polymers form clusters in a solution or emulsion. When this polymers form a film on the substrate surface, polymer molecular clusters are forced to adhere to the surface. Then polymer further under go shear stress because of exposed heat and moisture. As a result, the cohesive forces are weakened. Additionally, Polymers are visco-elastic i.e. they always move to attain thermodynamically stable format. Under these circumstances, molecular bonds are weakened and UV, a high energy source, can attack the polymer network to form free radicals. Free radicals are reactive centers on the molecule and can easily react with oxygen (oxidation), eventually break down molecular structure. Zycosil is monomeric material and penetrates several miltimeters inside core of the substrate. 2000 hours of UV test (310 nm, 0.55ev/$M^2$, most destructive UV range) results for the Zycosil treated substrates indicated that Zycosil is very stable and does not change chemically. Additionally, due to Zycosil penetrative treatment, the surface inside substrate, which is not exposed to UV, are also highly water repellent and protect the bulk of the substrate structure.*

- Zycosil upon reacting with substrate forms polymeric structure, why this polymeric structure is UV stable?

  *Yes Zycosil forms polymeric net work on the surface of the substrate. However formation occurs on a molecular level. The polymer formed is not linear long-chain molecule but it is cross-linked with the surface of the substrate. The polymer is encored on the surface by molecular bonds, therefore thermodynamically most stable format.*

- Why siloxanes and Silicones form coating?

  *Siloxanes and Silicones are polymer, commonly known as polydimethylsiloxane. The molecular size of these polymers depends on the degree of polymerization. Typically siloxanes are 20-50 ηm (nano meters) while Silicone polymers are 100-2000 ηm or larger. These polymers form molecular clusters in solution or emulsion. The molecular clusters size possibly 10-100 times the molecular size. Typical concrete pore size is 5-200 ηm. Lime stones and other substrates pores size even smaller than these. Bricks pores are 200-2000 nm, siloxanes are situated for this type of substrates. Therefore large molecular clusters can not penetrate inside the pores and forms film and covers the pores. Additionally, the pores are not continuous; they branch out inside the substrate. It is impossible for large polymer clusters to enter into the branches of the pores. For brick siloxanes penetrate superficially, however because of the braches of the pores, this penetration is very limited.*

- Why siloxanes and silicones are dissolved in Petroleum based solvent while Zycosil in water?

  *Siloxanes and silicones are not soluble in water because of high molecular size and water repellent structure. Therefore they are dissolved in hydrocarbon solvent. Zycosil unique chemical structure makes it water soluble. However, when it applied on the surface and is bonded to the substrate, the water repellent characteristic of the molecule dominates on the surface and provide water repellency.*

- What is the function of a solvent? What are the application differences between these solvents?

  *Solvents are used as carrier for the polymer (film formers, siloxanes, silicones and other). Hydrocarbon solvents are not comparable with inorganic substrates. Inorganic substrates are highly polar because of –OH groups on the surface. Hydrocarbon solvents are non-polar. Water on the other hand is very polar and comparable with the inorganic substrate. Because of hydrocarbon non-comparability, complete wetting of the substrate is not possible. Therefore an interface exists between the polymer solution and the substrate surface. Because of this interface the adhesion between polymer and the substrate is weak. Any defects develop upon exposure to UV or heat, microscopic cracks are developed. Then water can enter through these micro cracks and removes coating from the substrate. Therefore most polymer based coatings do not last more then few years.*

- What is difference between silane, siloxanes and silicone?

  *Silanes are monomeric compounds. Typically molecular size is 3-6 ηm. The Siloxanes are low molecular weight polymers, mostly polydimethylsiloxane (some siloxanes also contain surface reactive alkoxy groups) . Typical sizes of these molecules are 50-100 ηm. The silicones are high molecular weight molecules, mostly polydimethylsiloxane. Typically size of these molecules are 100-2000 ηm or higher.*

- The other waterproofing material contains Siloxanes-Silane mixture. The manufacturer claims that this product penetrates and gives better performance, what are advantages and disadvantages of this system?

  *Siloxanes-Silane mixtures contains a small amount of Silane, most likely, methyltrialcoxysilane or octyltrialkoxysilane. These molecules are small enough to penetrate inside the pore of the concrete. Since the concentration of Silane is relatively low, this penetration does not go beyond few tenth ofmilimeters.. Siloxanes form a coating on the substrate. Because of this coating, initially this system shows very good beading effect. Because of some penetration, this system works better than pure siloxanes or silicone based system. UV light can degrade polymer net work and allow depolymerization.*

- What way silicone system widely used in India?

  *The typical silicone based system is 7-16 % solution in a hydrocarbon solvent. The silicone based system initially gives better beading effect because of transparent coating film formation (1-2 micron thick), which helps visualization of the waterproofing. However these system fails in 3-5 years (see UTI building in Mumbai). Zycosil being a nano size molecule modifies surface by reacting with it and hence imparts a molecular level hydrophobic characteristic. The surface layer is about 10 ηm (0.01 micron).*

- The smallest water droplet can be as big as 100 micron (100,000 nm). The substrate pores are 5-2000 nm. How come water droplets with such a large size, penetrate inside the cementations substrate?

  *The water droplets are much larger size than the size of the pores. Therefore should remain on the surface of the substrate. However, almost all cementiceous surfaces contain –OH (hydroxyl) groups. These hydroxyl groups make the surface of the substrate very porous. Surface energy is the energy possessed by the atoms at the surface of the solid, whereas surface tension is the result of the attraction between molecules at the*

*liquid surface. For a liquid to wet a solid, the surface energy of that solid must be able to overcome the surface tension of the liquid, thus breaking the surface tension and forming a permanent film that will bond to the surface. Initial hydrogen bonding between water droplets and hydroxyl groups of the surface provides necessary surface energy. As a result, water droplets wet the surface by breaking down into very small units. The smaller units then penetrate in side the pores.*

- When Zycosil should be applied on a new concrete structure?

*It can be applied after the concrete cures (95 % hydration). Typically 28 days are required to cure the concrete. During curing period concrete needs water for the hydrolysis process. Therefore waterproofing with Zycosil should be applied after this curing period.*

- If the pores are reacted and covered with Zycosil, then why it is still breathable?

  *The surface of the pores are bonded with Zycosil. This happens at a molecular level. So the pore size is reduced by a nano scale and still keeps plenty of space available for the vapor molecules (size 0.18 ηm) to pass through.*

- Can Zycosil be applied on an acrylate based (Distemper, Apex, Plastic etc.) painted surface? Why?

  *It is not recommended because acrylate based painted surface pores of the substrate are closed and the bonding sites for Zycosil are covered. Therefore bonding of Zycosil with surface to provide permanent water repellency will not be possible with the acrylate based paint. Water based Zycosil can not penetrate in acrylate painted surface. However water based cement paint, keeps pores open and can allow bonding with Zycosil. Zycosil gives long lasting protection only because of the penetration 2-5 mm or more.*

- Can Zycosil be applied on a cement based painted surface? Why?

  *Yes, Zycosil treatment is ideal for this type of surfaces. The water based cement paints, keep pores open and can allow bonding with Zycosil. Zycosil gives long lasting protection because of its penetration deep into the treated surface. The surface remains clean and fresh for a long period (over 15 years).*

- Can Zycosil be applied on a plaster?

  *Yes, plaster surface can bonded with Zycosil similarly as the concrete surface.*

- How surface should be prepared before Zycosil treatment?

  *The surface must be cleaned thoroughly and should be free of dirt and oil. The mildew stains should be removed. Old paint should be removed. Best way to clean the substrate surface is by high pressure water jet (100-150 bars pressure). Mildew stains can be removed efficiently by high pressure water jet and 3-5% solution of bleach (sodium hypochloride).*

- Why waterproofing with Zycosil is called Treatment and Silicone and other types of waterproofing are called Coating?

  *Zycosil contains surface reactive compounds. It reacts with the substrate surface and alters chemical characteristics (hydrophilic to hydrophobic). Therefore it is known as treatment. The other type of waterproofing forms a film of the surface of the substrate thereby closing the pores of the substrates and creates physical barrier. Therefore this type of waterproofing is known as coating.*

- What is advantage of Breathable concrete?

  *Concrete curing is hydration process. The binder cement reacts with water to forms silicates of calcium and aluminum. Normal concrete cures to about 90-95 % in about 28 days. Remaining curing may take much longer period (may be 10-20 years). Then concrete achieve its optimum strength. Concrete must breath in order to facilitate hydration and drying process during curing. Additionally, breathable concrete remains in equilibrium with its environment, therefore hydrostatic and osmotic pressure differences are minimized inside the concrete structures.*

- Why newly constructed building surface develops black spots within 2-3 years? How can be cleaned? How can it be prevented?

  *The black spots are remains of biological growth (Mildew, Fungi). Concrete surface is very course and porous. Therefore concrete traps moisture in these pores. Biological growth occurs where moisture and food are available. Concrete and plaster surfaces retains moisture very effectively and promotes fungus growth. These biological growths die and*

*leaves organic residue (black spots). This residue becomes food for the next generation. These vicious cycles continues and covers the entire surface within few monsoon cycles.*

*Mildew stains can be removed efficiently by high pressure water jet and 3-5% solution of bleach (Sodium hypochloride). First the surface is cleaned by high pressure water jets to loosen most of the residue. Then 5% Bleach solution is sprayed over the surface. Allow 30-60 minutes toOxidize the residue before cleaning again with high pressure water jet.*

*This biological growth can be eliminated by removing one of the important component necessary, i.e. moisture. Zycosil changes surface characteristics from hydrophilic to hydrophobic thereby prevent moisture accumulation in the pores. Its specific molecular structure prevents formation and growth of fungus or mold hence keeps surface remains clean and fresh for a long period (over 15 years).*

- What is effloresing? How can it be prevented?

  *Construction materials are very porous and allow water to penetrate inside the core of the substrate. When the water comes out of the core structures, it carries chemical components of substrate. When water evaporates leaves residue on the surface of the substrate. Majority of these leached out materials are white therefore creates white spots on the surface and on the building structures (glass window, wood structures etc...). This process is known as effloresing. This process is detrimental to the structure since it creates voids and weakens the binder structure.*

  *Zycosil treatment prevents water penetration inside the core of the substrate. and hence prevents deterioration of the building structure.*

- Why Zycosil penetrates 2 mm in the concrete? What is benefit of depth of penetration?

  *Zycosil is a monomeric compound. The size of the molecule is less than 6 ηm. It can easily enter in the pores of the substrates. Because of the small size, the molecules flows through the pores branches in side the substrate. Importantly Zycosil is applied as water solution. Because of water comparability with the substrate, Zycosil treatment is very efficient in covering the surface and provides deep penetration.*

  *Depth of penetration provides important protections to the structures (a) withstands*

*hydraulic pressure generated by high wind driven rain (b) gives protection against micro*
*cracks (c) protect the structures from water damage after abrasion due to heavy traffic or*
*natural weathering of the surface (d) protects the concrete steel bars from corrosion.*

- What types of substrates can be treated with Zycosil?

  *Almost all material commonly used for construction can be treated with Zycosil. This includes (a) Concrete (b) Bricks (c) Sand Stone (d) Granite (e) Lime stone (f) Marble (g) Plaster (h) Cement sheet (i)Natural stones*

- What is average consumption of Zycosil?

  *This depends on the substrate and required depth of penetration. Zycosil is diluted with water before application. One Kg (approx. one liter) Zycosil is diluted with 10 Kg (10 Liters) water for the horizontal surface and one Kg (approx. one liter) Zycosil is diluted with 20 Kg (20 Liters) water for the vertical surface typically on the average one liter of diluted Zycosil is consumed per $4M^2$ surface area.*

- What are the waterproofing test methods for the building?

  *There are various tests to determine waterproofed surface. Rilem tube test is a simple non-destructive test available for the vertical and horizontal surface. The Rilem tube is attached on the waterproofed surface. Then it is filled with water and drop in water level is observed over a 20-minutes period.*

  *The other tests are destructive. A core sample of the treated substrate is taken and tested in the laboratory for water intake and the depth of penetration.*

- Weakest structural component of any structure is Joints. Why? How Zycosil provides protection at the joints?

  *Joints are relatively small component of the structures. It keeps large structures together. Joints are normally under more stress then rest of the structures. Water penetrates easily because of the porous nature of the joints components. Water swells the joints and it de-swells when ever water leaves the joints. Swelling and de-swelling process generates voids and develops cracks.*

*Zycosil bonds similarly with the joints materials as rest of the structure. This treatment prevents water penetration in to the joints. Therefore prevents swelling and de-swelling process.*

- Why cracks are formed in the concrete? How Zycosil protects structures after the cracks are formed?

  *There are two types of concrete: concrete that is cracked and concrete that has the potential to crack. When exposed to wetting and drying conditions concrete will expand and contract (similar to a sponge). If the stress associated with these volume changes exceeds the tensile capacity of the concrete, a crack will form. This specific type of crack is referred to as a shrinkage crack. Cracks are expected to form in concrete and act as a "pressure release valve". By intentionally jointing concrete, you decrease the thickness of the slab in that location. This allows a crack to form along a straight line within the joint since the thin section provides a path with less resistance than a thicker section.*

  *Zycosil penetrates inside the concrete structures. The micro cracks are normally 0.1 to 0.2 mm width and 2-3 mm deep. Therefore the crack surface is still protected from water infiltration.*

- Why Zycosil treated surface does not change appearance? How do we know the surface is treated?

  *Zycosil bonds with substrates and alter the chemical structure of the surface. These changes occur on a nano-scale (molecular level). Therefore it is not visible contrary to the coating based waterproofing.*

  *Rilem Tube is a simple test can be used to determine the treated surface.*

- Why building structures accumulates dirt?

  *Most building structures are very polar. This polarity is due to OH-groups on the surface. Dirt particles are also very polar and contain –OH groups on the surface. When these particles come in the vicinity of building surface, they are attracted by polar forces. These particles bind on the surface by these attractive forces (hydrogen bonding).*

- How Zycosil helps to keep building clean?

  *Zycosil bonds with the surface of the building materials and alters the characteristics of the surface from hydrophilic (very polar) to hydrophobic*

*(non-polar). Dirt particles being polar by nature do not attracted any more. If it stays on the surface, it can easily be remove by wind or rain water.*

- How Zycosil helps to protect from corrosion?

  *Corrosion of the concrete steel bars is an electro-chemical process. In this process, Iron, Fe oxidizes and looses two electrons. These electrons are transferred to Oxygen, O. Water in the concrete becomes electron transport medium and transfer electrons from Fe to Oxygen and corrosion process starts. Zycosil prevents water to penetrate inside the core of the concrete and keeps concrete dry and stops electron transport process and therefore prevents corrosion.*

  *Reinforced steel bars in the concrete are protected by a passive layer of iron oxides, which are formed due to the high pH of the concrete. This layer protects the iron bar from corrosion. Migration of the Chloride ions with water catalyze chemical reaction that destroys the passive layer and exposes the iron surface to further corrosion, called pitting corrosion.*

  $Fe^{++} + 2Cl \text{ -------} \rightarrow FeCl_2$
  $FeCl_2 + H_2O + OH \text{ ------} \rightarrow Fe(OH)_2 + H^+ + 2Cl^-$
  $2Fe(OH)_2 + ½O_2 \text{-------} \rightarrow Fe_2O_3 + 2H_2O$ *(anode)*
  $½O2 + H2O + 2e^- \text{ ------} \rightarrow 2\ OH^-$ *(cathode)*

  *There is no "net use" of chloride ions during the corrosion process. Therefore, once enough chloride ions reach the steel to break the passivation layer only water, oxygen and a conductive medium is needed to maintain the corrosion reaction.*

  *Corrosion of the still bars in the concrete also occurs because of components of the air pollution, particularly $SO_x$ and $NO_x$. These pollutants react and dissolve in water to form acidic solution. This acidic solution penetrates inside the core of the concrete structure. Acids accelerate corrosion process. Zycosil prevents water and acidic pollutants to penetrate the concrete and prevents corrosion due to air pollution.*