# WATERPROOFING with Protectosil® BHN - FREQUENTLY ASKED QUESTIONS

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- What is the difference between silanes, siloxanes and silicones?

  *Silanes are monomeric compounds. Typically molecular size is 1-1.5 ηm. Siloxanes are low molecular weight polymers. Typical size of these molecules is 20-50 ηm. Silicones are high molecular weight molecules, mostly polydimethylsiloxane. Typical size of these molecules is 100-500 ηm.*

- When should **Protectosil®** BHN be applied on a new concrete structure?

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

- How should the surface be prepared before a **Protectosil®** BHN 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 5% solution of bleach (sodium hypochloride). Before applying the substrate should be dry, so that the adsorption of liquids is as high as possible.*

- What is the average consumption of **Protectosil®** BHN?

  *This depends on the adsorbance of the substrate and required depth of penetration. Typically >150 g/M$^2$ are consumed.*

- Why does **Protectosil®** BHN penetrate several cm into the concrete? What is the benefit of a deep penetration?

  ***Protectosil®** BHN is a monomer. The size of the molecule is less than 1 ηm. It can easily enter in the pores of the substrates. Additionally, because of the small size, the molecules flows through the pores branches in side the substrate.*

  *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 treatment against UV radiation*

- How can I achieve the best penetration depth?

  Use a multi step application. Two or more subsequent spray applications guide to very deep penetration (8 - 10 mm). The drying time between the single steps is 7 days for the best performance. With only low performance loss a wet in wet application is possible as well.

- Other commercial waterproofing materials contain siloxanes-silane mixtures. The manufacturer claims that these products penetrate and give better performance, what are advantages and disadvantages of this system?

  *Siloxanes-Silane mixtures contains a small amount of Silane, most likely, methyltrialkoxysilane. This molecule is 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 of centimeter. 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. However it is important to note that methyl-group very susceptible to UV attack. The methyl group does not give protection under any hydraulic pressure.*

- Is a silicone system better than **Protectosil®** BHN?

  *No. The typical silicone based system is 7-16 % solution in a hydrocarbon solvent.* ***Protectosil®*** *BHN is solvent free system. Therefore silicones are relatively less costly then* ***Protectosil®*** *BHN. The silicone based system initially gives better beading effect at the surface, which helps visualization of the waterproofing. This effect is not long lasting because silicones are not UV stable.* ***Protectosil®*** *BHN because of the good penetration gives a long lasting waterproofing effect.*

- Why does **Protectosil®** BHN cost 3-4 times more than a silicone based system?

  ***Protectosil®*** *BHN is solvent free system. The product is 100% active. It is high technology based product. It provides full protections for a long period of time (over 10-15 years). "****If you want Gold, then you have to pay Gold Price".***

- Why do siloxanes and silicones used as hydrophobizing agents form coatings?

  *Typically siloxanes are 20-50 ηm (nano meters) while Silicone polymers are 100-500 ηm or larger. These polymers form molecular clusters in solution or emulsion. The molecular clusters size possibly 10 times the molecular size. Typical concrete pore size is 10-100 ηm. Lime stones and other substrates pore size even smaller than these. 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.*

- Why are siloxanes and silicones dissolved in petroleum based solvent while **Protectosil®** BHN based product in alcohols?

  *Siloxanes and silicones are not generally soluble in alcohols. Therefore they are dissolved in hydrocarbon solvent.* ***Protectosil®*** *BHN is soluble in common alcohols.*

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

  *Solvents are used as carrier for the polymers. 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. Alcohol 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.*

- Is it still possible to paint a **Protectosil®** BHN treated surface?

  *Yes the surface can be painted after* ***Protectosil®*** *BHN treatment, because* ***Protectosil®*** *BHN does not change the surface appearance. The peel strength is not affected. In addition after applying* ***Protectosil®*** *BHN other surface modification products such as* ***Protectosil®*** *SC CONCENTRATE or* ***Protectosil®*** *ANTIGRAFFITI can be applied.*

- How long do I have to wait with a **Protectosil®** SC CONCENTRATE or **Protectosil®** ANTIGRAFFITI treatment after **Protectosil®** BHN was applied?

  *The optimum is to wait for 2 weeks, because the* ***Protectosil®*** *BHN is fully crosslinked. This is especially in the case of fresh concrete recommended in order to avoid effluorescences.*

- Why does a **Protectosil®** BHN treated surface not change its appearance? How do we know the surface is treated?

  ***Protectosil®*** *BHN reacts with substrates and alters the chemical structure of the surface. These changes occur on a nano-scale (molecular level). Therefore it is not visible compared to coating. The main amount of* ***Protectosil®*** *BHN is within the substrate.*

  *RILEM (Karstens) tube is a simple test that can be used to determine the treated surface.*

- If the pores are reacted and covered with **Protectosil®** BHN, then why it is still breathable?

  *The surface of the pores are reacted with **Protectosil®** BHN. This happens at a molecular level possibly 1-3 ηm high on the surface. So the pore size is reduced by this amount and still keeps plenty of space available for the vapor molecules (size 0.5-1 ηm) to pass through.*

- Can **Protectosil®** BHN be applied on a painted surface?

  *It is not recommended because painted surface keeps pores of the substrate closed. **Protectosil®** BHN gives long lasting protection only because of the penetration 1cm or more. Additionally, the paint will eventually peal off. **Protectosil®** BHN gives best performance when treatment is made on a cleaned substrate surface.*

- Can **Protectosil®** BHN be applied on a plaster?

  *Yes, plaster surface can react similarly to a concrete surface.*

- What is the advantage of still breathable concrete?

  *Concrete curing is hydration process. The binder cement reacts with water to form 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 achieves 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. If the entrapped water cannot evaporate then spalling is very likely in winter as ice crystals are formed which need a higher volume than liquid water.*

- What is efflorescing? 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 efflorescing. This process is detrimental to the structure since it creates voids and weakens the binder structure. In the case of concrete the efflorescence is due to non bonded calcium. The **Protectosil®** BHN treatment prevents water penetration inside the core of the substrate and therefore also prevents deterioration of the building structure. Therefore **Protectosil®** BHN can prevent secondary efflorescence, but not primary which is due to insufficient amount of water related to the concrete mixture.*

- What types of substrates can be treated with **Protectosil®** BHN?

  *Almost all material commonly used for construction can be treated with **Protectosil®** BHN. This includes (a) Concrete (b) Bricks (c) Sand Stone (d) Granite (e) Lime stone (f) Marble (g)*

- What are the waterproofing test methods for the building?

  *There are various tests to determine waterproofed surface. RILEM (Karstens) tube test is a simple non-destructive test available for vertical and horizontal surfaces. This kind of tube is attached on the waterproofed surface. Then it is filled with water and the drop in water level is observed over a 10-minutes period compared to an area which has not been treated..*

  *The other tests are destructive. A core sample of the treated substrate is taken and tested in the laboratory for water uptake (by weight measurements and water storage), the depth of penetration (visually by ink) or pyrolysis GC in order to measure the concentration profile of the silane.*

- Joints are the weakest structural part. Why? How does **Protectosil®** BHN provide protection of the joints?

  *Joints are relatively small components of the structures. They keep large structures together. Joints are normally under more stress then rest of the structure. Water penetrates easily because of the porous nature of the joint components. Water swells the joints and it de-swells whenever water leaves the joints. Swelling and de-swelling process generates voids and develops cracks.*

  ***Protectosil®** BHN reacts similarly with the material of the joints as to the rest of the structure. This treatment prevents water penetration into the joints. Therefore the swelling and de-swelling process can be avoided.*

- Why are cracks formed in concrete? How does **Protectosil®** BHN protect structures after 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.*

  ***Protectosil®** BHN penetrates deeply into the concrete structure. Micro cracks are normally 0.1 to 0.2 mm of width and 2-10 mm deep. Therefore the crack surface is still protected from water infiltration.*

- Why do building structures accumulate 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).*

- Are very small alkyl groups like methyl-functions suited for concrete protection?

  *No. Methylsiloxanes can hydrolyse at the high pH we have in concrete. Soluble siliconates and complete loss of hydrophobization properties are the result. Therefore a chain length of minimum three carbon atoms is necessary. The isobutyl function in* ***Protectosil®*** *BHN shows very good penetration characteristics, excellent alkali stability and only low loss due to evaporation.*

- Is **Protectosil®** BHN alkali resistant?

  *Yes. This can be measured when the reduction of water uptake is determined after samples have been stored in a 5% KOH solution. The reduction of water uptake should be still >90%.*

- Why does **Protectosil®** BHN help against sulfate attack of concrete?

  *A sulfate attack on concrete results from a chemical reaction between the sulfate ion and hydrated calcium aluminate and/or the calcium hydroxide components of the hardened cement paste in the presence of water. Main reaction products are ettringite and gypsum, whose volume is greater than the solid reactants. Therefore stresses occur and as a result spalling.*