

Why use Nanotechnology for Protecting and Water Proofing Surfaces?

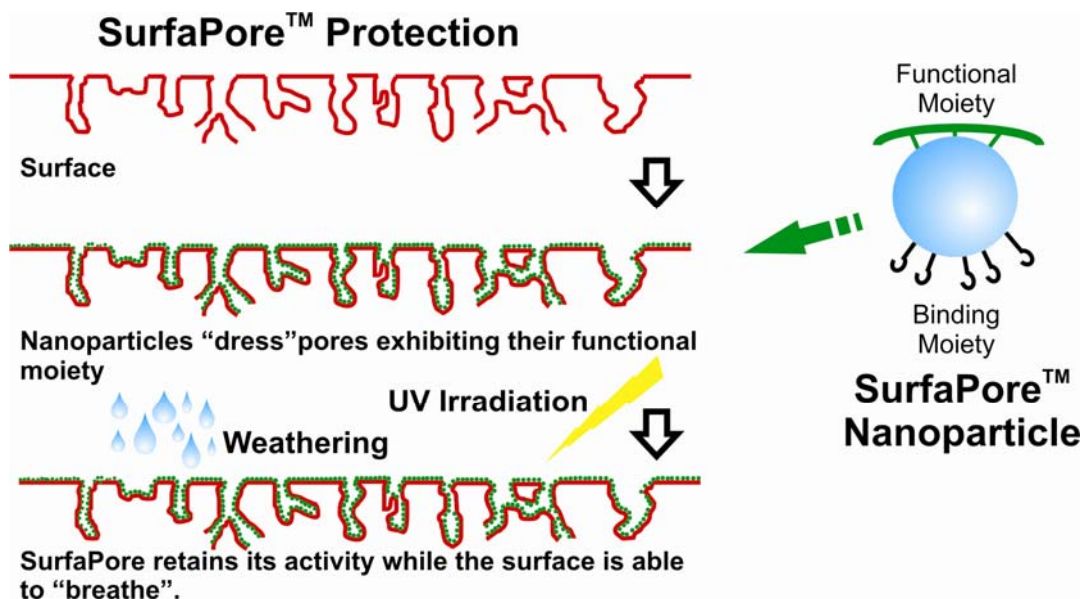
NanoPhos SurfaPore™ Product Line

What is nanotechnology?

Nanotechnology refers to the scientific field, which deals with very small structures, usually sized below 100 nm. One nanometer (nm) stands for one billionth of a meter (10^{-9} m) and it is so small that if earth was one meter in diameter, then one nanometer would have been the size of an apple! Nanosized materials reveal unique properties when compared to ordinary, bulk materials or even molecules. At NanoPhos, we take advantage of these unique properties to develop applications that are user-friendly, safe, cost effective, but most importantly, to address everyday problems.

Why nanotechnology on my surfaces?

SurfaPore™ formulations act completely differently, when compared to any two-component (2K) or silicone based formulations, as they do not create a “plastic film” on the surface applied. For example, SurfaPore C protects and waterproofs surfaces, by deeply penetrating the pores of cement based substrates: Instead of sealing the pores, nanoparticles “dress them”, assuring that water or other corroding factors are effectively repelled by chemical forces. In this manner, protection is provided deeply in the substrate which is therefore not affected by abrasion or mechanical wear. As nanoparticles do not form polymer chains, SurfaPore modified surfaces can last longer; even after eight years they exhibit 95% of their original activity or functionality. SurfaPore modified surfaces are more resistant to the “hard” part of solar light (UV radiation) which does not induce the “yellowing” effect.



It is evident that SurfaPore formulations do not alter the color and the natural appearance of the surfaces modified, as they do not create any film or membrane.

Why is “breathing” so important?

A very important advantage of SurfaPore™ technology is that modified surfaces can still “breathe” after application. In particular, in case of water leakage or moisture behind the SurfaPore C or R or W modified surfaces, water can evaporate to the environment without accumulating behind the building’s surface. This is achieved by the fact that water vapors can still travel outside through the pores of the material. At the same time, water is also blocked from the environment from being transferred inside the material. In this way, building failures (swelling, cracking, warping) are prevented. All in all, SurfaPore™ modified surfaces remain dry and unchanged in both appearance and mechanical properties.

Can marble and granites be protected from stains?

Frequently, stains can penetrate inside the microporosity of surfaces and destroy the aesthetic appearance of marbles, granites or unglazed ceramic tiles. NanoPhos’ nanoparticles can dress these small pores and seal them permanently. In this manner, our precious surfaces can possess anti-staining properties and retain their original natural appearance.



General Description of SurfaPore™ formulations

SurfaPore™ are water based formulations, developed and produced by NanoPhos SA, in order to provide effective water proofing, stain proofing, protection and “shielding” of building surfaces. As their viscosity is close to that of water, they can be easily applied by roller, brush or spraying. Their unique nanotechnology composition protects surfaces against water, corroding factors and weathering. This assures effectiveness, prolonged lifetime preserving the original, natural appearance. Although SurfaPore™ formulations are composed of advanced nanotechnology based particles, they are really cost effective.



Safety

SurfaPore™ formulations are considered not hazardous according to Council Directive 1999/45/EC and its subsequent amendments - they are water based, without hazardous solvents. It is important to note that their Volatile Organic Content (VOC) is far below EU regulations, even for the year 2010! Indicatively, for SurfaPore™ C the VOC is 24 g/L while the maximum EU VOC content limit value (Directive 2004/42/CE) for ready to use products (category A/c “coatings for

exterior walls of mineral substrate”, Type WB) is currently 75 g/L and has been set to 40 g/L for 2010. Material Safety Data Sheets are readily available.

Application Example: SurfaPore™ C

SurfaPore™ C can be applied on existing surfaces by roller, brush or spraying (manual or automated). The consumption rate is estimated at 8-10 m²/L, strongly dependant on the properties of the surface applied. Maximum water repellency is achieved 24 hours after application. No other modification is necessary. Only on very absorptive surfaces re-application is necessary, within 3 hours.



The versatility of SurfaPore™ C application is remarkable: Grout or cement can be formulated by replacing 1/3 of water used in the mix with SurfaPore C. Adequate mixing is required. There is no change in setting time, or mechanical properties of the resulting material. On the other hand, the material is water proof and thoroughly protected.

Tests & Results under International Standard Procedures

ASTM E514 – Pressure Driven Water Resistance

This testing procedure refers to the water resistance under constant pressure conditions. Five SurfaPore C modified masonry samples were examined under 500Pa pressure (water tank method) for 120h:

Reduce of Water Penetration: 89,2% ±2%

Reduce of Water Leakage: 99,4% ±2%

Stability under Ultra Violet (UV) Irradiation

This testing procedure examines the resistance of SurfaPore coatings under continuous ultra violet irradiation, for comparison reasons, a competitive silane, solvent based product is sited. As a measuring method, the contact angle between the SurfaPore modified surface and a 50 µL water droplet was measured. Adequate water repellency is achieved when contact angles exceed 90 degrees.

	Time (hours)	SurfaPore™ C	Competitive Product (silane/solvent based)
Initial Modification	0	137	140
(+ 500h UV/water condensation)	500	108	87
(+ 1000h UV/ water condensation)	1000	103	56
(+ 1500h UV/ water condensation)	1500	105	38
(+ 2000h UV/ water condensation)	2000	92	<20

SurfaPore™ C exhibits at least 3 times more resistance to UV irradiation.

RILEM Test 11.4 - Measurement of Water Absorption on Cement Based Materials

The test procedure RILEM 11.4 determines the water absorption rate of a vertical cement based surface, using a 10 cm glass tube, full of water. The loss of water from the tube, due to water absorption of the surface is measured in time (24h max). Glass tube water loss (in cm) is reciprocal to the water repellency and protection of the cement based surface. For water resistant surfaces, loss of water is under 4 cm, whilst for water proof surfaces the loss of water must be below 1cm.

RILEM tube water loss (cm)							
	15 min	30 min	1h	2h	4h	8h	24h
Unmodified Sample	0,7	1,8	2,5	>4	>4	>4	empty
Unmodified Sample + 1000h UV	1,1	2,2	4	>4	>4	>4	empty
SurfaPore C +1000h UV	0,10	0,10	0,10	0,10	0,20	0,30	0,40
SurfaPore C	0	0,05	0,10	0,15	0,20	0,30	0,50

ISO EN 1015-18 Capillary Coefficient Determination

Capillary Coefficient C (g/(dm².min^{1/2})) determination values are reciprocal to the water absorption ability. 100g of cement powder was used for preparing necessary samples. Each sample requires at least 17g of water to achieve a settable and workable cement paste. C values below 0.11 are considered extremely effective water protection.

Water/SurfaPore™ C Ratio (g)	C (g/dm ² .min ^{1/2})
17/0	0.19
0/17	0.06
14.5/2.5	0.12
12/5	0.10
10/7	0.06
Surface modification with SurfaPore C	0.05

Water Vapour Permeability Loss

Water Vapor Permeability was determined as the rate of water vapors “travelling” through a 2cm thick cement sample.

	Vapor Permeability	% Loss
Unmodified Sample	$6,02 \cdot 10^{-3} \text{ h}^{-1}$	-
SurfaPore C – Surface Application	$5,79 \cdot 10^{-3} \text{ h}^{-1}$	3,82%
SurfaPore C – Mixing with Powder instead of water	$4,81 \cdot 10^{-3} \text{ h}^{-1}$	20,10%