

Product Information

Nano-Based Stain-Proof Water Repellents For Polished Tiles

- ✓ *Stain Proofing*
- ✓ *Water Repellent*
- ✓ *Permanent*
- ✓ *NanoTech Based*
- ✓ *Water Dilutable*
- ✓ *Low VOC*

KEY FEATURES:

- Specifically designed for Polished and Stain Absorbing tiles.
- Ambient temperature applicable.
- Permanent Stain and Water Proofing
- VOC regulations compliant

KEY BENEFITS:

- High penetration depth
- Self-crosslinking and polymerization after application
- Exceeds ISO 10545-14 standards performance
- Protects xylene or organic solvent based stains
- Extremely low consumption

SurfaPore™ T

SurfaPore™ T: Sealing Nanotechnology for Polished, Porcelain and Absorbing Ceramic Tiles

Porcelain, polished ceramic tiles have many superior properties comparing to ordinary stone surfaces. These tiles are renowned for their superior strength, colour pallet and chemical resistance. However, polishing procedure creates micro-craters which accumulate dirt and destroy the aesthetic superiority of these high-value surfaces. SurfaPore™ T protects the unique properties of polished tiles against their major threat: stains. A unique nanotech driven formulation, specifically designed for sealing micro-pores and inducing water repellence.

It is important to preserve the aesthetics of polished ceramic tiles surfaces while protecting them against staining and water. After extensive research that helped understand the procedure of staining, we formulated SurfaPore™ T to exactly “fit” the structural and surface properties of these tiles.

A stain-roof and water repelling coating design for porous tiles has to confront multiple restrictions: It has to be compatible to the pore size distribution. Additionally the special coating has to seal permanently the “stain wells” and not induce any visual changes on these shiny surfaces. SurfaPore™ T has to be compatible with existing production lines, without inducing production “bottlenecks” or imperfections. User friendly composition and safety precautions are prerequisites.

SurfaPore™ T was designed to fit these requirements. **The nanoparticles based formulations allows an invisible modification of these tiles both at the production stage and post-installation. Nanoparticles allow development of permanent stain proof properties.** Give an end to the deterioration of your unique properties.

DESCRIPTION

SurfaPore™ T is a water stabilized emulsion, composed from nano-sized particles. Their action is depicted in *figure 1*:

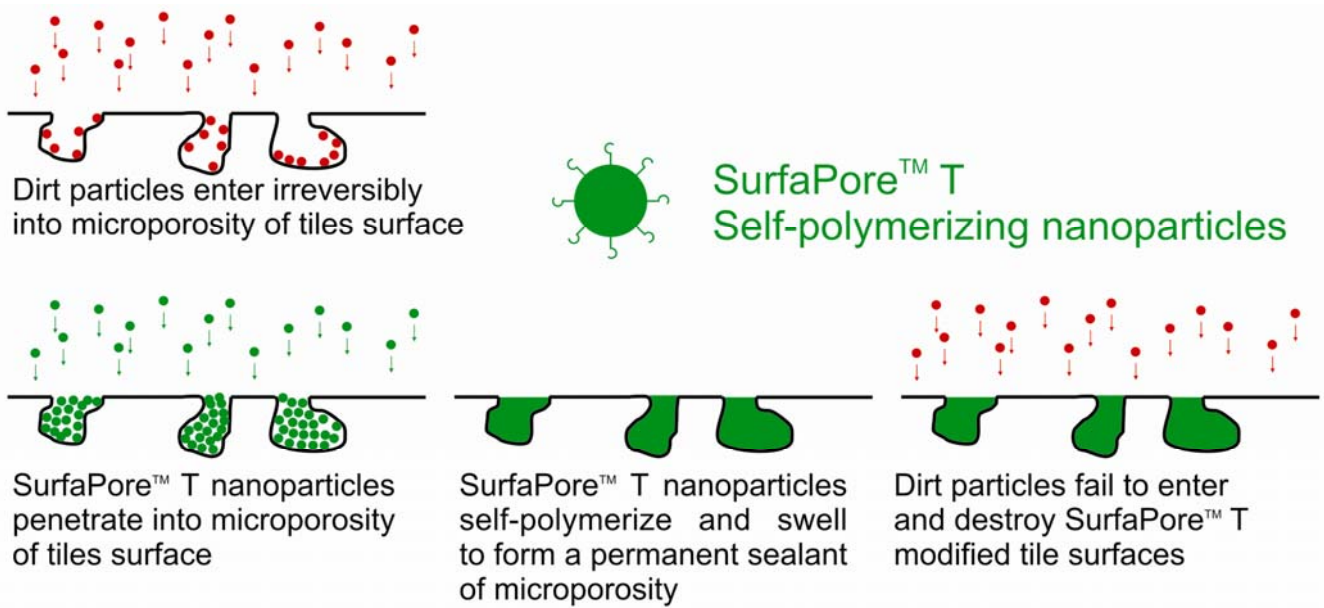


Fig. 1 - Comparative action graph of SurfaPore™ T, with functional nanoparticles structure also depicted

The resistance to stains of polished porcelain stoneware tiles depends to a large extent on the surface microstructure. The amount of stain retained by the tile surface is proportional to the concentration of superficial defects, either inherited by the ceramic body (i.e. pores) or originated during polishing (e.g. grooves, scratches) (see fig. 2).

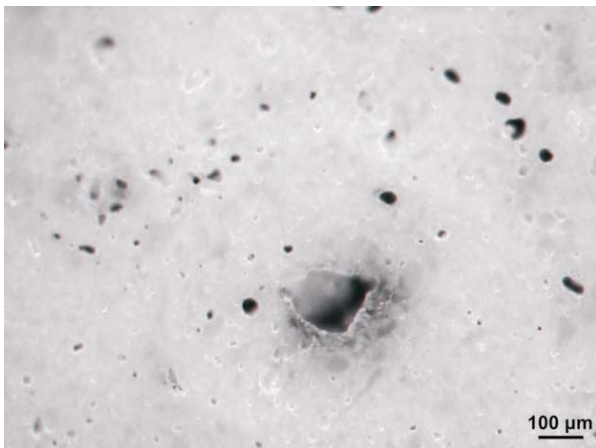


Fig. 2 - Polarized microscopy image depicting surface imperfections responsible for stains accumulation.

Superficial defects are attributed to the presence of two concurrent populations of different types of flaws: Flaws due to the production technology (pressing and sintering), i.e., the bulk porosity uncovered by the removal of the surface layer; and flaws due to machining-induced damage, i.e., cuts, scratches and chipping due to lateral cracks, as a consequence of an incorrect machining procedure. The morphology of the polished

working surface, therefore, does not favour either stain resistance or cleanability. Staining substances and dirt can penetrate into the uncovered pores and induced defects. Removal of the resulting stains often can be difficult. One of the most annoying consequences for the polished working surfaces concerns the aesthetic degradation because of the presence of halos and stains.

SurfaPore™ T action mechanism is simple in conception but effective in practice: The core nano-sized particles, suitably engineered to fit the pores of a polished porcelain stoneware tile, penetrate and “flood” pores that can accumulate dirt. The nanoparticles have the ability to self polymerize and create an impermeable rigid of inert material. At the same time, SurfaPore™ T has already anchored on the tile surface, so as the coating modification is permanent and effective. After modification, dirt particles fail to penetrate into the microporosity of the tile. Therefore, an important, value-adding objective has been achieved: Permanent pores impregnation provides stain proofing and easy cleaning properties.

Apart from stain proofing, the molecular design of SurfaPore™ T nanoparticles induces an additional useful property: The hydrophobic moiety, attached on top of the core nanosized particles, is responsible for the

creation of a continuous hydrophobic layer that covers free surface of each tile.

Most traditional sealers are based on “plastic” isocyanate hardened polymers or small silicon based molecules (most often corrosive Potassium Methyl Siliconate, PMS) that react with atmospheric carbon dioxide to create an impermeable water barrier. Even though their action might initially seem effective, they detrimentally diminish the useful life time of polished porcelain stoneware based products by restricting their breathing ability and by creating efflorescence spots (white spots).

NanoPhos introduces a brand new approach that promotes the distinctive advantages of the polished tiles surfaces. Instead of covering the tile surface with polymerizing additives, SurfaPore™ T dresses and fills the pores, the capillaries and the “wells” of the unglazed surface, providing a permanent solution for the staining problem. Instead of covering your favourite with a plastic membrane, use SurfaPore™ T nano-solution to impregnate pores and retain abrasion strength and shiny appearance. At last, a unique way of protecting has been invented: **A Gore-Tex™ for polished, porcelain stoneware tiles!**

FORMULATIONS & PACKAGING

SurfaPore™ T is a single component (1K) coating that is ready for application, without any manual intervention.

SurfaPore™ T is supplied in 30L PE canisters, 200L metal pails and 1000L PE palette tanks. All canisters are equipped with safety closures.

SurfaPore™ T is also available in ready-to-use, DIY (Do-It-Yourself) formulations. 1L PE bottles and 4L PE canisters are readily available. 1L bottles are equipped with safety closures. 4L PE canisters are equipped with air-tight aluminium sealing disks and a semi-transparent volumetric stripe.

TYPICAL PROPERTIES & SAFETY

Product safety information required for safe use is not included in this document. Before handling, read product and

material safety data sheets and container labels for safe use, physical and health hazard information. The material safety data sheet always accompanies the product supplies and is always available upon request.

SurfaPore™ S formulations are considered irritants and appropriate safety measures have to be undertaken.

SurfaPore™ S does not contain silicon hydrides and therefore it is not considered explosive. However, the closed cup flash point value sets SurfaPore™ S a flammable material.

Typical properties are summarized as follows:

| SurfaPore™ T | |
|--------------------------------|---------------------------|
| Appearance | Clear, yellow pale liquid |
| Non-Volatile content | 65% |
| Density | 1.048 kg·L ⁻¹ |
| Viscosity | 15 cSt or 15,72 cP |
| Volatile Organic Content (VOC) | 370 g·L ⁻¹ |
| Flash Point, closed cup | 27°C |
| Storage life (at 0°C -35°C) | 12 months |

Table 1 – Typical properties of SurfaPore™ T formulation.

This product reacts with atmospheric humidity. Prolonged contact with air should be avoided as well as contact with small amounts of water. **Keep containers well sealed.** When stored at or below 35°C in the original unopened containers, this product has a usable life of 12 months from the date of manufacture. Do not apply when the ambient temperature is at or below 5°C, or when the substrate is frozen.

HOW TO USE

SurfaPore™ T was designed to provide ease of use for both industrial and DIY applications. However, proper application is most crucial in order to combine maximum efficiency with unaffected aesthetic result. The following instructions are provided in order to achieve maximum pore penetration, without any surface residues.

Industrial Application

SurfaPore™ T as supplied is ready for use and no further dilution is necessary.

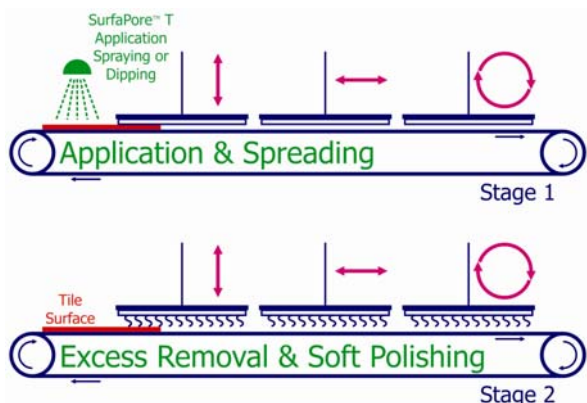


Fig. 3 – Graphical representation of SurfaPore™ T modification as part of tiles production line. Pink arrows depict the spreading/polishing direction of the overhead rotaries.

Achieve maximum SurfaPore™ T spreading on the unmodified tiles by using either curtain spraying equipment or dipping and subsequent spreading with rotary brushes (stage 1, *see fig.3*). Estimated consumption rate is 50-100 m²/L, strongly dependant upon the application method. Subsequently, remove the excess of application by using fast rotating brushes (rotating speed 150 rpm), until “wet” modification is not visible (stage 2, *see fig.3*). An optimal modification result is achieved if brushes of stage 2 are equipped with an absorptive clothing material. No other modification is necessary. Maximum stain excluding efficiency is achieved 36 hours post surface application.

Substrate heating: Heating the substrate before the application of SurfaPore™ T at temperatures of 70°C can help modification procedure as the liquid is thinned and is easily “sucked” in the microporous defects. However, it is not considered necessary.

Air-blowers heating: Heating the SurfaPore™ T “wet” coating during application is not recommended as a solid, dry crust may induce visual defects and diminish the shine of the tiles. However, post-excess removal hot air blowing can help reduce slippery residues that affect following packing procedure.

Equipment cleaning: Equipment or spraying equipment can be cleaned using water, before SurfaPore™ T dries completely. Solidified SurfaPore™ T might require mechanical removal.

Post Treatment Application – DIY

Use SurfaPore™ T ready-for-use canisters. Apply using a brush, a roller or a sprayer on the surface of the existing polished porcelain stoneware tile surfaces. Remove application excess by using an absorptive towel or paper. Continue polishing the tile surface, until no apparent wet residue is visible on the surface. SurfaPore™ T nanoparticles have already penetrated and sealed pores, inducing stain-proof properties. No other modification is necessary. Maximum stain excluding efficiency is achieved 36 hours post surface application. Consumption per unit area is estimated at 20-25 m²/L, depending on the absorption properties of the surface.

PERFORMANCE & RESULTS

APPEARANCE AND VISUAL EFFECT.

Results are based on laboratory testing of light coloured, polished, porcelain stoneware samples.

White polished porcelain stone tiles samples were modified procedures described in the previous section (HOW TO USE – Post Treatment – DIY section). The DIY application pattern was selected as elevated SurfaPore™ T load might induce visual surface defects. Comparison was made with a Spanish, market leader, product formulation with anti-staining properties. At least 10 samples were tested. Each treated sample was left to cure for 48h before testing.

Results are depicted in fig.4:



Fig. 4 – Picture of a modified, white porcelain stoneware tile after stain-proofing treatment. Both SurfaPore™ T and competing areas are depicted. The middle stripe indicates a non-modified area.

Visual inspection control indicates that there are no defects attributed to surface modification with SurfaPore™ T. The tile samples retain their shine and glossy essence.

STAIN RESISTANCE.

Industrial standard tests follow EN ISO 10545-14 to determine stain resistance.

White polished porcelain stone tiles samples were modified procedures described in the previous section (HOW TO USE section). At least 10 samples were tested. Each treated sample was left to cure for 48h before testing. Following EN ISO 10545-14 testing procedure, the following materials were used as staining agent: a) a green staining agent (chromium^{III} oxide 50 µm particles in glyceryl tributyrate) and b) a red staining agent (iron^{III} oxide 50 µm particles in glyceryl tributyrate).

Results are depicted in fig. 5:

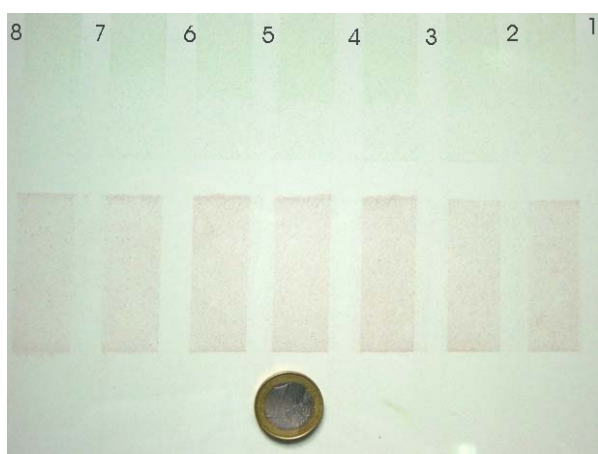


Fig. 5 – Staining performance following the EN ISO 10545-14 standard. Numbers indicate SurfaPore™ T modified vertical stripes.

As *figure 5* depicts, the vertical 1-cm stripes indicate SurfaPore™ T modified areas. Each stripe is placed about 2 cm away from another. The (partially) modified tile was covered with the staining emulsions of iron (III) and chromium (III) oxide. The stains were left for 10 minutes on the surface of the sample and subsequently thoroughly washed with water and sponged with an ordinary kitchen detergent. The results indicate that the unmodified areas in-between the vertical (modified) surfaces are highly susceptible to staining, whilst **the SurfaPore™ T modified areas exhibit zero tolerance to staining.**

In order to assess anti-staining performance of SurfaPore™ T against aggressive stains, a xylene based black marker was used. Comparison was made to a Spanish, market leading anti-staining coating formulation. Both coatings were applied in exactly the

same way. Stain removal was performed by flooding the stained areas with ethanol (alcohol):

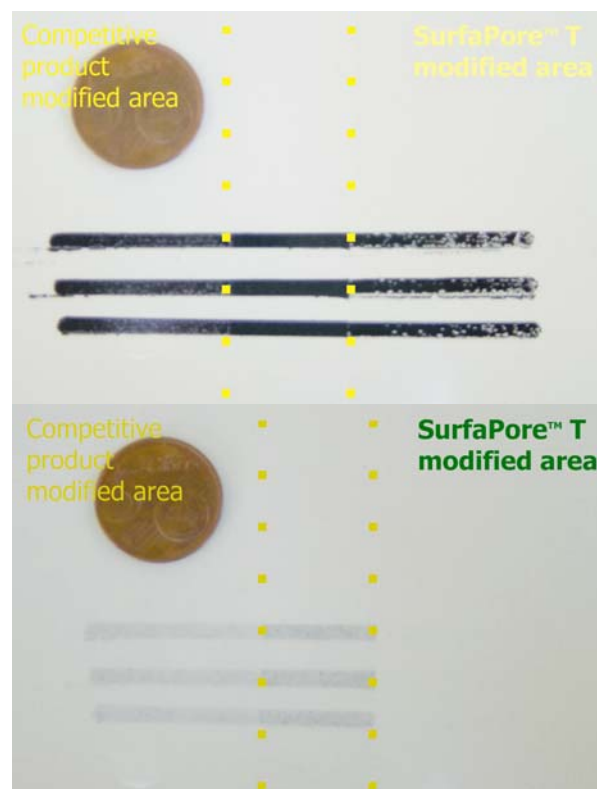


Fig. 6 – Staining performance using a xylene based black marker. Both staining procedure (upper image) and appearance after washing (lower image) are depicted. The middle stripe indicates a non-modified area. Note the beading effect of the organic stain on the SurfaPore™ T modified area (upper image).

Even during the staining procedure, the xylene marker ink was strongly beading, underlying the chemical incompatibility of stains with the SurfaPore™ T coating. This experimental fact also underlies the easy cleaning properties, developed on the modified area.

Figure 7 depicts a similar staining procedure.

The efficiency of SurfaPore™ T coating is exceeding any competitive products and elevates the quality level against staining in Class 5 (ISO EN 10545-14 standard). It is important that no other parameter of quality control (mechanical properties, anti-slip properties or other) is affected, as modification is taking place inside the microporosity of the polished porcelain stoneware tiles.

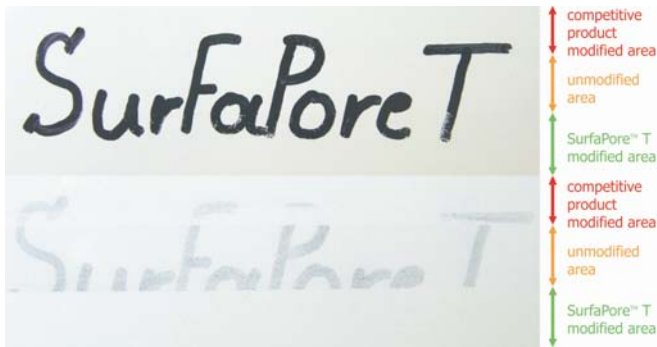


Fig. 7 – Staining performance using a xylene based black marker. Both staining procedure (upper image) and appearance after washing (lower image) are depicted. Note the beading effect of the organic stain on the SurfaPore™ T modified area (upper image).

AGEING TESTS.

In order to assess life time expectancy of SurfaPore™ T coating, modified samples were examined under concentrated oxidative bleach and steam treatment. Figures 8 and 9 depict the efficiency of coating, especially comparing to competitive products.

White polished porcelain stone tiles samples were modified according to procedures described in the previous section (HOW TO USE section). At least 10 samples were tested. Each treated sample was left to cure for 48h before testing. For the bleach test, coated samples were immersed in a 10% sodium hypochlorite solution for 2 hours. For the steam test, coated samples were steamed with a 3% aqueous KOH solution for 2 hours. Steam was injected at 3 bars. Staining tests were performed after ageing and thorough cleaning of substrates with fresh water. Black xylene marker test was used to evaluate anti-staining efficiency.

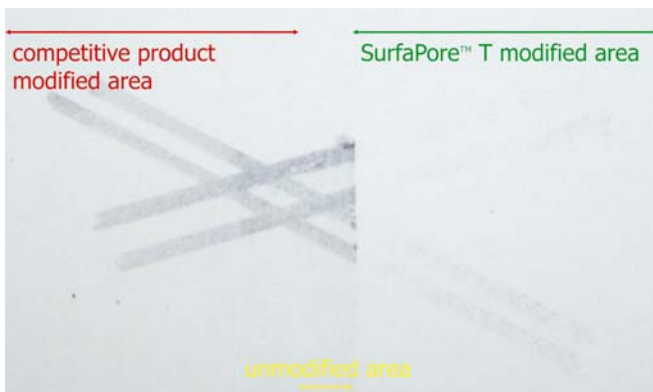


Fig. 8 – Staining performance after immersion in a bleach solution for 2 hours, using a xylene based black marker. The image depicts efficiency after ageing and washing the sample.



Fig. 9 – Staining performance after steam injection for 2 hours, using a xylene based black marker. The image depicts efficiency after ageing and washing the sample.

PRICING & AVAILABILITY

Pricing and availability of the SurfaPore™ T formulation is strongly dependant to the volumes and other crucial parameters. NanoPhos is committed to provide added value products in a cost effective way.

| | Packaging | Price per L |
|--------------|-----------|-------------|
| SurfaPore™ T | 30L | |
| SurfaPore™ T | 180L | |
| SurfaPore™ T | 1000L | |

The indicated prices do not include applicable taxes and are declared EXW Athens, Greece. Indicated prices cannot be considered as part of an offer quotation and are subject to change without any previous notice.

Apart of industrial solutions, NanoPhos SA is always seeking for value added partners that wish to co-brand and promote value added products in retail market. 1L PET bottles and 4L PET canisters are readily available. 1L bottles are equipped with safety closures. 4L PET canisters are equipped with air-tight aluminium sealing disks and a semi-transparent volumetric stripe.



Fig. 10 - SurfaPore™ T 4L PE containers.



Fig. 11 - SurfaPore™ T 1L PE bottles.



Fig. 12 - SurfaPore™ T 4L PE containers are equipped with semi-transparent volumetric stripe & aluminium air-tight sealing disk.

NOTES

¹ - GORE-TEX®, GORE® and designs are trademarks of W. L. Gore & Associates.

This product is neither tested nor represented as suitable for medical or pharmaceutical uses.

LIMITED WARRANTY INFORMATION – PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that NanoPhos' products are safe, effective, and fully satisfactory for the intended end use. Suggestions of use shall not be taken as inducements to infringe any patent.

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Product Data Sheet – Ver. 1.0 (April 2007)s