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Anti-Graffiti and Easy-To-Clean Properties On Porous Mineral Surfaces are Achieved by Using Waterborne Fluoroalkylsilane Systems

K. Weißenbach and B. Standke
Degussa AG, Germany

Abstract

Currently there are two "hot" topics in the field of building protection: protection against water ingress, and protection against all kinds of soiling, especially graffiti. Silanes can take care of both. Fluoroalkyl-modified silanes proviude excellent hydro- and oleophobic effects on a large variety of surfaces. Some years ago Degussa's first fluoroalkyl silane product DYNASYLAN® F 8261 was commercially introduced. Since then, we have developed a new family of water-based fluoroalkylsilane products which generate invisible, weather-resistant and breathable coatings on porous mineral surfaces. The outstanding surface properties created by waterborne fluoroalkylsilane products, especially on porous mineral-based surfaces, result in permanent anti-graffiti coatings that are easily cleaned. Anti-soiling effects and protection against algae and mildew are also achieved. This presentation will discuss the performance of waterborne fluoroalkylsilanes in various fields of application. The performance of waterborne fluoralkylsilane system is compared with that of conventional antigraffiti systems.

1 Introduction

People who care for buildings, building materials and architechture are interested in the protection of these materials. A special challenge in building protection is presented when a surface combining both water-repellent and anti-soiling properties is required. Concrete, different kinds of sandstone and limestone need different kinds of protection. This ranges from protection against water ingress to protection against all kinds of soiling, especially graffiti. The latter requires expert choice to ensure protection. The protection system should not damage or deteriorate the building material in any way. Important properties for these systems are water vapor permeability, water borne (solvent-free) formulations and the requirement that they do not change the appearance of the surface.

For all these problems two main properties of the surface are needed: hydrophobicity and oleophobicity. The combination of a hydrophobic impregnation and an antigraffiti or easy-to-clean coating on the surface provides a perfectly protected building material.

In large cities, especially near every train station in central Europe tags, love mails, hate slogans and other graffiti can be seen. Most of these graffiti are ugly—only few show real creativity and have the intention to enliven grey concrete areas with color. In these areas, crime rate is usually higher, people no longer feel secure and this leads to a vicious circle. Hence, the goal is cleaner cities with less graffiti hoping that this will break that circle.

2 Background

The presence of liquid water within porous mineral material can cause various reactions such as growth of algae and mildew, movement of salts, etc. Preventing liquid water from entering the material will minize these reactions. Comparing an unprotected sand-lime brick (Fig. 1 left) and a protected one (right) the difference can be clearly seen: the photo on the right shows a clean facade due to the excellent anti-fouling effect of Protectosil® Antigraffiti. The one on the left shows mildew, algae etc. Even older facades protected with this product look “like new”, i.e., remain clean, for long periods of time.

3 Easy-to-clean surfaces

Protectosil® Antigraffiti, an oleophobic silane system, prevents water from wetting the surface of porous mineral materials. The absence of water (not the impregnation) on the surface decreases fouling with mildew, algae, etc. A diluted aqueous solution of Protectosil® Antigraffiti applied to the facade results in a stain-resistant and easy-to-clean surface. Facades protected with this oleophobic silane system look just like new ones.

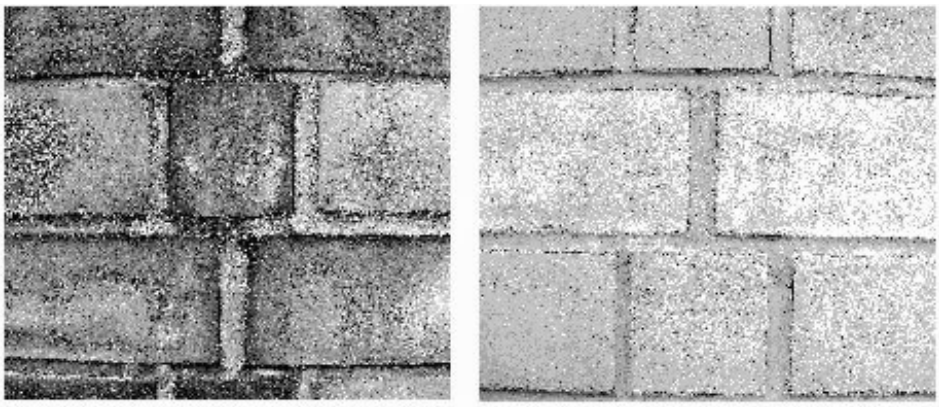

Figure 1: Left: unprotected sand-lime brick, right: protected sand-lime brick (Protectosil® Antigraffiti), both after one-year of outdoor weathering

4 Combination of easy-to-clean properties and hydrophobization

The oleophobic silane system chemically bonds to the surface of the material conferring to it very good hydro- and oleophobicity. To obtain this excellent surface effect the product was designed to have low penetration and to works only on the surface. However, to get the best protection against water damage, building materials must be protected in depth (hydrophobic impregnation). For this purpose an impregnation with a water repellent such as DYNASYLAN BHN (actual product depends on the building material) can be used since it is compatible with Protectosil® Antigraffiti that provides the easy-to-clean surface. This results in the combination of both effects: high penetration depth for very good resistance against water-ingress and an oleo- and hydro-phobic surface for anti-fouling effects. This is shown in Figure 2.

5 What kind of products are present on the antigraffiti market now?

Currently there are both permanent and temporary (sacrificial) anti-graffiti systems on the market. Both kinds have advantages and disadvantages. Table 1 shows a comparison of the two best-known systems: the polyurethane (PU) and the wax system.

The differences between the two mentioned systems are obvious. But to-date, there is no permanent, invisible, breathable and easy-to-apply antigraffiti system available on the market.

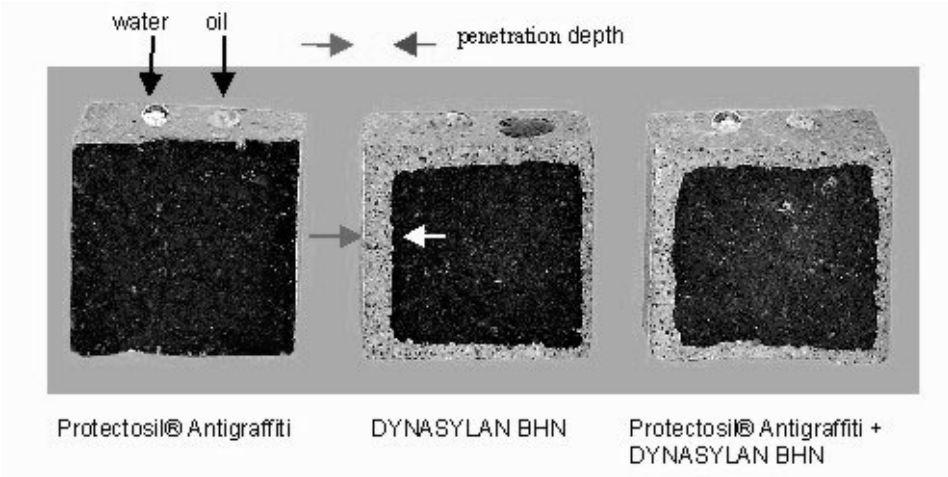

Figure 2: Penetration depth of, from left to right: a) Protectosil Antigraffiti, b) DYNASYLAN BHN and c) combination of a) and b)

	PU system	Wax system
Advantages	- Permanent (>10 cleaning cycles) - good anti-graffiti effect	- cheap - easy application - easy cleaning
Disadvantages	- visible - water vapor impermeable (vapor barrier) - complicated application - solvent based	- perhaps visible after cleaning and re-application - water vapor impermeable after re-application - notp ermanent

Table 1: Comparison between the two most common antigraffiti systems

6 The advantages of Protectosil Antigraffiti

The advantages and disadvantages of existing systems shown above lead to the development of our new product which aims to overcome the disadvantages of both the PU and the wax systems. Protectosil® Antigraffiti was designed to be permanent, invisible, breathable, waterborne and UV-stable.

Protectosil Antigraffiti

- is permanent (>15 cleaning cycles) [1],
- forms a nearly invisible coating,
- is highly breathable (SD = 0,064 m)[2],
- is water-borne,

- is stable against UV radiation
- is easy to apply,
- is solvent free,
- can be applied to many substrates (concrete, granite, marble, clinker, brick, mineral plaster...).

Protectosil Antigraffiti is an oleophobic silane system. The product can be applied with common equipment. First it is applied in diluted form, for example with airless spray equipment or brushes. The first application should be carried out from the bottom of the wall upwards to prevent premature impregantion by material running down the surface. The water-repellent effect appears within a few minutes. For permanent protection against graffiti, further applications are required. The surface must dry completely before applying the second coat. For the second and subsequent coats, it is recommended to apply the product in a fine spray. A layer of liquid droplets forms on the surface which must be worked in with a brush or a swab. It is important to make sure that the liquid is evenly distributed, i.e. the surface is wetted evenly. The coat must be applied in one operation to avoid overlapping. The subsequent coat must be applied after the previous coat has dried completely.

Protectosil Antigraffiti can also be combined with water repellents.

7 Oleophobic silane systems against graffiti. Water-based permanent graffiti protection

A protected surface which shows oleo- and hydrophobic properties repels paints, varnishes and many other kinds of markings very well. Paints and inks, since they do not wet the surface, cannot penetrate the surface to creep deeper into the porous mineral material. The low energy surface ensures that paints, inks and varnishes can be easily removed. In Figure 3 two red sandstone samples are shown, the one on the left is unprotected, while that one on the right is protected with Protectosil® Antigraffiti. Both stones were treated with the same paint. The top part was cleaned with the same graffiti remover and rinsed with water on both stones. The unprotected one shows the typical shadows of a "cleaned" but unprotected surface. The paint on the protected stone can be removed completely. The surface repellency effect can be seen in the paint circles.

8 Test procedure for performance evaluation

According to performance requirements by the „Regelwerk der Gütegemeinschaft Anti-Graffiti e. V.", samples–e.g. paving stones–are treated with the protection system and the performance test is carried out. Eight to ten different colors of paint

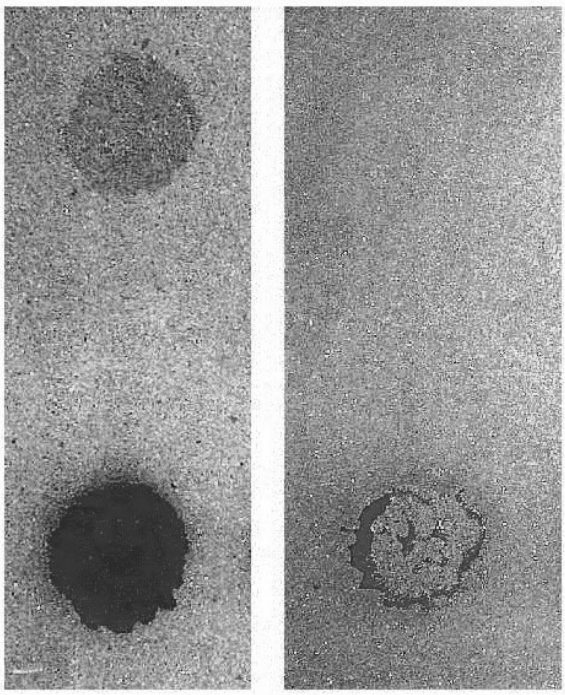

Figure 3: Red sandstone, left: unprotected, right: protected with Protectosil Antigraffiti; both sides top: cleaned with graffiti-remover and water

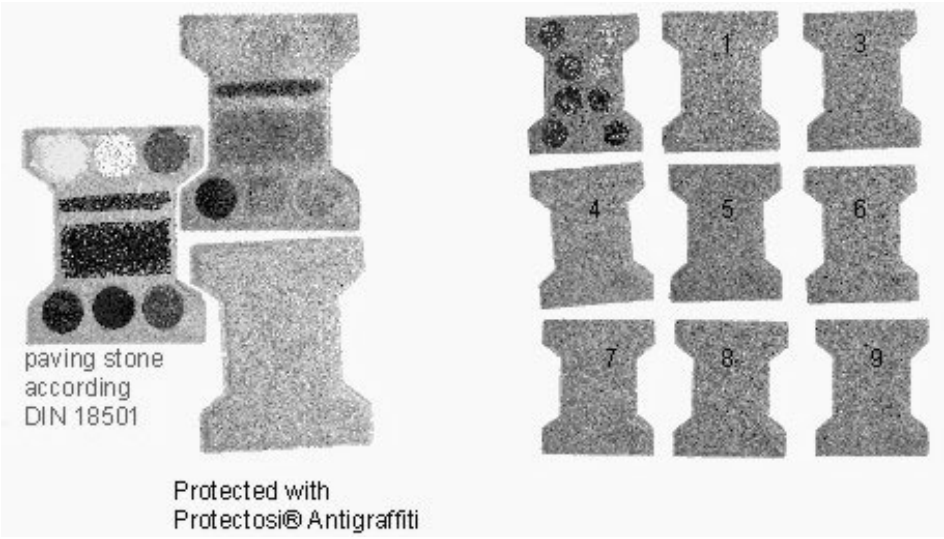

Figure 4: Stress tests to evaluate the performance of anti-graffiti systems.

are applied on the surface which then is cleaned. The difference between a protected and an unprotected paving stone can be seen on the lefthand side of Figure 4. The upper stone is unprotected and shows shadows after cleaning. The lower stone, protected with Protectosil Antigraffiti, shows no paint residues at all. This specimen is now subjected to the so-called stress-test, i.e., several painting and cleaning cycles. Four different paint colors are applied on the surface (see Figure 4, righthand side). After the first cleaning cycle, the outer spots remain in the same place, the inner ones are rotated clockwise. Next cleaning...

The numbers in Figure 4 are the numbers of stress-test cycles. It shows cycle 9 out of 15 cleaning cycles. Even after 9 cycles practically no staining due to paint residue is visible.

9 Conclusions

Water-based oleophobic silane systems like Protectosil Antigraffiti form invisible, breathable and UV-stable oil- and water-repellent coatings on porous mineral surfaces. The applications range from easy-to-clean to permanent anti-graffiti coatings. In combination with alkylsilane water repellents they offers additional water-repellent protection due to the excellent penetration behavior of monomeric silanes.

10 References

1. Regelwerk der Gütegemeinschaft Anti-Graffiti e. V. zur Zulassung von Anti-Graffiti-Systemen für die RAL Gütesicherung 841/2.
2. Prüfbericht 1-026/00 der iLF Forschungs- und Entwicklungsgesellschaft Lacke und Farben mbH (Bestimmung der Wasserdampfdiffusion in Anlehnung an EN ISO 7783-2)