THE ROLE OF WATER REPELLENT AGENTS IN ANTIGRAFFITY SYSTEMS

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"Getting rid of graffity" is the title of a well known book written by M.J. Whitford.
Of course the fight against undesirable graffity is meant by this author. The amount of undesired graffity is incredible. Amsterdam politiciens calculated that the cost of a total removal of current undesired graffity followed by an effective protection against new graffity will amant up to about 250 million dutch guilders.

PHOTO 1 Graffity on masonry

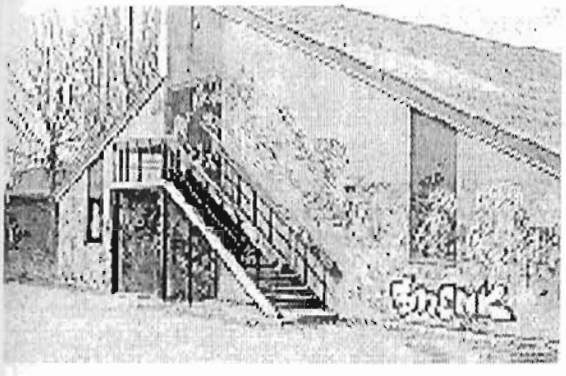


PHOTO 2 Graffity on concrete

To protect all kinds of substrates against all kinds of undesired graffiy it showed that it is not possible to meet all thinkable demands like:

- unvisability
- long lasting protection
- water based and/or water removable
- excellent adhesion to all kinds of substrates
- solvent resistant
- no discolourisation, chalking
- etc., etc.

The different demands combined with the various types of stained substrates forced the producers of coatings to develop several protecting systems.

These protecting systems are listed as:

- Permanent systems
- Self-sacrificing systems
- Semi-permanent systems

Permanent systems are protective systems not affected by the belonging cleaning products/ systems, even after frequent removal of graffity.
The base for these systems are mostly chemical resistant polyurethanes or epoxides.

Self-sacrificing systems are totally removed by the belonging cleaning products/systems.
They are mostly based on polysaccharides, waxes, acrylics (solvent-based as well as water-based), metallized acrylics and such-like.

Semi-permanent systems are known as two-layer sytems as well as one layer systems.
The two-layer systems are built up with a permanent coat followed by a second self-sacrificing coat.

The one-layer systems are based on both hydrophobic and oleophobic products like fluorated siloxanes.

The performance of these systems depends very much on the porosity of the substrate. After all, the sprayed or brushed lacquer- penetration in the pores depends on the porosity.
Since the water take-up also depends on the porosity of the substrate and most of the anti-graffity systems influence the water-permeability and above all the water vapour permeability,
it will be clear that water repellent agents and anti-graffity protecting systems always co-operate in one or the other way in cases of porous (mineral)substrates.

Many practical experiences during the last ten years build the foundation of the today's knowledge.
Also because of the latest developments in emulsified silanes/siloxanes there are a lot of possibilities to combine all kinds of water repellents with all kinds of "new- borne" anti-graffity systems.

There are three usefull possibilities:

- the use of (modified) silanes/siloxanes as anti-graffity themselves
- the use of water repellent agents in the recepture of the protective coating
- the use of water repellents under and/or above the protective system

At first it is to draw up what is a water repellent in this case.
Any filmforming polymer applied to a porous substrate is able to prevent waterpenetration, so for a clear view is here to say that only non filmforming (ore non "pore-filling") products like silanes, oligomer siloxanes and more or less comparable products like fluorated derivates, carboxylates and such are meant in the following discussions.

1 THE USE OF (MODIFIED) SILANES/SILOXANES AS ANTI-GRAFFITY THEMSELVES

Because of the non filmforming properties of these products they build an unvisable or hardly visable protection on porous mineral substrates.
Also because of the non filmforming properties graffity is able to penetrate into the pores of the substrate, so the product should at least be oleophobic to prevent adhesion.
It will be clear that therefore the performance of these anti-graffity systems very much depends on the porosity of the substrate, the type and the amount of active substance in the product and the application.

Experiences showed that the adhesion of coatings will increase when a mineral, porous substrate is treated with pure silanes/siloxanes.
At the same time it is determinated that unmodified silanes/siloxanes sometimes are able to prevent adhesion when we use a huge amount of active substance.
The forming (and sometimes addition) of siliconpolymer is the explanation for anti-graffity properties since most synthetic polymers, used as binder in coatings, don't adhere to many silicones.

A better performance is obtained by modified (fluorated)silanes/siloxanes.
These products are listed as semi-permanent systems, because of the fact that, after removal of the graffity, the water repellancy is still in tact but the oleophobic properties are gone.
The product has to be applied again.
It appeared that the anti-graffity properties improve more and more after repeatedly cleaning and apllicating until an uptimum is reached.

In practice a lot of good experiences are gained but also a lot of bad ones. The problem is always the same: it is hardly to predict if the product in combination with the type of substrate, due to the shape and porosity, will bring a good performance. Therefore a specimen has to be made to be sure in cases of "unknown" substrates .
A full saturation (although sometimes very expensive) is necessary and also sometimes a second treatment.

These type of products are solvent based, so one can expect that in the near future the use will decrease.

To remove graffity every possible and necessary solvent or remover can be used.
Of and on the "graffity artists" use types of coatings which hardly can be solved or in solution penetrate deep into the pores.
Support with (hot) high pressure water can help, but can also "damage" the esthetic view of the used construction material.
The use of only (hot) high pressure water is scarcely usefull , only sometimes in cases of treatment with unmodified silanes/siloxanes with the huge amount of active substance.

2 THE USE OF WATER REPELLENT AGENTS IN THE RECEPTURE OF THE PROTECTIVE COATING

Both solvent based as well as water based repellent agents are used in receptures of protective coatings.
They are mostly used (and only there possibly effective) in self-sacrificing anti-graffity systems.

The role of solvent based water repellents in solvent based anti-graffity products is debatable. They are hardly effective as a release agent (to improve the anti-graffity properties) on top of the coating and also not always effective to build a hydrophobated zone under the coating.
That depends in which degree the mixture of binder and water repellent agent are
seperated through the absorbtion of the substrate, as a function of the difference in moloculair chainlength.

In water borne systems the use of water based water repellents is somewhat more effective.
They can be used as an expedient to improve the water take-up of the binder or other, more or less filmforming components.
This can be important for systems that have to be removed by hot water but are also affected by cold water (rain!).

Due to the composition of some of the suitable water repellent agents, the effect is influenced by the alkalinity of the substrate. On neutral substrates the effect is less than on alkaline substrates.

There is never any direct positive influence found on the anti-graffity properties of the system.
Sometimes a slight negative influence is found after exposure to UV-light and other weather conditions.

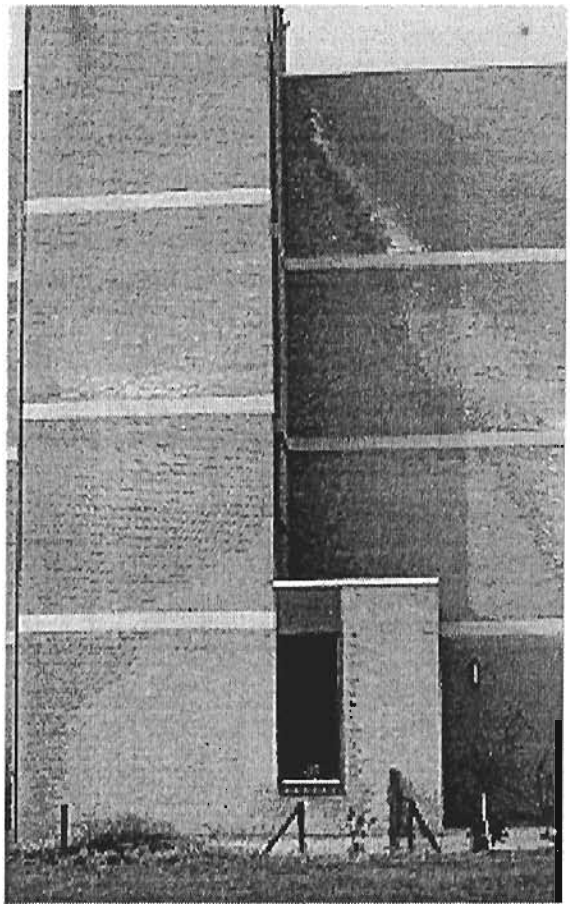
All the above described experiences are not very exiting, but especially the water borne water repellents are still improving. The investigations are still on-going and better results are to be expected in the near future.

3 THE USE OF WATER REPELLENT AGENTS UNDER/AND/OR ABOVE THE PROTECTIVE SYSTEM

The use of water repellents is not directly linked to the use of anti-graffity systems.
Although the combination of hydrophobing and a following anti-graffity treatment in one case is patented.

Since anti-graffity systems hardly ever are used as a full treatment of the facade, the discussion how to hydrophobate is started.
Is a full surface treatment with water repellent agents necessary or is only a treatment above the protective anti-graffity system sufficient?

PHOTO 3 A facade full of risks for a good anti-graffity finish



To describe are the different influences of both possible water repellent treatments with all the different anti-graffity treatments of building materials:

Permanent systems:

1. Full facade hydrophobation.

There is no doubt that this is the best pre-treatment for permanent anti-graffity systems.
As described before, these systems are based on chemical resistant polyurethanes or epoxides.
These polymers show a water vapour permeability of μ 50.000 - 100.000.
So it is very important that no water is penetrating behind the coating layer.
This could happen because of a mechanical damaged layer but also because of vertical water movement in a porous building material.
A good full facade hydrophobation prevents detachment of the coating or discolouring of transparant systems.

PHOTO 4 Permanent system peeling of through water(vapour)

2. Partially facade hydrophobation

In most cases however, it is to be expected that between the application, drying and reaction time of the water repellent agent and the treatment with permanent systems, the "graffity artists" will find enough time to satisfy their needs.

To solve this problem it will be clear that in many cases the anti-graffity treatment is made before the hydrophobation, which is made afterwards and above the anti-graffity treatment.

In cases of brick masonry the first two layers directly above the ground are kept free of any treatment. Also some joints are will be opened in order to prevent rising damp or water to penetrate behind the permanent system.
It certainly helps in many cases.

Self-sacrificing systems:

1. Full facade hydrophobation.

1.1. water-based/ (hot)water-removable self-sacrificing systems.
(In these cases the systems could also be listed semi-permanent while the hydrophobation keeps its function after removing the anti-graffity product)
Most of the self-sacrificing systems show a good water vapour permeability ($< \mu$ 1000).

In cases of polysaccharides there might be an adhesion problem or rather a penetration problem.
These types of anti-graffity systems prefer a certain porosity to give the best long-lasting performance. A perfect hydrophobation prevents penetration.
Further on, the rinsing water, coming from the hydrophobated and not anti-graffity treated part of the facade, has a negative effect on the gel-strength of the polysaccharide.

In cases of waxy products this type of problem is less strong because of the less water take-up of the product.
The use of waxy products on hydrophobated building material is even patented.(DE 3630520 C1) This combination prevents the absorbtion of applicated or removed (melten) wax and graffity into the porous substrate.
This among others is proved by REM-exposures. (see photo 1-2.)

PHOTO 5 Cottaer sand-stone
Right-side: wax layer (appr. 2 μm)

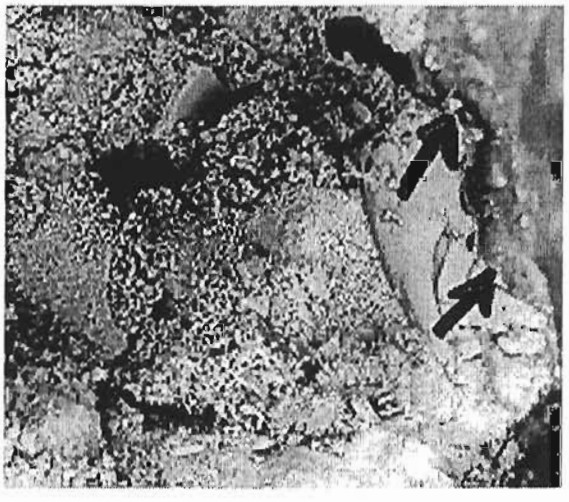


PHOTO 6 Close-up photo 1
Wax layer - no penetration into the pore

1.2. Water-borne acrylics

The full facade hydrophobation does not show any positive or negative effect on the performance, esthetic view or else in cases of good composed waterborne acrylics.
Some slight improved adherence is measured .
No hydrophobation brings more problems where water, salts etc. affect the long-lasting adherence and discolouring of the mostly transparant systems.

Semi-permanent systems

The one-layer system is a water repellent agent itself.

The two layer systems are to be treated as permanent systems since the first layer is a permanent product.

2. Partially facade hydrophobation.

2.1.water-based/ (hot)water-removable self-sacrificing systems.

In cases of polysaccharides there is a huge problem because of the difference in colour of the facade after some rain.
The hydrophobated part keeps dry and "light-coloured". The anti-graffity treated part turns dark
and wet. This difference is not accepted and has to be avoided.
The problem disappears of course after drying of the system.

In cases of waxy products this type of problem is again less stronger because of the less water take-up of the product.
Depending on occasional water take up under the waxy product, it is possible that some waxy products turn white.
This appearence is gone after drying.

1.2. Water-borne acrylics

There are hardly no problems to be expected in case of partially hydrophobation in combination with good composed water-borne acrylics.

4 LITERATURE

STICHTING BOUWRESEARCH, Het voorkomen en bestrijden van gevelbekladding Nr.242

STICHTING BOUWRESEARCH, Gevelgids IV, Antibekladding
WTA: AK Reversibelen Oberflächenschutz "Anti-Graffiti-Systeme"
H.RAMESOHL: Graffitischutzsysteme/Patentschrift DE 3630520 C1