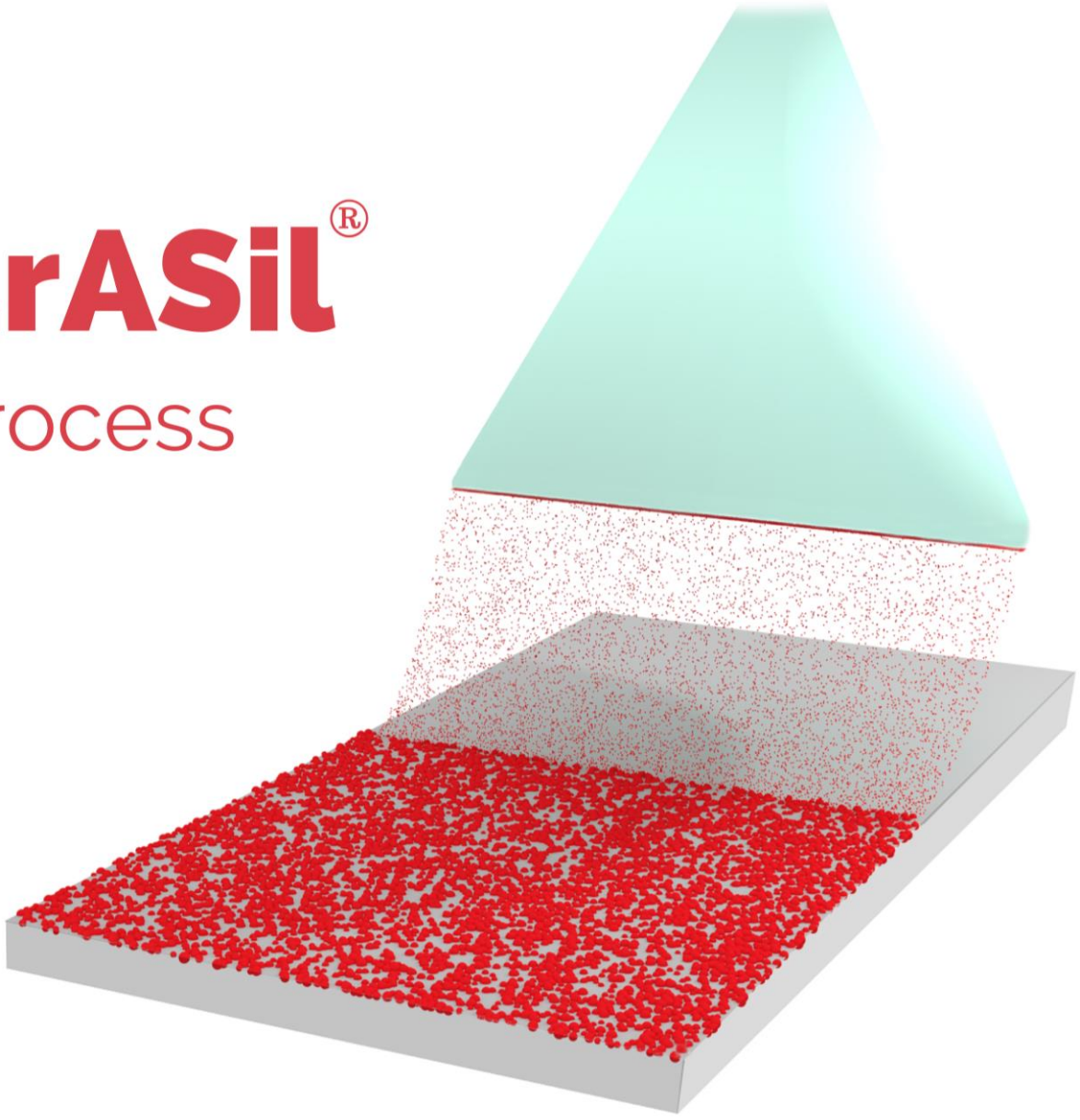
# Surface Pretreatment Technology

## SurASil®

Process



# Surface Pretreatment - principle

## 1. Introduction

The treatment of surfaces for influencing the adhesion of glues, coatings or printing media by means of combustion is a method established for years in numerous industrial fields. A further significant improvement of the adhesion can be achieved by deposition of a reactive silicate layer which is produced by flame pyrolysis.

Through combustion of a silane additive component in a combustion gas atmosphere, are produced very dense and adhering silicate layers with high surface energy on materials, such as:

- Metals
- Glass
- Ceramics
- Plastics

The field of applications of the SurASil® Process extends to automotive, plastic engineering, glass industry, printing industry, coating technology, construction manufacturing, aerospace, photovoltaic, optics, sensoric, electronic systems as well as medical engineering.

## 2. The Flame

The substrate to be coated will be treated with the outer (oxidative) part of the flame by continuous movement of the burner over a short time. The treatment must not occur with the inner, blue-shining (reductive) cone of the flame.

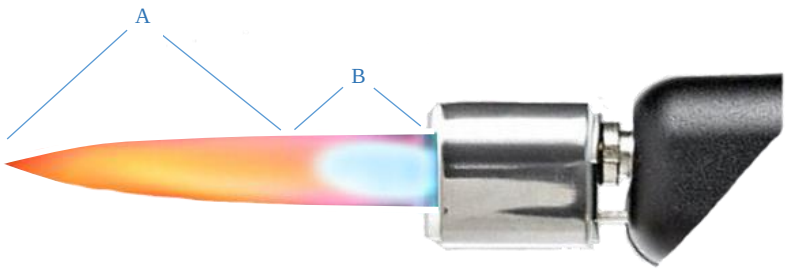



***Figure 1**. Flame A – oxidative area (operation area for flame silication). Flame B – reductive area*

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### 3. Surface Pretreatment for improved Adhesion

The surface pretreatment process realizes:

1. The generation of a high-energy silicate layer (layer-thickness max. 40 nm) on the material surfaces via flame pyrolysis (surface silicate coating).
2. The application of an adhesion promoter, suited to the adhesive, the coating or to the printed medium.

The combination of adhesion promoters with corresponding functionalities represent the basis of long-term, water- and solvent- stable adhesions, coating and printings. Further applications are temporary corrosion protection as well as generation of diffusion barrier layers.

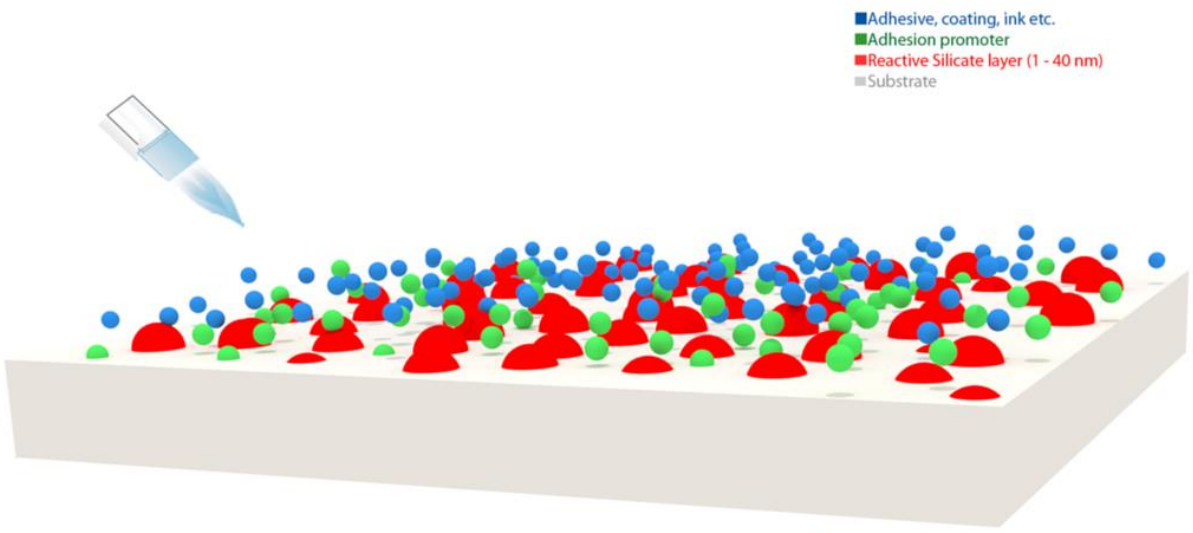
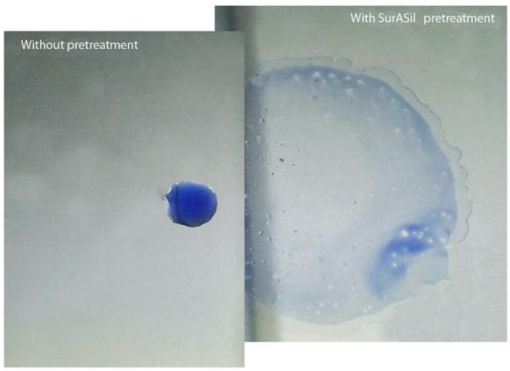



***Figure 2**. Schematic representation of a silicate layer deposited by flame pyrolysis.*




The effect of SurASil® pretreatment on surfaces is depicted in Figure 3. The surface energy (mN/m) of the pretreated surface (right) is significantly higher than of the non-treated surface (left). The SurAChem® test inks were used for the qualitative measurements of the surface energy.

**Figure 3.** *Surface-energy measurement using the SurAChem® test inks*

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Surface-roughness (Figure 4 - left), as also contact-angle measurements (Figure 4- right) show the different surface-characteristics after the SurASil® pretreatment. The nano-scale surface roughness increases significantly after being pretreated, as also the measured contact-angle on the pretreated surface decreases significantly, indicating the rising of the surface-energy.

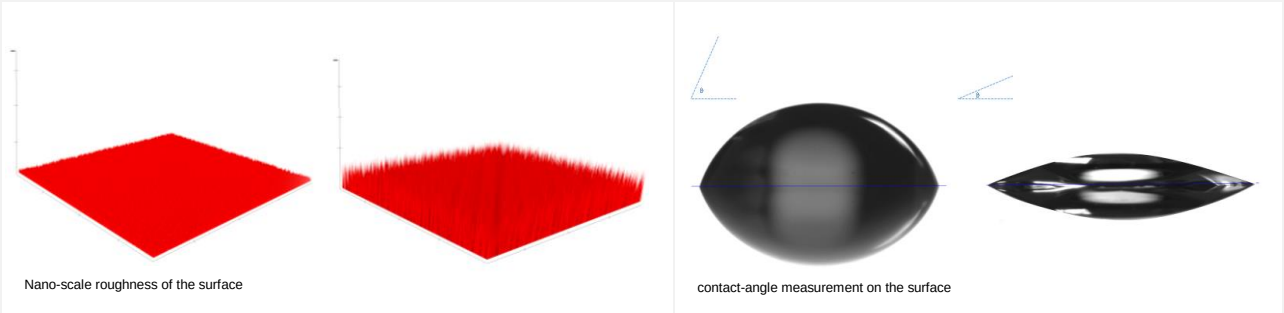


***Figure 4.*** *demonstration of surface-roughness (left) and contact-angle (right) before and after pretreatment*

## 4. Principle of the Adhesion Promotion by Surface Silication

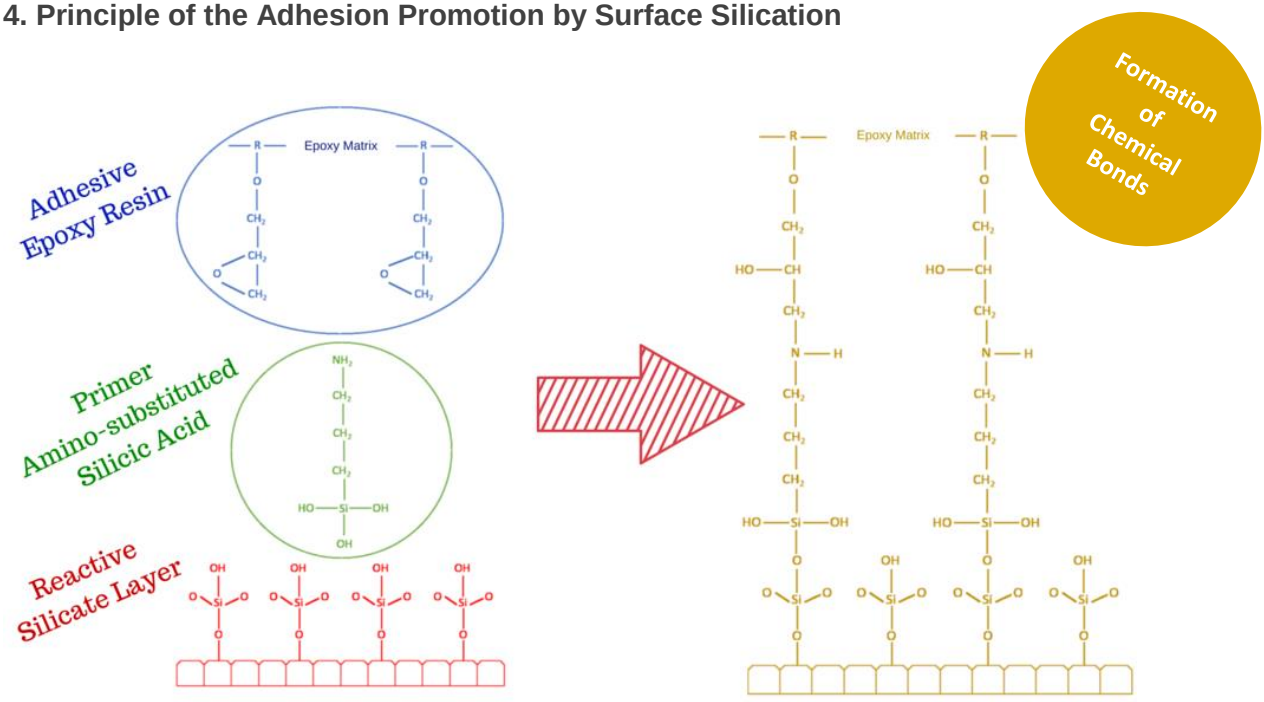


**Figure 5.** *Adhesion promotion via surface silication*

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# Surface Pretreatment - principle

## 5. Devices and Systems for Surface-pretreatment

### 5.1 Surface-pretreatment for Laboratories and Handcraft

The SurAChem® hand-held fire torches are appropriate for the pretreatment of smaller surfaces. The surface-pretreatment with the hand-held fire torch SurAChem® VG 02 is well suited for the advertising sector and applicable for small areas up to DIN A4 size. The hand-held fire torch SurAChem® VG 03 with different burning widths can be used perfectly for advertising- as well as industrial applications of areas with several square-meters.

For the application and refilling are used cartridges, containing the reactive gas mixtures SurASil® 200 and SurASil® 600.

**Figure 6.** *Hand-held flame silication devices for surface pretreatment (SurAChem® VG 02 – left, SurAChem® VG 03 – right).*

The silicate layer represents, in combination with the SurAChem® adhesion promoter GE 141 (for epoxide resins), GM 138 (for acrylates/methacrylates) as well as GA 139 (for polyurethanes) the basis for a long-term, water- and solvent stable adhesions, coating and printings. Further applications are temporary corrosion protection as well as the generation of diffusion barrier layers.

**Figure 7.** *SurAChem® adhesion promoters*

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### 5.2 Industrial Surface-pretreatment Systems

The silicate coating technique is appropriate for surface-pretreatment operations in industrial applications. Here, a silane-additive-mixture will be carried to the burning mixture (gas/air) by a burner-control unit. Materials for different application areas can be pretreated using continuous plants (see Figure 8) for flame pyrolysis to significantly increase the adhesiveness of coatings, glues and printing media, as also to achieve the manufacturing of continuous production-lines.

The burning width & geometry as well as the handling and transportation through the burner can be correspondingly adjusted, depending on the size, shape and material properties of the pretreated components.

**Figure 8.** *Surface-pretreatment technique for industrial applications*

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## 6. SurASil®-Process - Application instructions

The treatment-duration of the surface depends significantly on the type of the material and, as a result, on the possible treatment speed. For metal, glass and ceramic surfaces as well as thick-walled plastics, the treatment velocity should be between 10 and 50 cm/s. The best velocity can be determined by pretests with the SurAChem® test inks (Figure 9).

**Figure 9**. *SurAChem® test inks*

For thin-walled or heat sensitive components, in particular thermoplastics, It is recommended to increase the treatment velocity to 50 to 100 cm/s and, if applicable, to repeat the process. Local overheating should be avoided. In general, the temperature of the components should not exceed 150 to 200 °C. This is important particularly for thermoplastic materials.

The pretreated components should be stored at a room temperature and protected from contaminations. The storage time of the components between pretreatment and utilization of the adhesion promoter should not exceed one week. With the utilization of the adhesion promoter, the storage-time can be prolonged to one to two months. Nevertheless, a short-term subsequent processing (adhesion, coating, printing) is recommended.

## 7. Surface Pretreatment - Example

The following test results compare the adhesion of two different SurABond® glues without and with flame silication as well as under basic and stressed conditions (Figure 10).

The untreated and chemical unstressed component reaches only about 50% of the adhesion of the pretreated component.

After a 20 hours water-boiling stress test, the adhesion of the untreated material drops down to about 25% compared to the pretreated one.

The adhesion of the pretreated component remains almost constantly high even after 20 hours of stress-test.

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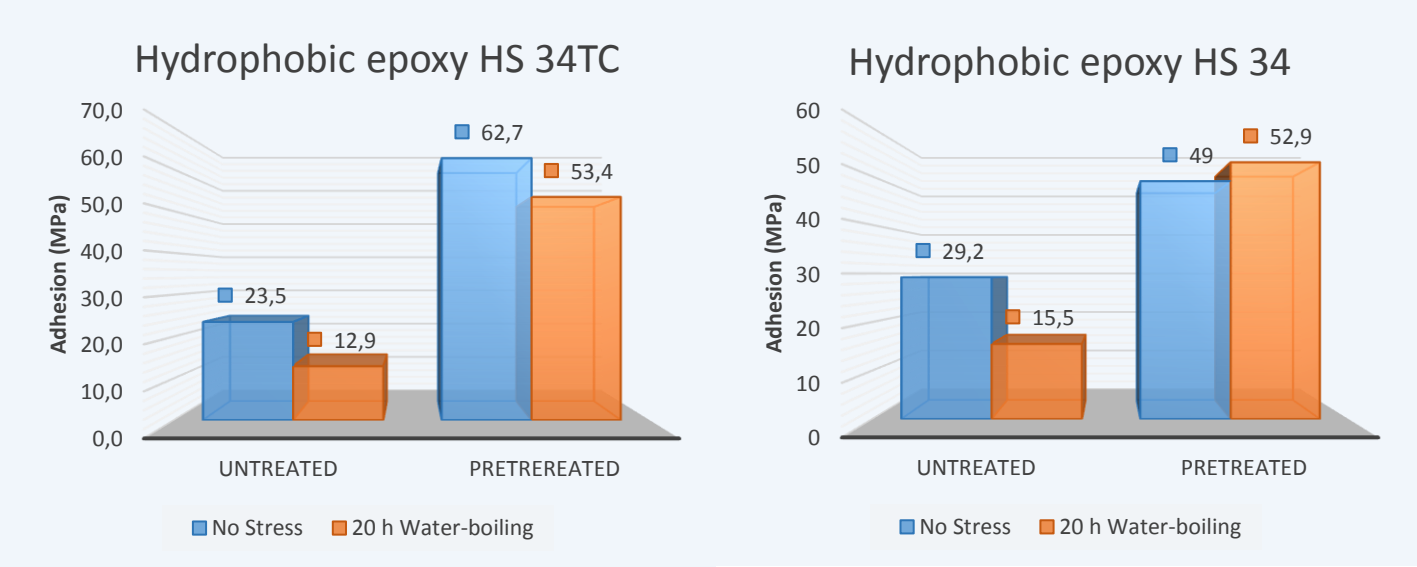


**Figure 10.** *Determination of the adhesion of different SurABond® glues on substrate surface without and with flame silication under basic and stressed condition*


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