

Cleaning and activating of polymer surfaces

When manufactured articles are made available for gluing, printing or coating with flawless surfaces, the prerequisite for optimum result exists. For that purpose, in most cases they must be meticulously cleaned and/or activated, that is, pre-treated.

At the point when selecting the material and production method of the articles the subsequent coating process should be already considered. For example, when external or internal release agents are used they have in most cases a negative effect on wetting and adhesion. The lubricants used for moving parts of the injection molding press should be either highly viscous or replaced by a suitable coating on that press component. The removal of the molded parts from the injection mold should be best done with suction devices without silicone or with clean gloves.

Ionisation

If the surface of the manufactured article is covered by dust, particles from forklift exhaust, production processing aids, abraded material from transit interleaves, and pollen, then cleaning of its surface is absolutely necessary with regard to the quality of the finished product. Dust or other loose par-

ticles can be removed from the surface by ionization. The ions produced by the process neutralize the electrostatic charge on the surface so that the particles become loose and can be readily removed from the workplace. Ionizers are frequently used for the in-line cleaning of piece goods, webs and transport trays. The discharge has a long-lasting effect when applied already in demolding from an injection mold (**fig. 1**). This way the molded parts do not attract dust until the next processing step.

Brushing

Another effective cleaning method is micro-cleaning by means of sword-brushes that has been used successfully in production for more than ten years. This process is suitable for plastics and metal surfaces as well as for ceramics, wood and paper. The principle of this cleaning method is based on the mechanical action of the linear brushes and the capillary force between the wet fila-

ment and the particle to be removed. The brushing unit can be easily used with robots, for example in cleaning automotive external component parts (**fig. 2**). The cleaned surface is immediately ready to be painted since this is a dry cleaning method.

CO₂

For the more strongly clinging contaminations, such as fingerprint, cleaning with carbon dioxide (CO₂) is highly effective. The low temperature (-78 °C) of the CO₂ particles cause the impurity to become brittle and the subsequent particles with a high kinetic energy carry away the loose particles of the impurity. Since the transition of CO₂ from solid to gaseous state takes place without any residue, this is also a dry cleaning method and the cleaned parts can be immediately painted, glued or coated. This cleaning process is gentle because of the "snow" particles do not abrade the polymer surface. The part must be well fixed because the high flow rate of the cleaning stream would cause the treated goods to be lifted off.

Testing

Because the technical cleanliness of components and structural groups in the manufacture of vehicles and equipment is

Fig. 1: Ionization in the injection mold (Source: www.dr-escherich.com)

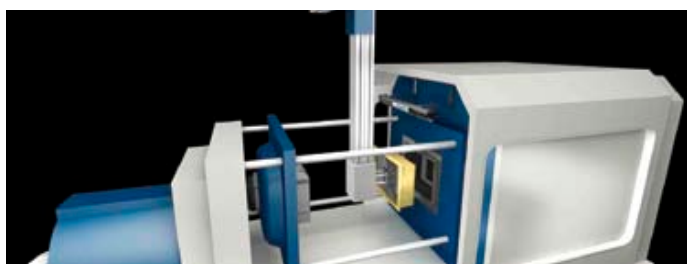
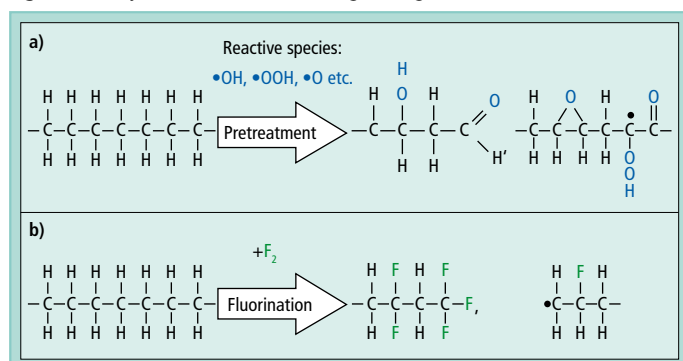


Fig. 2: Sword brushes guided by a robot (Source: Wandres GmbH micro-cleaning)



Fig. 3a, b: Polymer activation (Source: Engineering Office Fischer)



an important aspect of quality, the cleaning methods should be tested in advance with regard to their effectiveness. To accomplish that, it is recommended to determine the degree of residual contamination or cleanliness; this provides reliable information about the cleanliness of the component. Depending on the application of the manufacturing article there are standards, such as VDA 19 and ISO 16232 standard specifications, which set the criteria for testing and assessment.

Surface activation

In case that the cleaning procedure does not achieve the required adhesion, an activation of the surface of the article is necessary. This increases the surface energy of the polymer surface so that functional groups containing oxygen are available for the interaction with the coating (fig. 3a). One of the available methods for the activation

of flat parts and simple geometries is the flame treatment that has been used successfully for more than 50 years. The treatment units can be easily automated and passed by means of linear systems or robots over the treated surface. If the flame treatment station is integrated with the coating station, there is no possibility to become contaminated again.

Corona treatment is suitable not only for webs for printing or lamination but also for surfaces of parts with simple geometry and the maximum cross-section of 100 mm.

Another possibility to activate polymer surfaces is the atmospheric pressure plasma treatment. This method allows a highly effective activation of selected areas such as adhesion and sealing grooves, complete surface such as cell mobile phone housings, covers and honeycomb structures for sandwich elements. Modifications with

low-pressure plasma and fluorination can be used successfully for more complicated geometries even when the treated articles are placed into the vacuum chamber in the free-flowing form.

In the low-pressure process the gas present in the chamber is ionized by applying electromagnetic fields. This produces highly reactive plasma that is capable of changing the surface properties in a well-directed manner. With this technique the parts and components are not only activated but also cleaned, structured and coated. If the transport of the articles for cleaning is intermittent, the plasma unit can be placed in-line or as an airlock from the grey room to the clean room (fig. 4).

Fluorination utilizes the high reactivity of the fluorine molecule, which produces new highly polar groups on the surfaces of plastics already at room temperature and without introduction of additional energy (fig. 3b). These groups increase the polar proportion of the surface energy to the point that there is no need for a primer before the application of aqueous paint systems.

Conclusion

There are several procedures available for optimally preparing a part for coating. Thus, it is crucial to match the material with the cleaning and/or activation system in order to meet all test specifications and produce high quality products.

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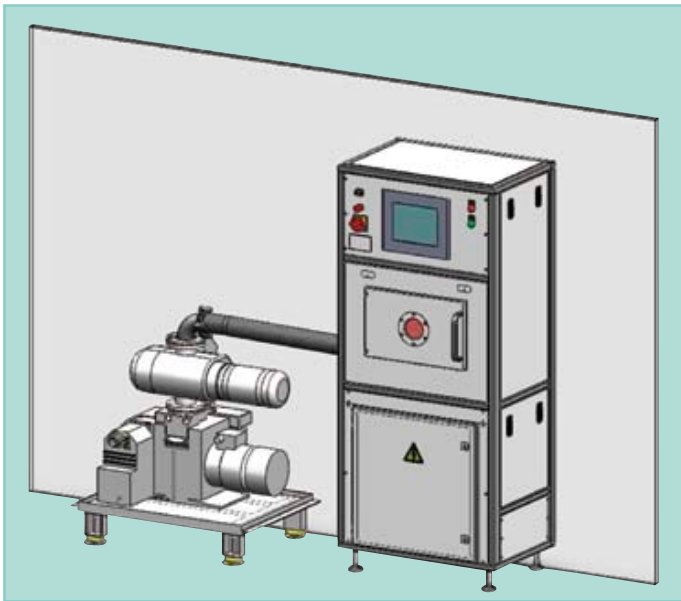


Fig. 4: Low pressure plasma chamber serving as an airlock between the grey room and the clean room; parts are placed at the grey room and taken out from the chamber at the clean room (Source: Pink GmbH)

