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Automobillackierung in Indien

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Lean-Paintshop-Konzepte _ Weniger Lackierkosten pro Karosserie

Korrosionsschutz _ Nutzfahrzeughersteller ersetzt Zinkphosphatierung

Plasma-Vorbehandlung _ Makellose Optik und optimale Haftung

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MICROFINE PRECLEANING WITH ATMOSPHERIC-PRESSURE PLASMA

Crystal clear optics

Brilliant, scratch-resistant surfaces on high-grade plastic display windows can only be produced by costly coating processes after injection moulding. Pretreatment with atmospheric-pressure plasma greatly improves their adhesive bonding properties and their painted appearance.

Electronic displays in motor cars have contact made to them via a film applied by the hot sealing method. This applies to instrument displays in motor vehicles as well as to radios, on-board computers, mobile telephones and laptop monitors. The film forms a flexible connection between the printed circuit board and the contact surface usually consisting of two thin glass plates. Sensitive components in vehicle interiors are protected by a thin front-end plastic plate, the display window.

One of the leading inter-national specialists in the finishing of plastic surfaces, GfO Gesellschaft für Oberflächen-technik mbH [Surface Technology Company] in Schwäbisch-Gmünd, planned two years ago to use a new inkjet process by the name of Selectacoat.

For this process a new unit for painting plastic display windows was to be constructed. The plan was that the entire painting process taking place in a cleanroom should proceed at high speed under fully automated and environmentally friendly conditions.

Photo: GfO
To increase adhesion and ensure a flawless appearance of the costly coats of paint display front windows are treated with atmospheric-pressure plasma prior to coating

Central issue: Which pretreatment method?

An important aspect here was the question of which pretreatment method to use. The reason for this is that the requirements of the automotive industry for durable paint adhesion and immaculate surfaces can only be met by additional microfine cleaning and activation of the plastic parts prior to painting.

Instead of the manual pretreatment carried out hitherto by means of alcohol and soft cloths, a reproducible, high-quality and fully automated pretreatment technique suitable for in-line processes was to be employed. For the latter reason plasma cleaning by the usual low-pressure method (vacuum chamber) was ruled out since this technique is more suitable for batch production.

The solution: In-line plasma treatment

GfO found the solution at Plasmatreat GmbH, Steinhagen, which developed "Openair" atmospheric-pressure plasma technology. This plasma process patented as early as 1995 is characterised, inter alia, by the fact that the plasma beam, which in this case emerges from jets, is electrically neutral. Its intensity is so high that treatment speeds of several 100 m/min can be achieved. In doing so the plastic surfaces heat up by less than 20 °C. The jets can be used for the most diverse parts . They are also compatible with robots and can be integrated into existing production lines.

Photo: GfO
In cleanroom 1 the workpieces are manually input and collected. In cleanroom 2 (right) the displays are pretreated in-line by plasma under normal atmospheric pressure before they are painted.

The Openair system brings about multiple effects: it activates the surface by selective oxidation processes and increases its surface tension by a significant factor. In this way values of more than 72 mN/m are possible on many plastics. At the same time the surface is statically discharged and very deeply cleaned. Moreover, by adding a precursor selective nanocoatings may also be applied in order to influence product properties in particular ways. By this means plastics having surfaces particularly receptive to adhesive bonding can be produced.

Surfaces having novel properties

Due to the high activation achieved by the process quite novel surface properties can be produced. As Christian Buske, Managing Partner of the Plasmatreat Group, points out, "It is possible, for example, to make hitherto incompatible substrates to bond to one another so that water-based or UV-based adhesives stick to very adhesion-resistant surfaces such as non-polar plastic."

Treatment is generally carried out in entirely uniform manner, the parameters are reproducible and can be verified by a process control system. Furthermore, the atmospheric-pressure plasma technology can be used not only for adhesive bonding, but also as a pretreatment process prior to painting components in the interior of automobiles. Examples include switches having laser-etched symbols, high-gloss decorative strips and

Photo: GfO
Coloured display window for the air conditioning system. Plasma pretreatment ensures perfect viewing and optimum adhesion of the scratch-resistant coating

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A rotary jet pretreats plastic parts over their entire surface area and without contact. The plasma ensures ultrafine cleaning and high activation of the surface without adverse thermal or visual effects on the material

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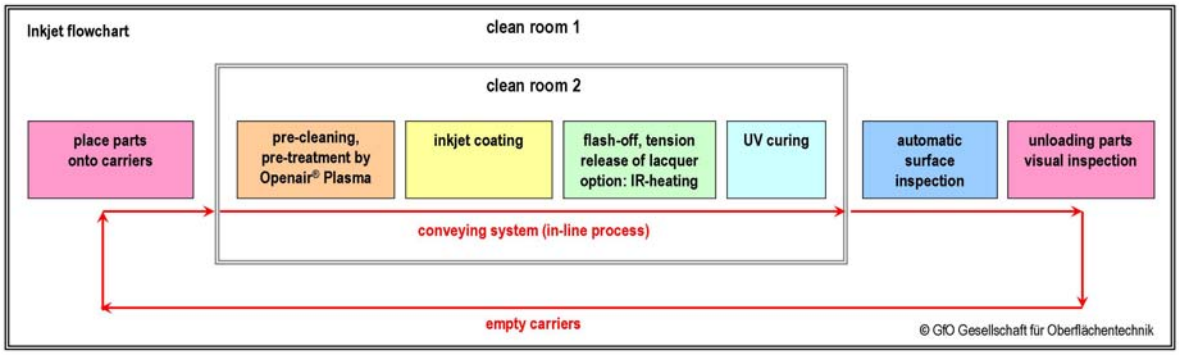
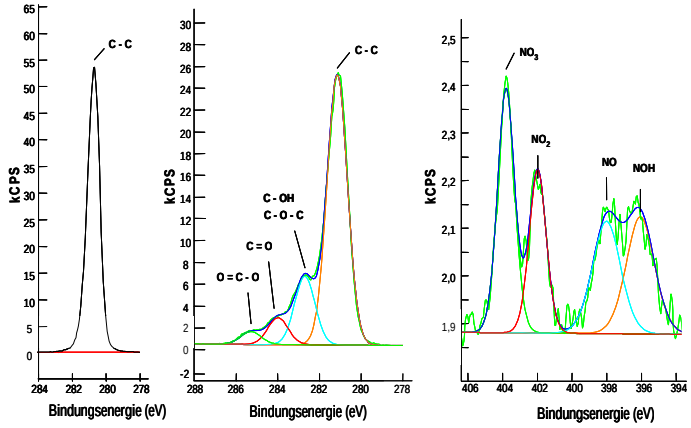


Workflow cycle for surface treatment at GfO



Graphs: Fraunhofer IFAM

< Activation of plastics (spectroscopic analysis of a polypropylene)
Three graphs of kcps versus Binding energy (eV)

Diagram 1: untreated PP (surface energy: 27 mN/m)
Diagram 2 and 3: PP treated with Openair plasma (surface energy: 72 mN/m)

covers or ventilation grilles and glove compartment handles.

Pretreatment for scratch-resistant coatings

At GfO the plasma process is employed for pretreating PC or PMMA plastics prior to the application of scratch-resistant coatings. These plastic parts are used as display windows placed in front of instruments, control lamps or navigation and communications systems in the automobile cockpit. On the one hand, the display window protects the delicate technology from manual damage and the infiltration of dirt and moisture. On the other hand, it allows the troublefree withdrawal of the actual display unit from the rear of the housing in the event of repair. A disadvantage of such display windows is that polycarbonate is easily scratched and that depending on the angle of incidence of the light unwanted reflections may occur. The coating is intended to counteract such effects.

Optimum integration into the process

The painting process takes place in two cleanrooms, one inside the other. Located in the outer cleanroom are the conveyor system carrying the empty product transporters, the insertion and removal stations and the automatic control system by means of image processing. The automatic coating process itself proceeds in a second room of an even higher cleanroom class

Initial precleaning to remove relatively coarse soiling is followed by atmospheric-pressure plasma treatment. A rotary jet specially designed for gentle all-over treatment conveys the plasma at almost the speed of sound onto the surface and immediately afterwards the finely cleaned and highly activated plastic parts are given their scratch-resistant coating in the painting station. In a flash-off section the paint can relax. Due to the high surface tension achieved by the plasma treatment the paint forms a homogeneous film. In a final step the paint is UV-cured before the display windows leave the inner

cleanroom and are transported to final quality control.

Simple start-up

After an eight-week test phase GfO had decided to base the new installation from the outset on the technology supplied by Plasmatreat. In January 2007 the volume production plant was started up. Here, solely for the automotive industry, large volumes of plastic plates are pretreated with plasma in environmentally friendly manner and given a scratch-resistant coat of paint. To these are added display windows for other sectors such as medical technology, white goods, aviation and the electronics industry.

As a result managers at GfO can conclude that rejects have been reduced considerably, the speed of the process has been increased and overall far greater economic efficiency has been achieved. Apart from the new inkjet process the greatest contribution to this has been made by pretreatment with atmospheric-pressure plasma. The process replaces earlier chemical processes and in doing so additionally ensures improved environmental conservation at the workplace. The process is also persuasive with regard to the necessary flexibility: for each product individual parameters (spacing, power, speed) can be defined. Only the optimum operating point for the plasma jet is then specified. A pleasant side-effect emphasised by GfO is that the Openair system is distinctly easy to maintain. According to GfO's Sales Manager, Norbert Weiss, no maintenance has been needed so far: "The plasma system runs simply and runs and runs."

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