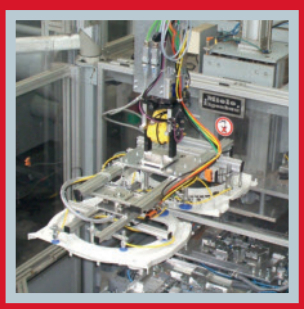
Volume 99 www.kunststoffe-international.com 3/2009

Kunststoffe international

Magazine for Plastics

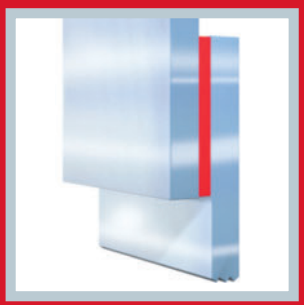
Automation



A Robot Operates the Peripherals around the Injection Molding Machine

Page 22

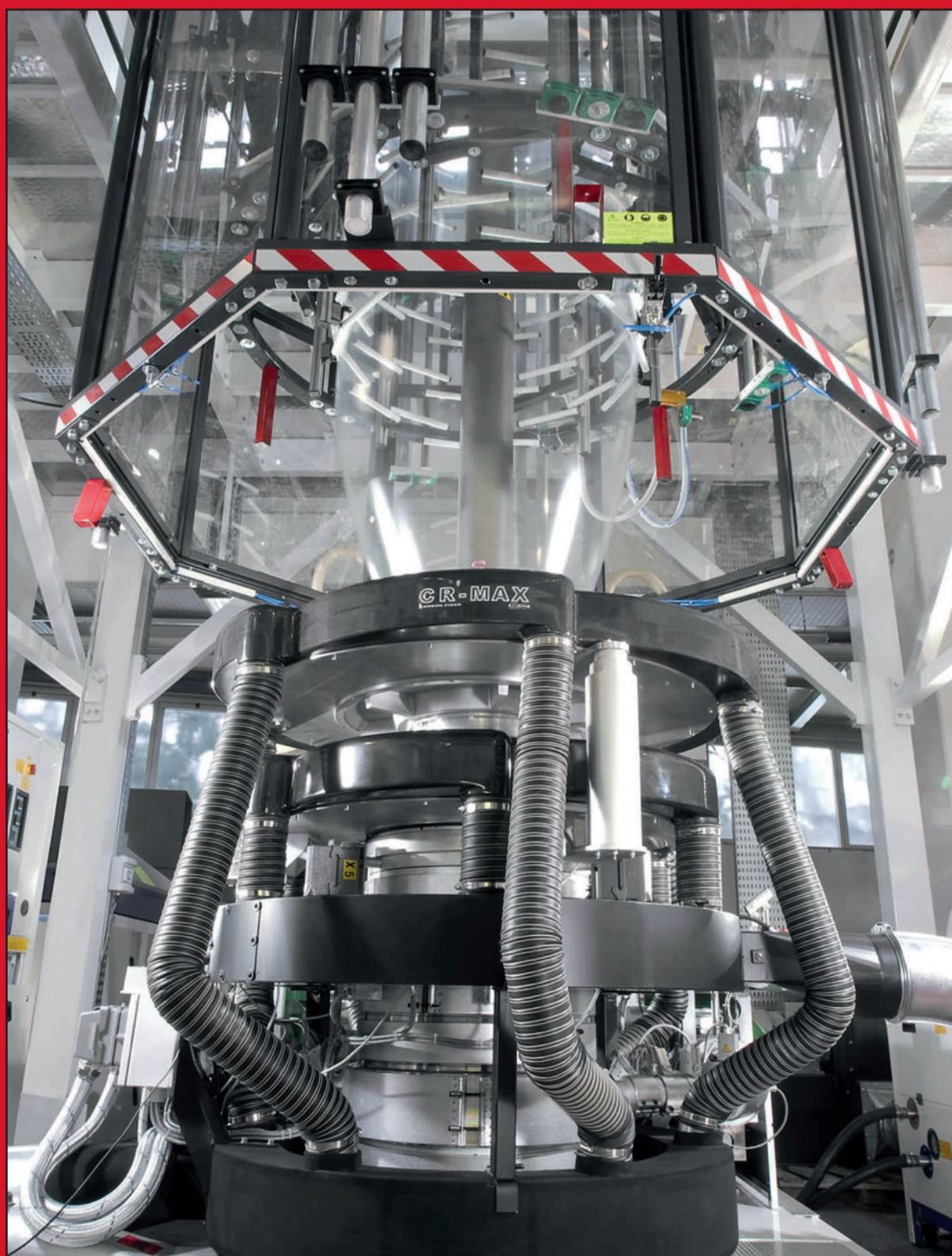
Joining Processes



Bonding Polyolefins without Pretreatment

Page 73

SPECIAL



HANSER

The plastic display fascia is crystal clear because it underwent microscopic pretreatment by atmospheric plasma before varnishing (photo: GfO Gesellschaft für Oberflächentechnik)

Plasma Provides Transparency

In-line Pretreatment. To produce brilliant and scratch-proof surfaces of plastics display fascias, sophisticated coating techniques are employed after injection molding. A South German enterprise pretreats components with atmospheric plasma, which improves adhesion properties and brings the coating's appearance to perfection.

INÈS A. MELAMIES

Wherever there is vibration or motion – be it in car radios or vehicle computers, mobile phones, pocket calculators or in laptop monitors – electrical contact in electronic displays is established by a sheet that was applied by heat sealing. This film flexibly connects the PCB to the contact surface, which usually consists of two thin glass panes. Thanks to LCDs and other types of displays, a car's instrument panel has grown to resemble a plane cockpit over the past 20 years (Title photo). The sensitive components inside the vehicle are protected by a very thin plastic front pane, the display fascia.

New Requirements

GfO Gesellschaft für Oberflächentechnik mbH based in Schwäbisch-Gmünd, Germany, is one of the leading experts in the area of refinement for plastics surfaces. The company recently introduced a new inkjet technique named Selectacoat, for which a new system to varnish plastics display fascias was especially constructed. The process was aimed at fully automating and accelerating the entire varnishing process conducted in the cleanroom, while causing no harm to the environment.

One of the main aspects was preliminary treatment, because unless the manufacturer thoroughly cleans and activates

Manufacturer

Plasmatreat GmbH
Bisamweg 10
D-33803 Steinhagen
Germany
Tel. +49 5204 9960-0
mail@plasmatreat.de
www.plasmatreat.com

Translated from Kunststoffe 3/2009, pp. 108–111
Article as PDF-File at www.kunststoffe-international.com; Document Number: PE110025

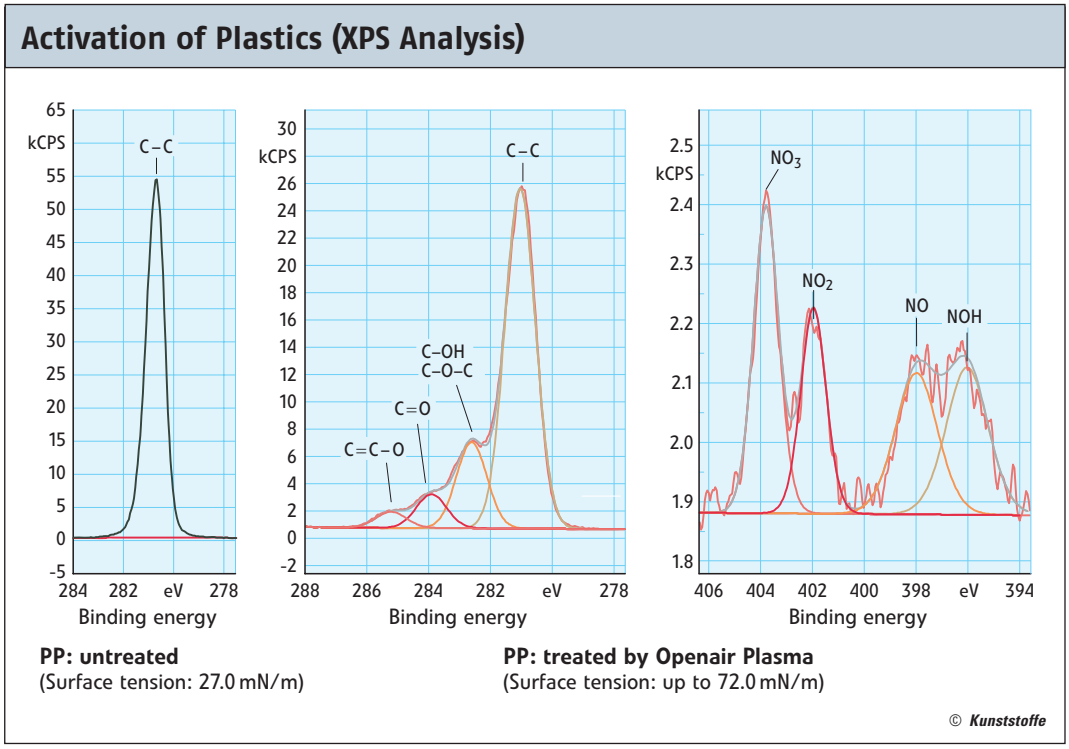


Fig. 1. In comparison to untreated PP (left) the PP treated with Openair Plasma (center and right) achieves a surface energy which is many times higher (kCPS = kilo counts per second, eV = electron volt)
(source: Fraunhofer IFAM)

the plastics parts before varnishing can he be sure of the varnish to adhere and the surface to remain flawless at long term. Up to that point, the front panes would be pretreated manually by alcohol and cloth. This was to be replaced by reproducible and high-quality pretreatment. Several techniques were dismissed, some of them for their high operating costs. Neither could plasma cleaning in a low pressure process (vacuum chamber) be applied, since this technique is suited rather for batch manufacturing than for this new type of in-line production. GfO found the solution at Plasmatreat GmbH, Steinhagen, Germany, which developed the Openair atmospheric-pressure plasma technology.

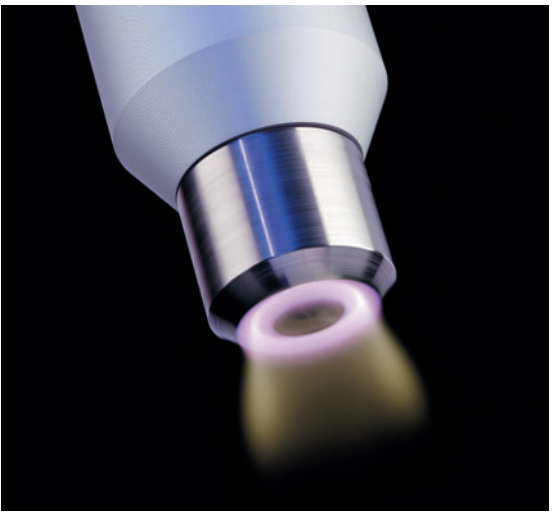


Fig. 2. A rotation jet makes sure the entire surfaces of the plastic front panes are treated. The atmospheric plasma almost has the speed of sound when impinging upon the surface, while causing no thermal damage to the material
(photo: Plasmatreat)

In-line Plasma

This technique of plasma treatment was patented in 1995, and is applied worldwide to pretreat material surfaces in almost every industrial sector today. Its particular feature is the electrically neutral plasma beam emitted by jets, which considerably enhances and simplifies applicability. Its intensity is so high that treatment speeds of several 100 m/min can be achieved. The plastics surface typically heats up to $\Delta T < 20°C$ while treated. The system is outstanding for its multiple effects: it activates the surface by targeted oxidation, thus multiplying surface tension. As a result, values over 72 mN/m are possible with many plastics materials (Fig. 1). Technically speaking, plasma state means electrically conductive gas. As the potential-free plasma beam impinges upon the surface, the charge carriers in the statically loaded part can discharge towards the grounding. This means the surface is statically discharged. At the same time, it is microscopically cleaned and highly activated. Moreover, adding a precursor (organosilicon compound), selective nano coatings can be applied in-line, this enabling the producer, for instance, to tailor surfaces to the demands posed to the specific final product characteristics.

Surfaces with New Properties

The Openair technique allows for monitoring in compliance with DIN ISO 9000. It is environmentally friendly and based on a jet system. The jets are available in a large variety of geometries. There are no restrictions to their use with robots, and they can be integrated into an existing manufacturing line at any time (Fig. 2).

"Apart from other benefits, our plasma technique, with its high level of activation, enables manufacturers to create surfaces with perfectly new characteristics," says Christian Buske, CEO of Plasmatreat Group. "This process makes it possible for such substrates to adhere, that could not be joined before. Consequently, watery or, in many cases, UV-based adhesive agents can stick to highly adhesive-resistant surfaces, such as non-polar plastics. Even plastics that had been regarded as incompatible until today can now be joined. Treatment is generally consistent, parameters are reproducible and can be submitted to process monitoring."

Switches with laser-engraved symbols, high-gloss trim strips and covers, brilliant blends, fan grills or glove compartment handles – in today's cars there are many more plastics parts with the most elaborate varnishing. In these applications, atmospheric plasma technology is also suited to join assembly groups by adhesion, as ▶

Fig. 3. Colored display fascia for air conditioning system. Treating the panes with plasma at atmospheric pressure leads to spotless optics and optimum adhesion of the scratch-proof coating (photo: GfO)

well as serve as a method of pretreatment for varnishing them, as is done, for instance, in BMW and Rolls Royce brands.

Display Fascias – Function and Production

Whether transparent clear or colored – the small flat plastic panes from polycarbonate (PU) or polymethylmethacrylat (PMMA) hide highly complex information centers, displays to visualize information, dozens of control lights, navigation and communication systems. The front display fascia is inserted and fixed to the casing by adhesion bonding. Its main functions are (Fig. 3): First, to shield the sensitive system from damage, soiling, humidity or dust that might ingress from the exterior. Second, it is to facilitate rear removal of the display itself from the casing, in case of repair. Display fascias from e. g. PC are easily scratched and often there may be reflections making it sometimes difficult to read the data. GfO therefore applies a scratch-proof coating that, moreover, does not only resist chemical impact from detergents, but gives intense deep gloss to colored parts.

Injection molded components are required to be extraordinarily clean when received at the coating works. Nevertheless, when exposed to air, it often cannot be perfectly avoided that dust particles reach the surface. It is therefore indispensable for the components to undergo preliminary treatment.

The process of varnishing is performed in two cleanrooms, one inserted into the other, (Figs. 4 and 5) with the carrier units moved by a conveyor system from station to station. In the outer (class 10,000) cleanroom, the parts are first placed in the unit manually. Later the plastic panes are checked visually or automatically (image processing), and eventually removed here. Automatic coating itself is performed in another, cleaner room (class 100,000). Following preliminary cleaning to remove most of the soiling, the parts are treated by atmospheric plasma. A rotation jet specially designed for gentle and large-surface treatment then conducts actual pretreatment. As the plastics materials are microscopically clean and highly activated now, plasma treatment is immediately followed by application of the scratch-proof coating inside the varnishing station (Fig. 6). In an exhaust air section, the varnish can release tension. Thanks to the high surface tension caused by plasma treatment, the varnish now becomes a homogeneous film. In a final step, the varnish is UV hardened before the display fascias leave the inner room to undergo the final quality inspection.

Fig. 4. In cleanroom 1, the staff place and remove parts manually on the conveyor system. In cleanroom 2 (right, in the back), the displays are pretreated in-line by normal pressure plasma before varnishing (photo: GfO)

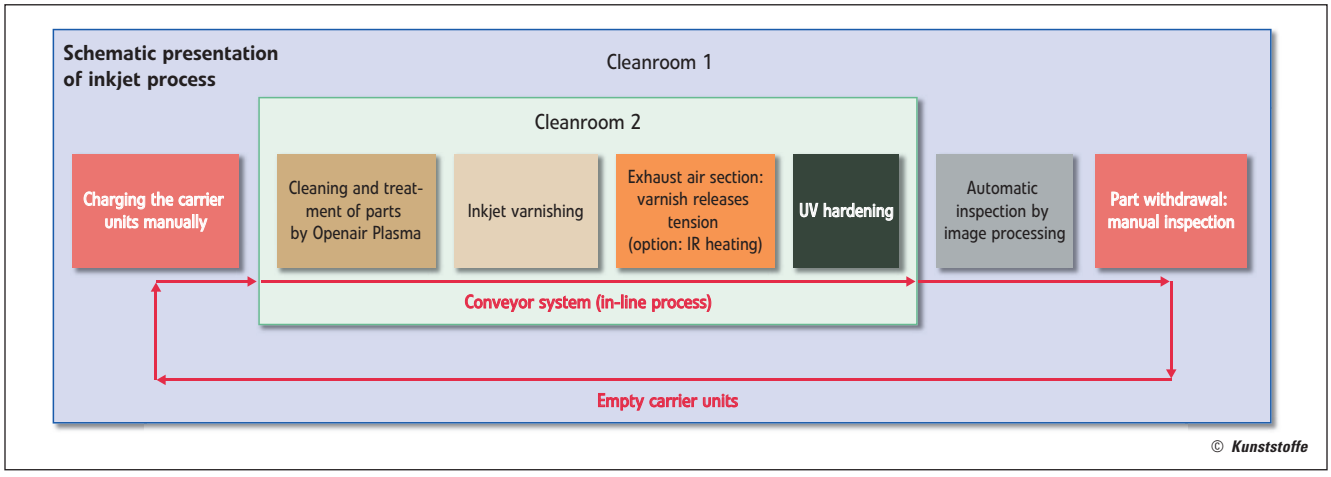


Fig. 5. By integrating the plasma unit into the varnishing line, the process could not only be automated entirely, but also be made reproducible and much more environmentally friendly (source: GfO)

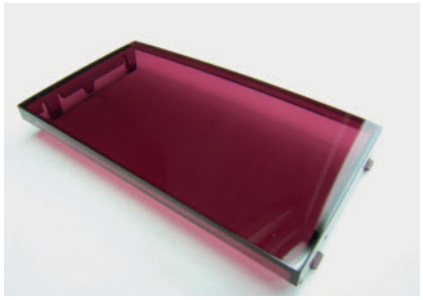


Fig. 6. Following microscopic cleaning and intense activation by plasma radiation, the plastics are given their scratch-proof coating in the varnishing unit (photo: GfO)

Operation Started Easily

Following only eight weeks of testing, the manufacturer decided to perform the Plasmatreat method on their new equipment right from the beginning. In January 2007, the serial plant started operation. For automotive customers alone, thousands of plastic panes a year are pretreated and coated with scratch-proof varnishing. Plus large quantities of display fascias for use in e. g. medical devices, household equipment, aviation and electronics industry (Fig. 7).

Flaws, and thus waste, was considerably reduced and process speed was significantly stepped up, as was efficiency – all of these benefits due to not only the new inkjet method, but also to the highly efficient pretreatment by atmospheric plasma. When asked, if the innovative pretreatment technique had caused any severe difficulties to the coating expert or his staff, Norbert Weiss, GfO Sales Manager denied: "We didn't have any problems while integrating the system into the new plant. Also staff training was free of difficulties. Neither have we noticed any critical materials up to now. Every automotive manufacturer has his own products, and each of his components has its own parameters (distance, performance, speed). This means that the plasma jet is merely set to the optimum working point to make sure the customer's quality requirements are adhered to."

User

GfO Gesellschaft für Oberflächentechnik mbH
Güglingstr. 74
D-73529 Schwäbisch-Gmünd
Germany
Tel. +49 7171 9107-0
info@gfo-online.com
www.gfo-online.com

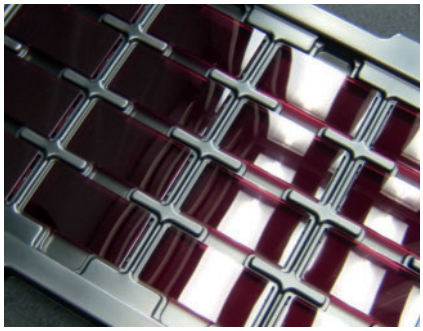


Fig. 7. Display fascias are employed for a wide range of purposes. Just as other plastics parts inside cars, more and more of them undergo plasma treatment before elaborate varnishing (photo: GfO)

Concerning intervals of the pretreatment system's maintenance, Weiss is very satisfied, adding: "No maintenance has been necessary up to now. The plasma system just keeps on working."

Summary

There is barely any limit to the variety in applications of the in-line plasma system described here. Concerning the production process, reliability and quality are among the system's major benefits. Conventional methods of pretreatment, such as cleaning with wet chemicals, are entirely replaced by the plasma process, and some operating steps are eliminated. Costs are thus reduced significantly in the area of production processes, and this issue may lead some industrial companies to retrofitting their plants, in these difficult economic times. The method is suited to meet demands such as easy integration into the process and compliance with cataphoretic painting of the surfaces, as well as requirements for perfect environmental friendliness. ■

THE AUTHOR

INÈS A. MELAMIES is a specialized journalist, who works for Blue Rondo International management consultants.