Adapted and translated from the German original - Plastverarbeiter 10/2011

Atmospheric plasma for selective pretreatment in automotive construction

Pictures: Plasmatreat

Maskless Dashboard Foaming

Plasma substitutes flame treatment for better adhesion. Masking before filling the dashboards with foam is a labor-intensive process. A way out of masking and what other advantages can be derived therefrom is shown by a South German automotive component supplier for the Audi Q5 using the atmospheric plasma process.

In 1987 the first dashboards for the Audi 80 came off the production line at Peguform's plant in Neustadt a. d. Donau, the nowadays worldwide leading plastic parts manufacturer for the automotive industry. More than 20 years and many car models later, it is the Audi Q5 sports utility vehicle that receives its cockpit here. The dashboard structure is composed of three material layers: a long glass fiber-reinforced plastic structural member, a PUR foam layer and a so-called slush skin which is a molded PVC skin. Peguform produces the structural members in polypropylene (PP) by injection molding. This type of nonpolar plastic material mandatorily requires pretreatment to allow for the adhesion processes. The objective of such a pretreatment is to increase the surface energy. The higher it is, the better the subsequent adhesion to the foam.

For manufacturing the Q5 dashboard structural member, the Neustadt-located company planned to construct a new pretreatment plant but in this case the manufacturer decided to go for an alternative pretreatment method, the Openair plasma technology, rather than the conventionally employed flaming technology. In this respect Oliver Berger, Production Manager at Peguform, reports that – besides the far higher operating costs – one essential cost factor in the construction of a new flaming plant would have been the necessity of installing not just one but two automatic masking systems, namely one for the left-hand drives and one for the right-hand drives. After completion of the test phase, the advantages of the plasma-based pretreatment plant were quite obvious to the manufacturer. Peguform was convinced that, besides the savings in operating costs, a plasma-based approach was worthwhile thanks to the option of a patterned plasma treatment and the resulting elimination of masking tasks combined with the strong adhesion effect due to the high activation energy of plasma. Series production with the new plant started early in 2008.

Author

Inès A. Melamies, freelance journalist, Bad Honnef

Plasma activation improves adhesion

The atmospheric plasma process developed by Plasmatreat, Stein-

The plasma nozzles mounted to two robot arms scan the surface true to contours whilst precisely sparing those areas where no PUR foam adhesion is desired.

The nozzles provide selective treatment. The cold plasma brings about risk-free cleaning and activation of the long glass fiber-reinforced polypropylene surface of the dashboard even in the case of complex component geometries.

hagen, is based on a nozzle principle for the most varied component geometries. The systems work under normal ambient conditions and are solely operated with compressed air and high voltage. The plasma strongly activates the surfaces of plastics, metals, glass or ceramics by selective oxidation processes whilst simultaneously discharging the former and bringing about microfine cleaning of the surfaces. The most important measure for assessing the probable adhesion of an adhesive layer or coating on solid material is its surface energy. Tests on nonpolar thermoplasts such as PP indicate low surface energies, mostly between 28 and 32 mJ/m². Experience, however, has shown that good prerequisites for adhesion are first achieved with surface energies greater than 38 - 42 mJ/m². A plasma treatment, i.e. a strong activation of the material surface, can bring about a distinct increase in surface energy. Trials conducted by the originator of the process have revealed that values up to over 72 mJ/m²

In the opened state, the foaming installation looks like a gigantic sandwich toaster. The PUR foam is applied to the black slush skin inserted below, spreads over the complete surface between the PP support structure (above) and the skin after folding up, and adhesively bonds the two parts to one another.

Instrument panel after plasma treatment. Adhesive slush skin and foam bonding and rear-side skin weakening in the area of the air bag (above). A milling system produces the instrument openings. The back-foamed slush skin can be easily removed by hand from the non-plasma-treated areas.

become possible for most plastic materials. The system excels by its high process safety which in turn has a very positive effect on the adhesion and the product quality.

Selective treatment

The plasma system equipped with three rotary nozzles operates with an emission speed of approximately 250 m/s. The activation is therefore also effective in the case of complex geometries - such as small recesses and undercuts. The working range of the plasma is close to the nozzle so that variations in distance due to different tolerances on components and tools hardly become noticeable in the pretreatment track width. One of the positive effects is the true-to-contour scanning of the plastic surface. The plasma nozzle can make changes in direction over the component and is capable of passing over tracks, not only over lines. This contrasts strongly with conventional flame treatment in which major changes in direction must be made outside the component to avoid burns on the surface by the thermal impact at the point of reversal.

If the "distance from the component" or "duration of the flaming" parameters deviate from the specification, even if only slightly, a 1000 °C hot flame can become detrimental to the thermally sensitive PP. And this is especially true when a long glass fiber-reinforced plastic material is involved. Should the PP melt due to overheating, the fibers would lie loosely on the surface which would result in extremely poor adhesion to the PUR foam. Also, a heat accumulation could occur in the area of the recesses of the display instruments during flame treatment because the heat cannot dissipate, leading to the same result. The Openair technique excludes these risks. The atmospheric plasma, also known as "cold" plasma, does not heat the plastic material to a temperature over 30 °C during the treatment.

Masking becomes unnecessary

The foam injected by the foaming installation between the PP carrier and the slush skin for the soft touch of the dashboard must adhere at certain places but not at others. Areas not to be treated include, for example, bolt-on points or add-on parts or - in the case of higher end designs - places where the back-foamed slush skin is to be replaced by real leather later on. For flame surface treatment applications, all areas where no foam adhesion is desired must be masked with thermally stable masks.

The Openair technology eliminates the need of masking since the robot-guided plasma beam operates in a patterned manner. Unlike the flaming process, it is capable of following the component geometry with millimeter precision. In the untreated areas, the spot-faced slush skin with the back-foamed PUR foam can be easily peeled off. Areas where complete openings of the structural member are to be provided for instrument installation, are milled out in a separate work step. Peguform's experience with the stable pretreatment process from Plasmatreat proved to be

COST EFFICIENCY

Selective treatment eliminates masking

Peguform uses Openair plasma as the pretreatment process for dashboard foaming. There is no need for masking the components previously because the nozzles, unlike conventional flame treatment, provide selective treatment. Masking the components becomes unnecessary because plasma enhances the adhesive properties of the surfaces only at places where improved adhesion is actually required. Areas where no foam adhesion is desired, are spared.

successful. Not a single field failure was recorded since the start of production of the Audi Q5 dashboards. The decisive advantages include, among others, the reliability and high effectiveness of this method in the production process. Adding to this are the ease of integration into automated process operations and the higher cost effectiveness compared to conventional methods – and all this going hand in hand with good environmental compatibility.

CONTACT

Plasmatreat, Peter Langhof, Key Application Manager, Steinhagen, peter.langhof@plasmatreat.de, Halle A1, Stand 1422
Peguform, Oliver Berger, Produktionsleiter Instrumententafeln, Neustadt a.d. Donau, o.berger@peguform.de