Plasma nozzles on PP cockpit (photos: Plasmatreat)

Plasma process allows mask-free dashboard pretreatment

Cold, clean and high surface tension

Masking before filling instrument panels with foam is a labour-intensive process. A way out of masking and some other advantages which can be derived from it is shown by an atmospheric plasma process that has been in use by a German automotive component supplier for the Audi Q5 series.

A few years ago the plastic component supplier Peguform received an order for manufacturing the instrument panel for the Audi Q5 series. The dashboard structure was supposed to be composed of three material layers: a long glass fibre reinforced plastic structural member, a polyurethane (PU) foam layer and a so-called slush skin which is a moulded PVC skin. Peguform produced the structural members in polypropylene (PP) by injection moulding. This type of nonpolar plastic material has to undergo pretreatment to allow for the subsequent 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 company planned to construct a new pretreatment plant at its factory in Neustadt, Germany and to go for an alternative pretreatment method, an atmospheric plasma technology, rather than the conventionally employed flaming technology. After completion of a test phase, the advantages of the plasma-based pretreatment plant were quite obvious. Besides achieving cost savings, the factors which convinced Peguform were above all the patterned plasma treatment and the associated elimination of masking tasks combined with the strong adhesion effect due to the high activation energy of plasma. Volume production with the new plant started early in 2008.

Plasma activation for high surface tension

The atmospheric plasma process developed and patented by German company Plasmatreat in 1995, and in use globally today, 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 metals, plastics, glass or ceramics by selective oxidation processes, simultaneously discharges the former and brings about microfine cleaning of the surfaces. The surface tension (mN/m) is the most important measure for evaluating the probable adhesive strength of an adhesive layer or coating. Tests carried out with test inks on nonpolar thermoplastic materials such as PP indicate low surface tensions, mostly between 28mN/m and 32mN/m. But good conditions for adhesion can only be obtained by experience from 38 to 42mN/m onward. A plasma treatment, which means a strong activation of the material surface, can bring about a distinct increase in surface

Dashboard with body openings

Foam slush machinery

tension. Trials at Plasmatreat have revealed that values up to over 72mN/m become possible for most plastic materials.

Patterned pretreatment

The Openair plasma system equipped with three rotary nozzles operates with an emission speed of approximately 250m/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 become hardly 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, whereas major changes in direction must be made outside the component when applying the flaming technique since the thermal impact on the point of reversal could otherwise cause burns on the surface.

Unmasked process

The foam injected by the foaming installation between the PP structural member and the slush skin for the soft touch of the instrument panel 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 exclusive designs, places where the back-foamed slush skin is to be replaced by real leather later on. All areas where no foam adhesion is desired must be masked with thermally stable masks for the flaming process. The Openair technique eliminates the work step 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 millimetre precision. In the untreated areas, the spot-faced slush skin with the back-foamed PU foam can be easily peeled off. Areas where complete openings of the structural member are to be provided for instrument installation, are milled out separately.

Cold process does not damage glass fibre reinforcement

If the "distance from the component" or "duration of the flaming" parameters deviate from the specification, even if only for a minimum, a 1,000°C hot flame can become detrimental to the thermally sensitive PP. And this is especially true when a long glass fibre reinforced plastic material is involved. Should the PP melt due to the heat of the flame at one time or another, the fibres would lie loosely on the surface so that good adhesion to PU foam would no longer be ensured. A heat accumulation could furthermore occur in the area of the recesses of the display instruments while flaming since the heat cannot dissipate which would lead to the same result. The Openair technique claims to exclude 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.

Peguform's experience with the stable pretreatment process from Plasmatreat proved to be successful. According to the company, not a single field failure has been recorded since the start of production of the Audi Q5 dashboards. The decisive advantages include, among others, the reliability and high effectiveness of the Openair 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.

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