Plasma Pretreatment for Optimal Bonding and Adhesion

Pretreatment processes for an improved bonding and adhesion are well-proven methods in bonding and metallisation of plastics. Among a wide range of possible processes, plasma pretreatment under normal pressure (environmental conditions) is gaining interest.

The new (patented) OpenAir® method invented by PlasmaTreat, Steinhagen, is suitable for precision cleaning and improvement of the adhesion in multicomponent injection-moulding for plastic/plastic or plastic/metal bonding. As the plasma source has a compact size and can be used under normal pressure, it can be moved directly over the parts to be joined.

Advantages of mobile, adjustable plasma source:
- Integration into the process chain (Inline-method)
- Local treatment of parts with complex geometry
- Partial treatment of large parts

Advantages for multicomponent systems:
- Removal of organic constituents
- Integration of reactive and/or active groups on the surface (activation)
- Breaking of adhesion-resisting surface layers (oxide coatings)

Method and Potential

The OpenAir® method is an atmospheric plasma process for the pretreatment of surfaces. In a closed plasma chamber a plasma is created by high voltage discharge. This plasma is directed to the surface of the component in a stream of compressed air as non-thermic, largely potential-free plasma, cf fig. 1.

The short contact time of the plasma stream enables a (temperature-)gentle, yet effective pretreatment. The high-energy particles (ions, electrons, radicals, electrically stimulated particles, ...) are the source for the fast physical-chemical process at the surface. The microscopic effects can be shown by microscopic or radiation analytic methods like atomic-force-microscopy (AFM), x-ray spectroscopy (XPS) or IR measuring, the practical application being important for:
- wetting and
- adhesive interactions

for a better adhesion of materials in the contact area. For adapting the plasma effect according to the geometry and the materials, variable nozzle geometries and adjusted direction moves are available. Thus, inserted parts (metal sheets, foiles) as well as multi-injection moulded parts can be pretreated.

Improvement of Adhesion

The improvement of the adhesion by inline plasma pretreatment in multicomponent technology is exemplified by the results for different hard/soft (thermoplas/TPU) combinations, cf fig. 2, as well as by thermoset-thermoplas combinations.

The following improvements in adhesion are possible:
- positive-joint composites from combinations hitherto badly adhering or non-adhering
- improved adhesion of compatible combinations
- reduced influence of adhesion-relevant processing parameters

For the practical appliance, this means:
- extension of the compatibility matrix
- connection of standard materials (no need for adhesion modified polymers)
- low processing temperatures and pressures
The studies commenced to establish the inline plasma technology in the field of multi-component injection moulding are currently performed at the Neue Materialien Fürth in a collaborative venture between the companies Krauss Maffei, PlasmaTreat AG and the Institute of Polymer Technology. Basic application-oriented trials are performed on an appropriate experimental setup in a pilot plant of Neue Materialien Fürth that consists of a two-component injection moulding machine, a 6 axis buckling-arm robot and a variable plasma equipment.

**WE OFFER**

**Participation in the industrial working group „2-component Injection Moulding with Inline Plasma Treatment“**

This joint venture of several industrial partners from raw material producers and users wishes to systematically investigate into the potential of different material combinations. The working group is open to new members.

**Application oriented investigations:**

Inject Moulding tests of material combinations selected by you are possible with our experimental tools or with your own tools within the scope of industrial projects.

**Contact**

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