Medical Device Manufacturing Applications using Openair® Plasma Systems

Surface re-engineering for new material combinations such as LSR

The medical device industry requires standards of manufacturing that go beyond what is found in most other manufacturing sectors.

Surfaces must be not only be clean, but pristine. Sterility is often essential as well. Materials frequently must be biocompatible. Performance reliability is paramount: bonds must be secure, leakproof and permanent. Printing must be clear and permanent to avoid incorrect dosing or usage.

Plasma etching for improved adhesion has long been a part of the medical device industry but, prior to the introduction of Openair® Plasma technology, it could only be sustained in a low pressure chamber.

Plamatreat’s Openair® plasma systems overcome these hurdles. They have the advantages of working in open atmosphere, using air as a process gas, and being integrated in-line with existing processes.

Openair® Plasma: an Enabling Technology

- **Pristine surfaces.** Eliminates organic and silicone based contaminants.
- **Removes biocontaminants.**
- **Reliable bonds.** Plasma treatment significantly improves bond strength and/or ink adhesion on most materials.
- **Reduce reliance on chemical additives.** Plasma treatment often eliminates the need for adhesion promoters, enabling the use of truly medical grade materials
- **Functionalizes** the surface by creating reactive polar groups on non-polar surfaces.
- **Advanced Functionalization** is also possible with our PlasmaPlus® plasma polymerized functional coatings.
- **High surface energy.** In most cases, full wettability (above 72 dynes).
- **Effectively removes dust and static.**
- **Incorporate grip or soft touch features** to your products using plasma assisted multi-component molding.
- **Replace mechanical assembly.** Overmolding parts can replace labor and adhesive cost of assembling. Combinations such as TPU on PP or medical grade LSR to medical grade PC are possible through plasma treatment in the mold itself.
- **Environmental Sustainability.** Enables substitution of solvent-based materials with water-based materials and, with air as the normal process gas, uses only renewable resources. No ozone or other significant emissions are produced.

Easy to Integrate into Manufacturing Processes

- **Easy to install:** requires only electricity and compressed air.
- **Continuous Process:** integrate directly in-line with other processes. No need to accumulate WIP.
- **High Speed:** up to 300 M/min (1,000 fpm) possible in cleaning applications.
- **Flexible:** effective on a range of geometries from planar surfaces to complex 3D shapes.
- **Large Process Window:** proximity to surface and speed are the only major process parameters.
- **Versatile:** Effective on metallic and non-metallic surfaces. Can be applied to sensitive electronic components.
- **Cost effective:** relatively low initial investment; very low running costs.

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Openair® Plasma is a key technology: Constantly rising raw material prices and growing demands for quality require new technologies. Medical devices often incorporate LSR on seals, grips and keypads. Adhesion of LSR to high-tech substrates like PPSU and PEEK can present unique challenges.

Openair® plasma in multi-component injection molding and extrusion

Joints between different materials in composites play a major role in the medical industry. By joining different components a product can be given new physical properties which the individual materials do not possess alone. This allows products to be made which exhibit great rigidity and strength while simultaneously having a surface that is both flexible and tactile.

The advantage of operating at normal pressure (ambient conditions) and the compact configuration of the plasma generator allows for numerous applications in multi-component injection molding and extrusion. With the aid of Openair® plasma technology LSR can now be injected directly onto materials that previously could not be directly joined.

Process:

After extrusion or injection of the first component the contact surface between the materials is briefly activated with plasma.

Following this the mold is closed again and the LSR is injected on top. In extrusion the second component is extruded using an additional die.

- Pretreatment can take place either directly in the mold or when transferring parts to another mold.
- In-line use: By means of simple electric and compressed air connections, Openair® plasma technology can be integrated equally well into existing and new production lines and processes.
- The process is environmentally friendly and reduces costs.

Multi-shot molded products made using the Openair® Plasma process exhibit:

- Use of new material combinations such as LSR
- Powerful adhesion
- Proven technology
- Flexible processing with pretreatment in the mold or in-line with extrusion
- Higher process quality and consistency
- Improved costs and environmental efficiencies