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rhenus lubrineering – Kosten senken ohne Risiko

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Topic

Optimization of bonding processes by means of atmospheric-pressure plasma treatment

Regardless of whether the subject is gluing folding boxes or injection moulding technology, the surface treatment of aluminium components or displays, or whether it is to do with coating CD blanks, ultrafine cleaning in microelectronics and medical technology or even use in automotive engineering, shipbuilding and aircraft construction – scarcely any bounds are set to the universal application of atmospheric-pressure plasma.

Atmospheric-pressure plasma is opening up numerous applications in industry, especially when used in cleaning, activating and coating processes. The Openair plasma technology

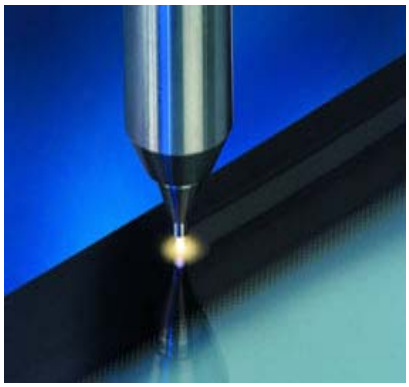

Photo: Plasmatreat
Figure 1. The electrically neutral Openair plasma beam allows ultrafine cleaning, high activation and selective nanocoating of the most varied surfaces.

developed and patented by the German company Plasmatreat as early as 1995 is characterised by a threefold action: the plasma beam activates surfaces by selective oxidation processes, discharges them at the same time and brings about ultrafine cleaning. A particular characteristic is that the emerging plasma is electrically neutral which greatly extends and simplifies its application. Its intensity is so high that treatment speeds of several 100 m/min are achievable. The typical rise in temperature of a plastic surface during treatment amounts in this case to $\Delta T < 20$ °C. At the same time this pretreatment owes its worldwide expansion in just a few years not least to a special feature: whether used in an injection moulding or imprinting machine, in a gluing or painting unit – the jet systems employed for this purpose can always be integrated in-line into a new or already existing production line.

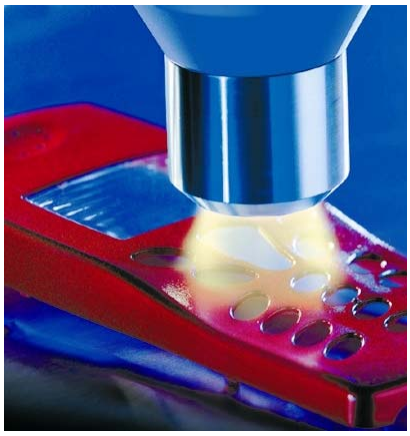

Photo: Plasmatreat
Figure 3. Pretreatment of a mobile phone housing with a rotating Openair-Plasma jet.

Environmentally friendly adhesion enhancement

"Our system, without any restrictions, is capable of in-line integration and compatible with robots. We have succeeded, inter alia, in decisively rationalising

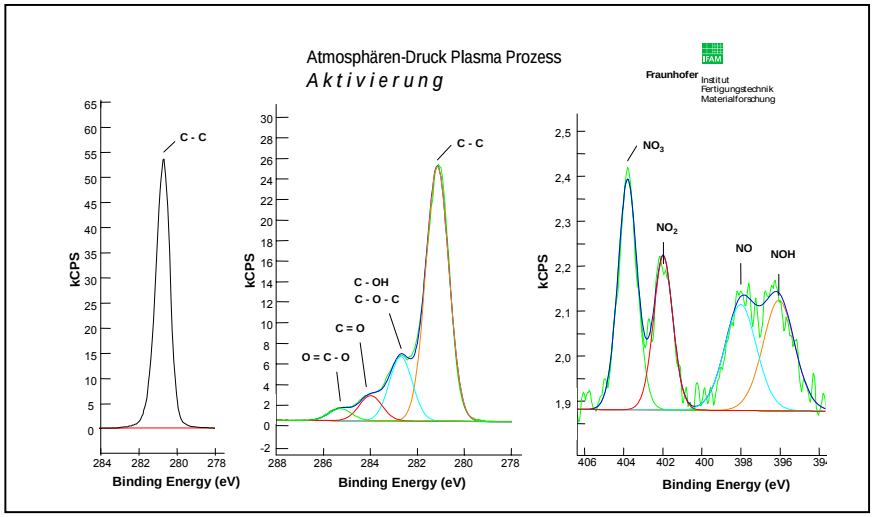

Diagram: IFAM
Figure 2. XPS examination of an untreated polypropylene and of one treated with Openair plasma.

processes such as the removal of mould release agents from PU mouldings by the use of our technology." declares Dipl.-Ing. Christian Buske, Managing Partner of the company.
Surface tension is the most important measure for evaluating the likely adhesion of a bonding layer or of a surface coating. Plastics have a low surface tension between < 28 mN/m and 40 mN/m. Practical experience, however, shows that only surface tensions of 38-42 mN/m and higher provide good conditions for adhesion. By means of pretreatment with Openair plasma a marked increase in surface tension can be achieved. In this way values of up to 72 mN/m are possible on many plastics.
A decisive advantage of the technology consists in that hitherto incompatible substrates can be made to bond so that water-based and often UV-based adhesives adhere to very adhesive-resistant surfaces such as non-polar plastics. Polycarbonate windows in the upper half of mobile phone housings can be glued into place using solvent-free UV adhesives.

Photo: Yves Guillotin
Figure 5. In the largest natural gas tankers in the world Openair plasma is employed for the secure bonding of the insulation.

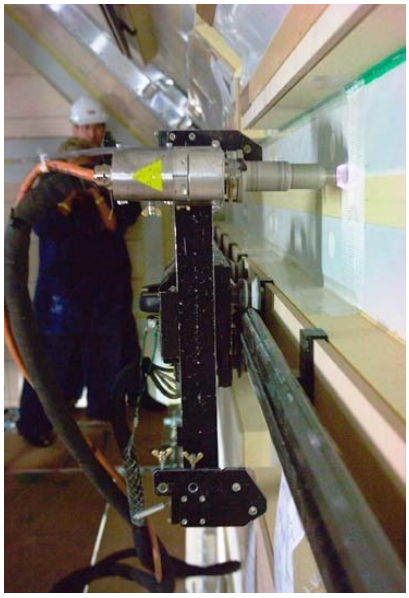

Photo: Yves Guillotin
Figure 6. Over a length in each tanker of 40 km the robot drives the plasma jet at a speed of 6 m/min and at a distance of 10 mm over the surface to be treated.

But equally well casein-based adhesives can be used for labelling plastic containers.
The process is decidedly beneficial to the environment. Additional pretreatment by chemical primers or the scrubbing and rinsing of surfaces can be dispensed with completely. As a result of this emissions of VOCs (volatile organic chemicals) in production can be eliminated from the outset. The treatment ensues extremely uniformly and can be checked by a process control system.

Photo: Plasmatreat
Figure 4. The automotive industry imposes high demands: Pretreatment with Openair plasma ensures an immaculate visual appearance of the painted surface and the absolute leak-proofness of headlights.

Automotive industry
The surfaces of non-polar plastics are difficult to wet. In particular water-based adhesives and paints must be activated before bonding or application by a pretreatment process. In the automotive industry pretreatment with atmospheric-pressure plasma is selectively employed, inter alia, in the installation of headlights. Here the process guarantees firm, diffusion-tight bonding and hence secure sealing against the penetration of moisture. In the case of air-bag covers made from PU not only is the adhesive bond guaranteed after pretreatment but also residues of additives left from the injection process are thoroughly removed by the plasma.

Plasma in shipbuilding

When the world's currently largest liquefied natural gas tankers, the Provalys and the Gaselys, started cruising the world's oceans last year the German plasma process made a decisive contribution to this event. For only with the aid of this technique was it possible to ensure the precise bonding of the essential tank insulation.

In order to transport the gas by ship it is cooled down to minus 163 °C in liquefying plants in usually remote producing countries which reduces the original volume to 1/600. At its destination the liquefied natural gas is converted again to the gaseous state and fed into the natural gas grid.

At the French shipyard "Les Chantiers de l'Atlantique" (Aker Yards) a newly developed insulation technique was to be used for the first time for the tanker insulation. This allowed the structure of the insulating layers and their thickness to be reduced in such a way that it was possible to increase the capacity of the tanker by 8,000 m^3. The objective was to ensure the absolute leak-proofness of the bonding of the new composite insulating panels directly to the inner hull of the ship. The installation of costly ventilation systems and air-conditioning plants was one perquisite for perfect bonding processes, but an even more decisive factor was the best possible pretreatment of the surfaces of the glued joints.

The shipbuilder initially tested different methods for this but neither chemical processes nor flame treatment of the surfaces yielded the desired success. 100 % leak-proofness is not achievable by these methods. Only the use of the atmospheric-pressure plasma technology developed in Westphalia fulfilled all the environmental, safety and efficiency conditions. Yves Pelpel, Aker Yards Contract Manager, declared, "With its system technology Plasmatreat provided a solution that allowed the surface treatment necessary for the insulation bonding processes directly on the building site under ideal conditions."

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