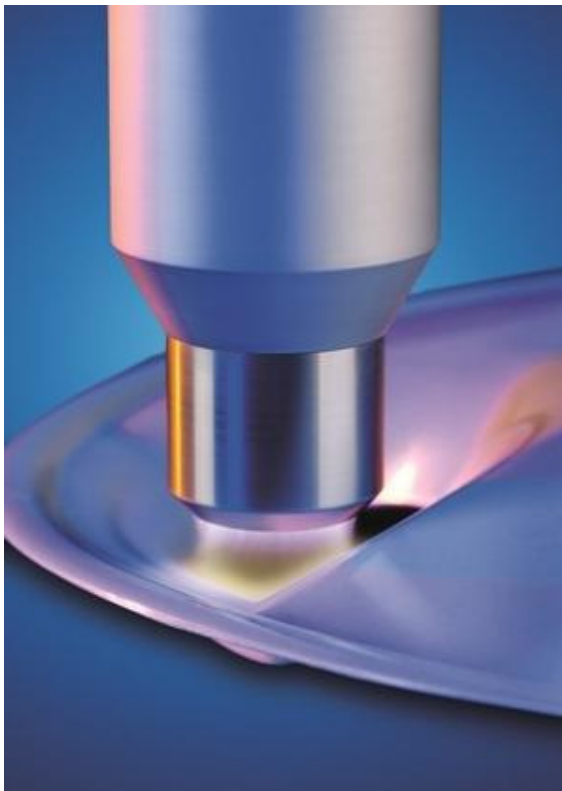


Plasmatreat presents plasma treatment progress

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DÜSSELDORF, GERMANY — Plasmatreat GmbH presented a live demonstration at K 2013 of its new Openair atmospheric plasma treatment unit designed for fully automated EPDM profile treatment processes.

Christian Buske, CEO of Steinhagen, Germany based Plasmatreat, said EPDM rubber door seals is the second oldest Openair application area, where the plasma jet process produces a combination of soft touch and anti-sticking properties, as well as preventing "freezing" to steel bodywork in winter.

"Today, nearly 100 percent of such door seals are subjected to plasma treatment", Buske said, adding "the effect depends on the jet and varies

according to the operator."

Hutchinson GmbH in Aachen, Germany, is an example cited by Plasmatreat of a company that has been pre-treating automotive EPDM profiles with Openair plasma systems since the late 1990's prior to painting, anti-stick coating or flocking the profiles with fine nylon fibers. The plasma technique has substituted more laborious brushing or primer treatment techniques.

A new PFW10-R version of Plasmatreat's tube-shaped "Tube" EPDM and TPE door seal profile plasma treatment equipment can work with 4-8 nozzles, manually or with automatic positioning and selection of plasma jets by rotating around 270° and to 4-10mm distance from the profile within one minute. Up to 1,024 plasma jet positions can be recorded.

The company also showed at K 2013 a 1.80m wide plasma system for pre treatment of large plastic panels, such as garage doors, before they digitally inkjet-printed "with lot sizes down to one" with 20-30 picoliter ink drops at

speeds above 30m/min with Hymmen printing equipment fitted with Wujifilm Diamatic Inc. piezoelectric print heads. Plasmatrete offers a range of panel treatment systems covering treatment widths of 600-3,200mm and with speeds of 2-50m/min.

Headlamp cover and lens hard coating pre-treatment is the oldest application for Plasmatrete equipment, running for around 15 years. Plasma treatment of these parts prior to hard coat application significantly reduces stress, leading to elimination of colored "rainbow lines" caused by different degrees of light diffraction, Plasmatrete claims.

At K 2013, the company showed a new means of measuring surface tension online with full integration of a prototype SA1001 "Surface Analyst" device from Brighton Technologies Group Inc. demonstrating its 0.5 μ L droplet surface energy analysis capability on car headlamp covers. The degree of wetting is determined as a surface contact angle calculated from measurement of the shape of constant volume droplets applied as single drops to the surface by a piezo-pump.

The company's Openair systems are also used to remove mold release agent from sealant grooves in injection molded PP headlamp housings, simultaneously increasing surface tension for high housing-to-seal bond strength. New PfW30 nozzles have speed-regulated plasma density control and automatic adjustment to maintain uniform flow and prevent re-treatment. The nozzles can maximize sealant coverage when used in rotary systems to ensure gap-filling of cross-sections up to 15mm x 15mm. Spectral analysis of the plasma jet light emission provides full process control.

Plasma technology has been known for 40 years, Andy Stecher, CEO of Plasmatrete US LP in Elgin, Ill., said during a press briefing at the Plasmatrete booth. Stecher pointed out that there has been a long period of experience with vacuum-based plasma treatment systems, but with these "although you can fill a whole room at one time, you have to wait two to three minutes for the vacuum to develop — this is not good for continuous production."

Plasmatrete was founded in 1995 to develop and market alternative non-vacuum plasma jet treatment systems, which Stecher says are used for example in all automotive headlamp production today. Plasma treatment basically involves separation out of electrons, leaving the remaining ions with such high energy that they want to re-combine immediately enabling, for example, surface OH groups in polymer molecular chains to be modified in such a way that they can be bonded to other materials without use of primers or adhesives..

In two-component injection molding, this means plasma treatment of a hard primary component enables the soft secondary component to crosslink on the plasma treated area, giving such high bonding strength "that you can't remove it afterwards," Stecher maintains. It also means a non-polar polymer such as polypropylene, which requires some form of treatment for adequate bonding, can be overmolded with strongly bonded silicone rubber or thermoplastic polyurethane.

On the 160 square meter exhibition booth shared by Plasmatrete and its

system partner and foamed-in-place technology specialist CeraCon, a new robotic cell demonstrated achievement of strong bonding between non-polar polypropylene plastic and single-component polyurethane foam through plasma treatment of the PP. The companies also presented charts showing two-component tensile bond strengths with PU applied to PP (7Mpa), PA12 (8MPa) and polycarbonate (9MPa). Corresponding values without plasma treatment were close to zero with PP, 2Mpa with PA12 and around 1.5Mpa for PC.

At the K 2010 fair, the two companies had run a live demonstration of a Plasmatreat PT Release silicone-free mold release coating applied to a PP/PU door stopper, the PU seal having been applied in the mold Ceracon's S-FIT soft foam injection technology as an alternative to 2-component molding with TPE.

Stecher said that one of the first questions raised by U.S. companies when confronted with Plasmatreat's Openair technology is "what does it cost". Here Stecher advises that Plasmatreat's seven different systems "take cost out of production processes. Based on electricity cost of 10 US cents/kWh, a typical plasma treatment unit from the company consumes around \$200 per year to run. I spend more on coffee machines for our staff. And of top of that, costs are saved through elimination of primers or adhesives and it is easier to introduce automated part handling."

Christian Buske added that other costs saved with plasma jet processes come from elimination of drying time, use of ovens and recycling of volatile organic compounds (VOCs). Buske describes plasma jetting as "double green" — namely in terms of the environment and money (dollars, i.e. "green backs"). Buske says the process is now widely used in high technology areas such as in electronics at "silicone valley" companies in California and in the life science market, such as for coatings on micro-titration plates. These developments have been supported further since the Plasmatreat US acquisition in April 2013 of the US low pressure plasma treatment specialist 4th State Inc. in Belmont, California.

The 1.50m wide continuous roll-to-roll R2R60 plasma chamber from 4th State serves for surface modification of rolls of fabric, non-wovens, films and foils prior to their being glued, printed or coated. In the medical industry for example, this includes "cost-efficient" functionalization of cyclo-olefin-copolymer (COC) and polystyrene (PS) films for immunoassay and microfluidic systems, as well as tailored modification of membranes and fabrics for chemical filtration and separation equipment.

The U.S. pharmaceutical company Baxter International Inc. "had a huge payback with plasma jetting compared with the wet chemical processes that it has replaced," Buske said, who added that older low pressure systems are still replacing older alternative processes. In medical packaging, plasma treatment is used to generate "reactive nitrogen species" that damage germs within "a matter of seconds", alternatively by production of reactive oxygen species via dielectric barrier discharge (DBD), damaging cell membranes and blocking essential metabolic processes in micro-organisms.

The plasma jet process is also used to apply aluminum/polyethylene surfaces to wood plastic composites, especially in the Chinese market, with the first three units already running in the country.

A new application is use of plasma treating on carbon fiber reinforced plastic (CFRP) parts for the new BMW i3 car. After the parts have been milled on Gildemeister milling equipment, overlapping areas, where additional tailored CFRP reinforcement is applied, are plasma treated before the parts are adhesive bonded together to form a strong bond. This takes place despite CFRP parts often being covered by mold release agent — as plasma treatment provides deep-pore cleaning and surface activation.

Also new from Plasmatrete is an Aurora low pressure equipment series for polymer functionalization and modification that has been developed in co-operation with 4th State Inc. The Aurora equipment housing was designed by Knut Braake, owner of Braake Design, Stuttgart, Germany. It won a Good Design award in December 2012, presented by Chicago Athenaeum Museum of Architecture and Design in cooperation with the European Centre for Architecture, Art, Design and Urban Studies. Brake Design also designed the housing of the new "Tube" EPDM profile station for Plasmatrete.

The Aurora unit is presently marketed in the USA, but details were available at K 2013. Its cold plasma enables treatment of thermally sensitive polymers and there is primary plasma treatment capability for 3D parts. Plasmatrete says the 2011 acquisition of the U.S. company Plasma Technology Systems (PTS) in Belmont, Calif., had broadened its "molecular re engineering system solutions for custom surfaces" to include complementary low-pressure radio frequency technology and equipment, as represented by the new Aurora systems.

Plasma jetting is also used today for applications such as powder coating and application of 2 micron conductive layers on plastic electronics housings to provide electromagnetic and radio frequency interference (EMI/RFI) shielding. A new FPC fine powder coating version was shown in Düsseldorf, with the claim that it "allows new product design and environmentally safe functional metallization of plastic surfaces."

EFC Engineered Functional Coating Plasma GmbH of Ingolstadt, Germany, presented information on the FPC process on the Plasmatrete booth, showing how the Plasma Conduct process that it licenses can be used to apply 15-30µm thick copper/copper alloy coatings on plastics such as PEEK, PMMA, PP (e.g. flat cable), 30 percent glass fiber reinforced nylon and ABS while the substrate temperature remains below 100 °C during the coating process.

Plasmatrete refers here to 17 different metals and metal alloys and also to polycarbonate, PVC plastics and CFRP/GRP composite substrates, with coating thicknesses 1-200µm and average particle size distribution of 0.6-25µm. Aside from conductivity for EMI/RFI shielding, the company says FPC can be used to improve heat transfer, enable soldering and provide corrosion resistance and tribological properties (e.g. improved wear resistance on metals).

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