

May/June 2009

PROCESS cleaning

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Spiral-Bottom Round Bowl Machine

This machine from Almco KleenTec has a full-circle baffle said to keep parts in the media mass constantly for faster, more precise processing. *p. 14*



High Efficiency Dryer

This Crest energy efficient thermal dryer is designed to dry in batches, quickly and thoroughly. *p. 54.*



Solvent-Free Parts Cleaner

Service Line Inc.'s focus has been on replacing solvent-based cleaners and eliminating hazardous chemicals. *p. 58.*

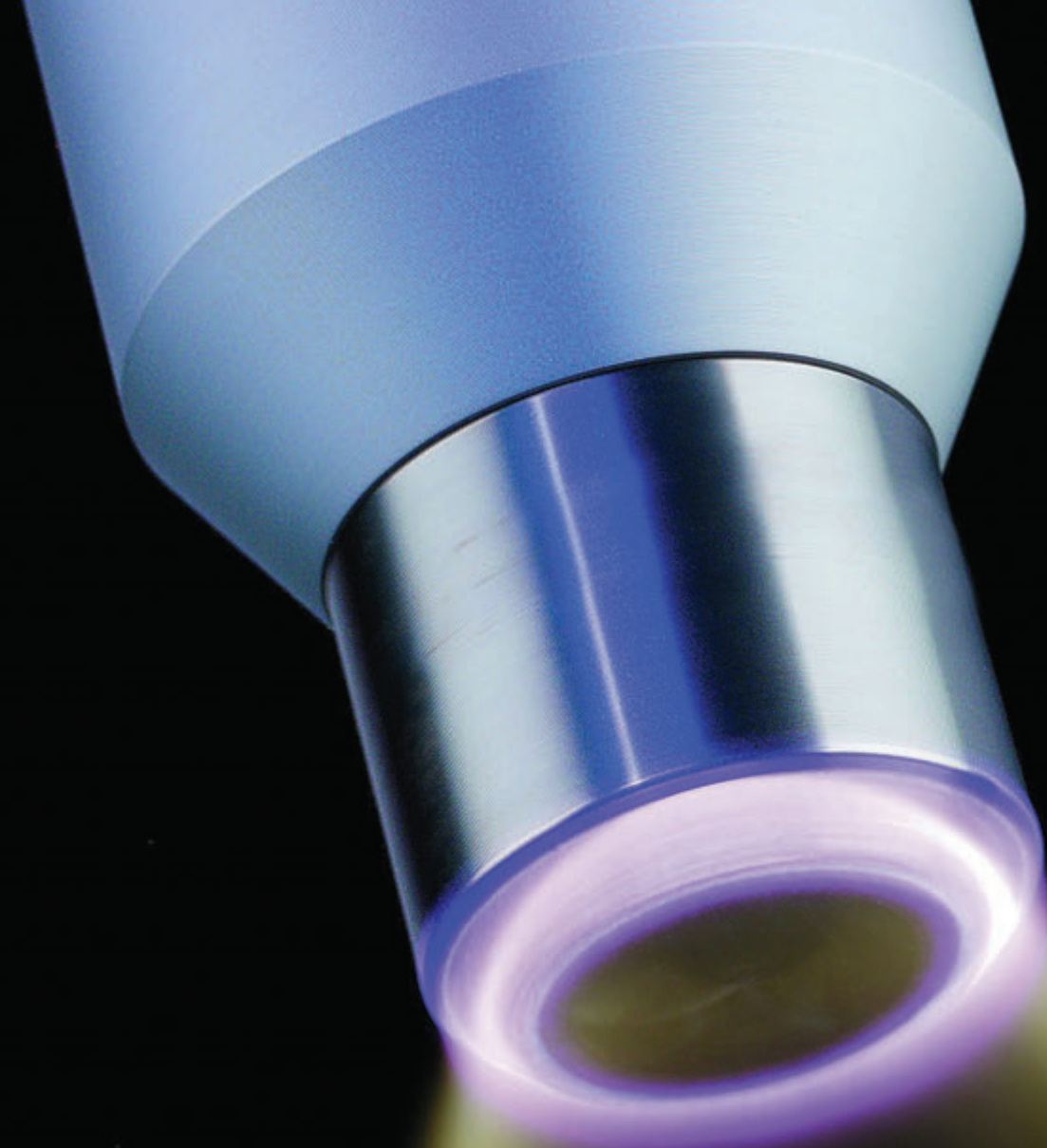
Pretreat with Plasma

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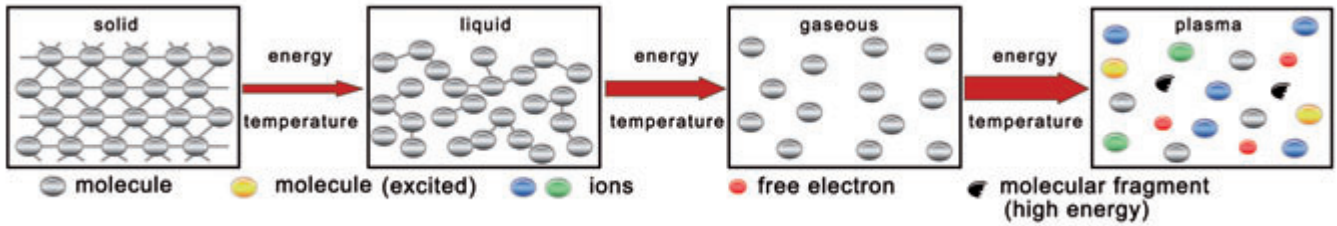
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Sa(v)fe with Plasma

From mobile phones to aluminum coils—the list of items could be extended endlessly. Pretreatment with atmospheric pressure plasma is arousing ever more interest among users who require microscopically fine precleaning and high activation of surfaces prior to the finishing process.

INÈS A. MELAMIES



“Plasma – the 4th state of matter.”

Modern products require high-grade coatings. Nothing is more annoying for a customer than flaking paintwork, which in many high-tech products may even be associated with faulty operation. Whether it’s a metalized folding box or cell-phone housing, aircraft part, car body or aluminum coil, manufacturers are putting ever more effort into improving their surface coating processes. This also requires action to optimize pretreatment. Such pretreatment processes range from ionization or flame treatment through wet chemical processes, power washing and use of primers right up to dusting with ostrich feathers.

Despite the sometimes high investments made, the proportion of reject parts in production caused by painting over particles of dust is often well above 10%. Static charging of surfaces, tiny but still unacceptable remnants of fine dust in less accessible areas, or environmental pollution are the most

common problems in the aforementioned processes.

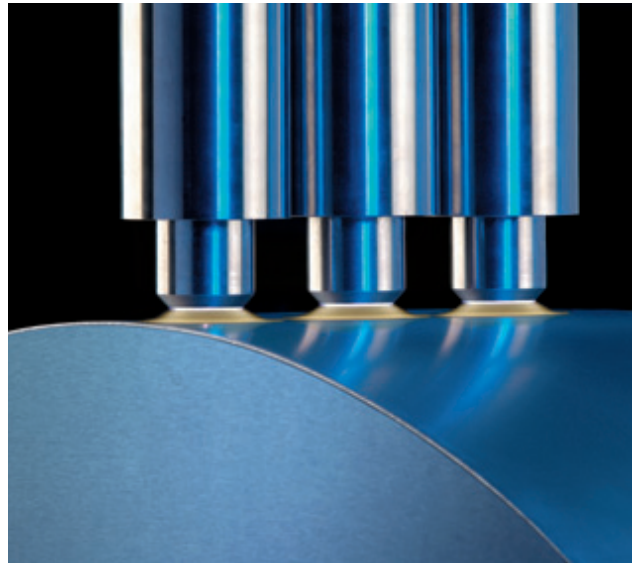
An innovative atmospheric-pressure plasma technology by the name of Openair eliminates the problems identified above and, hence, drives down the proportion of rejects. It has been opening up numerous novel applications when used in processes involving the microfine cleaning, high activation and nanocoating of surfaces of the most varied materials. The results are an immaculate surface and optimum adhesion of paints and adhesives. The primary objectives are to achieve savings in material and process costs compared with conventional pretreatment methods and to create environmentally friendly conditions.

What is Plasma?

Plasma is based on a simple physical principle. As a result of input of energy, the states of matter change: Solid becomes liquid, and liquid turns to gas. If further energy is now supplied



Depending on the power of the plasma jet, a single Plasma-treat plasma beam can be up to 50 mm in length and achieve a treatment width of 25 mm. Depending on the power required for the desired treatment, the plasma source can be adjusted for spacing of 10–40 mm and at speeds of 6–600 mm/min relative to the surface of the material to be treated.



Apart from the single jet, patented Openair rotary systems are available for pre-treating relatively large areas. With plasma jets of suitable diameter in an appropriate arrangement, surfaces up to 2,000 mm wide can be treated in a single pass.



After injection molding but before painting cockpit module housings are first cleaned inline to pore depth with Openair atmospheric plasma.

to a gas it becomes ionized—the electrons are given more kinetic energy and leave their atomic shells. Free electrons, ions and molecular fragments are produced, and the gas passes over into the plasma state, a further state also known as the “fourth state of matter.” Due to its instability, however, this state could hardly be used at normal atmospheric pressure.

The Openair atmospheric-pressure plasma process developed and patented by Plasmatreat (headquartered in Steinhagen,

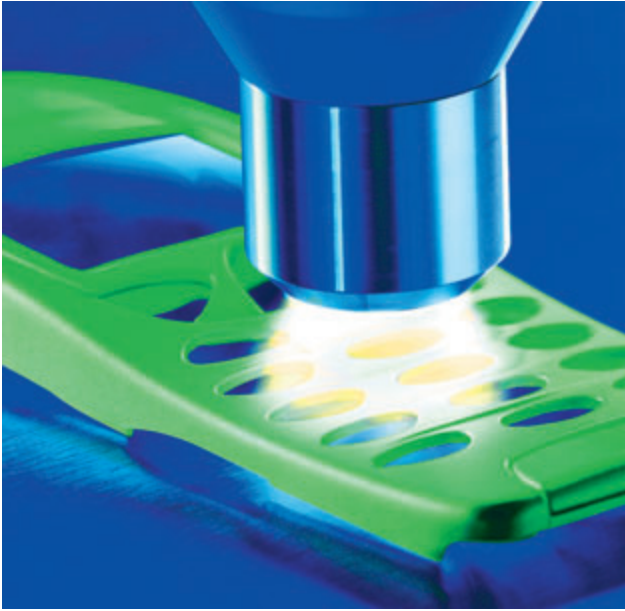
Germany, with North American offices in Mississauga, Ontario, Canada) in 1995 opened up new opportunities. By developing and using plasma jets, it became possible for the first time to integrate this state of matter, scarcely even used so far in industry, into production processes (“in-line” application) and make plasma usable under normal atmospheric conditions for the pretreatment of the surfaces of materials on a large industrial scale.

Electrically Neutral Plasma Beam

The jets are operated solely by air and high voltage. Depending on the geometry of the jet, the emergent plasma is effectively available over an operating width of 25 mm wide or at a treatment distance of 40 mm. The plasma beam is formed and focused at the jet outlet and gives up its energy on contact with a surface. The most important components of the plasma installation are the plasma jets and generators. Inside the plasma jet the atmospheric-pressure plasma is generated by high-voltage discharge. A directed stream of air along the discharge pathway isolates parts of the plasma and transports them at nearly sonic speed through the jet head to the surface of the material to be treated. The jet holds back those parts of the plasma stream carrying charge. In addition, it determines the geometry of the emergent beam.



The new 49-m-long coil coating plant at Griesser AG, Switzerland, establishes a milestone in plant engineering by using Openair plasma for cleaning 800 tons of aluminium strips per year.



High quality pretreatment of a mobile phone housing can be done with a rotating plasma jet.

A particular characteristic of the emergent beam of plasma is that it is electrically neutral, which greatly extends and simplifies opportunities for use. Its intensity is so high that machining speeds of several hundred meters per minute can be achieved. Heating of plastic surfaces during treatment typically amounts, in this case, to less than 20°C.

Openair plasma modifies the surfaces of materials. The system is characterized by a threefold action. It activates the surface by selective oxidation processes, discharges the surface at the same time and brings about microfine cleaning. If a special precursor material is added to this plasma jet beam, selective inline nanocoating of surfaces can be accomplished. Due to the process of discharging on surfaces, the plasma system affords cleaning effects superior to those of conventional systems. The decisive factor in this is the electrostatic discharge action of a free beam of plasma. This effect is reinforced by the high outflow rate of the plasma, as a result of which loosely adhering particles are removed from the surface.

The Plasmatreat technology owes its worldwide expansion to a particular feature: Whether used in injection moulding or printing machines, in gluing or painting installations, the jet systems are always installed by the user directly in the assembly line. "The system is capable of implementation in-line and is, without restriction, compatible with robots, offering extraordinary cost-effective solutions," reports Plasmatreat CEO Christian Buske.

Automotive Interior Plastic

Plastic parts in car interiors, such as switches with laser-etched symbols, high-gloss trim strips and covers, scratch resistant display windows and sparkling dials, ventilator grilles, or glove compartments handles, are nowadays provided with very expensive coats of paint. Here Openair technology can be used as a pretreatment process, both for bonding and for a first-class surface finish.

Car Body Repair Finish

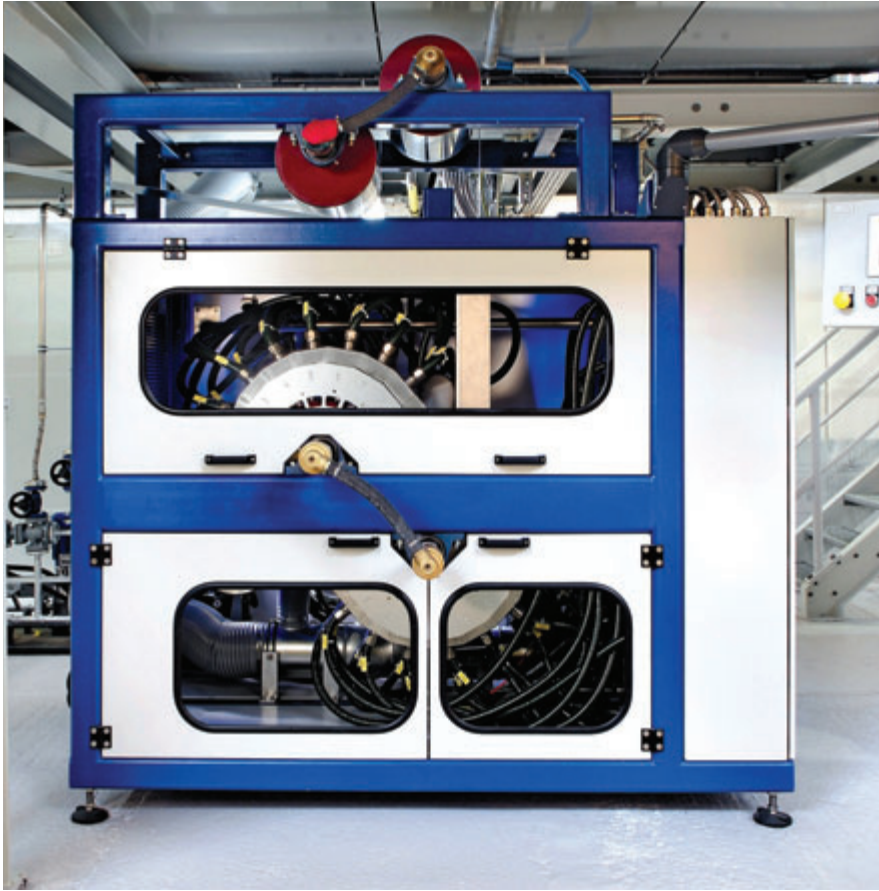
Appearance sells cars, both new and used. The first thing a car buyer sees is the paintwork. Studies have shown that the most important factor in the purchase decision for a late model used car is, in fact, the visual impression made by its paintwork.

Paintwork remains one of the most costly operations in motor car production, even though optimization of the spray painting process and the widespread use of painting robots have greatly improved the effectiveness of paint application and largely eliminated manual painting in the process workflow. For some years now, water-based paints have been used in series production and, more recently, in repair work. For this purpose two-coat systems are used almost exclusively in car production today.

The primary objectives are to achieve savings in material and process costs compared with conventional pretreatment methods and to create environmentally friendly conditions.

After application of the anticorrosive primer to the bare metal, and filler for smoothing out any uneven areas, a base coat is applied as the color-bearing layer. This, in turn, is covered by a two-component clear coat that forms a glossy, high-strength protective layer on top of the colored layer and protects the entire structure from mechanical, chemical and environmental stresses. This final coat of paint, however, can reveal production faults or damage in the paintwork finish. If that happens, repainting is the only option for a quality finish.

Repair or repainting jobs are often a particular headache for car manufacturers and paint shops. The key problem, and certainly the principal cause of the wastage rate in repainting work, is the sanding process required beforehand. If, on final inspection in series production, a damaged area of paint is



The Openair plasma installation, which is only 2 m wide, replaces a 60-m-long cleaning line and, hence, large amounts of chemicals and thousands of tons of waste water.

found on a freshly painted car body, this car must be given a new base coat as well as a new finishing coat. In order, however, to ensure good adhesion between the damaged outer coat and the new color-bearing layer, the former must first of all be completely sanded. After sanding, the car is then transferred back into the production sequence for repainting.

Sanding is not only extremely expensive, but it is also an uncertain process. This work gives rise to a great deal of dust, which cannot always be completely removed, even by complex suction systems. The use of Openair plasma technology affords a trailblazing solution: First, damaged areas are selectively

Since implementation of this plasma process, the speed of the entire coil coating plant has quadrupled in comparison with the old methods.

repaired. The entire outer coat is then pretreated with plasma, which renders the otherwise essential large-area sanding of the protective coating unnecessary.

With the aid of four to six handling robots, the entire process takes no more than about 10 min. The car body, with its now ultrafinely cleaned and highly activated outer finish, can very quickly be transferred back into production for repainting.

Testing has shown that this atmospheric-pressure plasma process can operate not only more economically than the conventional sanding process, but also more effectively, with improved adhesion between the new base coat and the “old” finishing coat.

Mobile Phone Housings

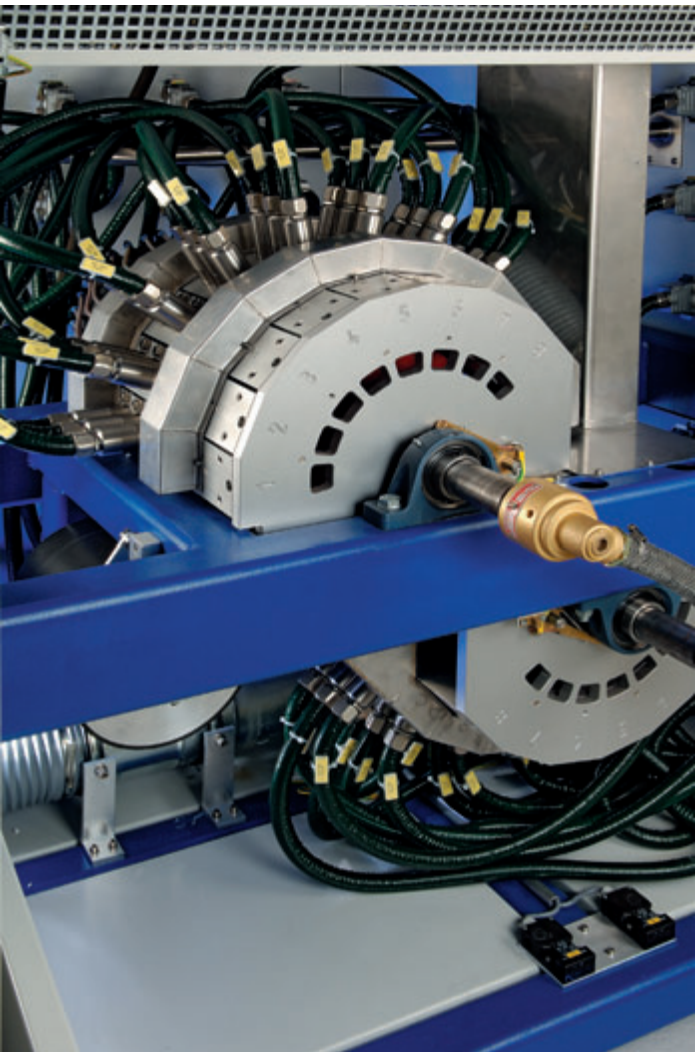
The paint finish on mobile phone housings today imposes the highest demands on the surface. The finished surface must be absolutely free of defects and under no circumstances should its overall appearance be affected by imperfections. Even scarcely visible dust particles on the surface of the housing after painting

result in unsightly unevenness. In this case electrostatic effects are the principal cause of the adhesion of dust.

In response to these issues, Plasmatreat successfully installed cleaning units for notable mobile phone industry suppliers in South Korea and Finland. Operating as an in-line process immediately prior to painting, several rotating plasma jets clean the plastic surfaces. In these installations, the users were able to reduce the proportion of rejects from 12% to less than 5%.

A Case for Coil Coating

Currently, the most common problems in the processing of aluminum include corrosive attack on surfaces, residual contamination by sheet metal roller oils, and the negative effects on the environment from energy-intensive wet chemical pretreatment processes. At Griesser AG (Aadorf, Switzerland), one of Europe’s largest manufacturers of sunshade systems, these issues are now being addressed by the Openair plasma system. It handles microfine cleaning of aluminum coil before the application of the conversion layer (chem-coater) and completely replaces environmentally polluting wet-chemical



Set up in offset fashion, 24 jets per side of the coil achieve a hydrophilic, activated surface having a contact angle of constantly 15°–28°.

processes in the precleaning operations.

In trial testing at the company, conventional chemical pretreatment was used as the reference system. Taking into account the material-plasma parameters to be optimized (plasma focus, intensity/energy input) the results showed not only the usability and high effectiveness of atmospheric-pressure plasma, but also that in all areas the plasma pretreatment achieved distinctly better results than the chemical reference procedure.

The development leadtime for the plant, from the initial idea of running the cleaning installation in-line to having it fully operational, was about five years. Since implementation of this plasma process, the speed of the entire coil coating plant has quadrupled in comparison with the old methods.

Use of the system is proving to have a significant impact

on environmental conservation. The computer-controlled Plasmatreat installation, which measures only 2 m × 1.5 m, has replaced a 60-m-long cleaning line. Depending on the degree of soiling of the coils in the factory, large volumes of chemicals and thousands of tons of effluent can be immediately avoided. Also, because no waste is produced in the precleaning process, the otherwise customary neutralization (wastewater treatment) is unnecessary. In the piece coating plant alone, it is the difference of 20 tons of filter cake (requiring special disposal) per year. Employees also value the environmentally friendly working conditions, where before, using wet-chemical pretreatment often meant noxious vapors and high temperatures in the workshop.

Possibly the most notable change is the amount of aluminum coil processed. In the old setup, 400 tons of aluminum coil could be processed every year, but now the volume is more than 800 tons.

Functional Versatility

This technology provides an exciting alternative in pretreatment options. Additional advantages of using the system include reliability and quality in the production process. Accordingly, it allows plants to meet the expected high customer expectations. Furthermore, other requirements such as simple integration into process workflows and higher efficiency in comparison with traditional methods can be met while easily remaining compatible with environmental standards.

Today Plasmatreat operates globally with technology centers in Germany, the U.S., China and Japan as well as sales offices and agencies throughout the world. The company employs more than 100 engineers, technicians and specialist consultants and is involved in more than 300 different applications in various industries.**PC**

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