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Atmospheric-pressure plasma technology displaces chemicals in precleaning prior to coil coating

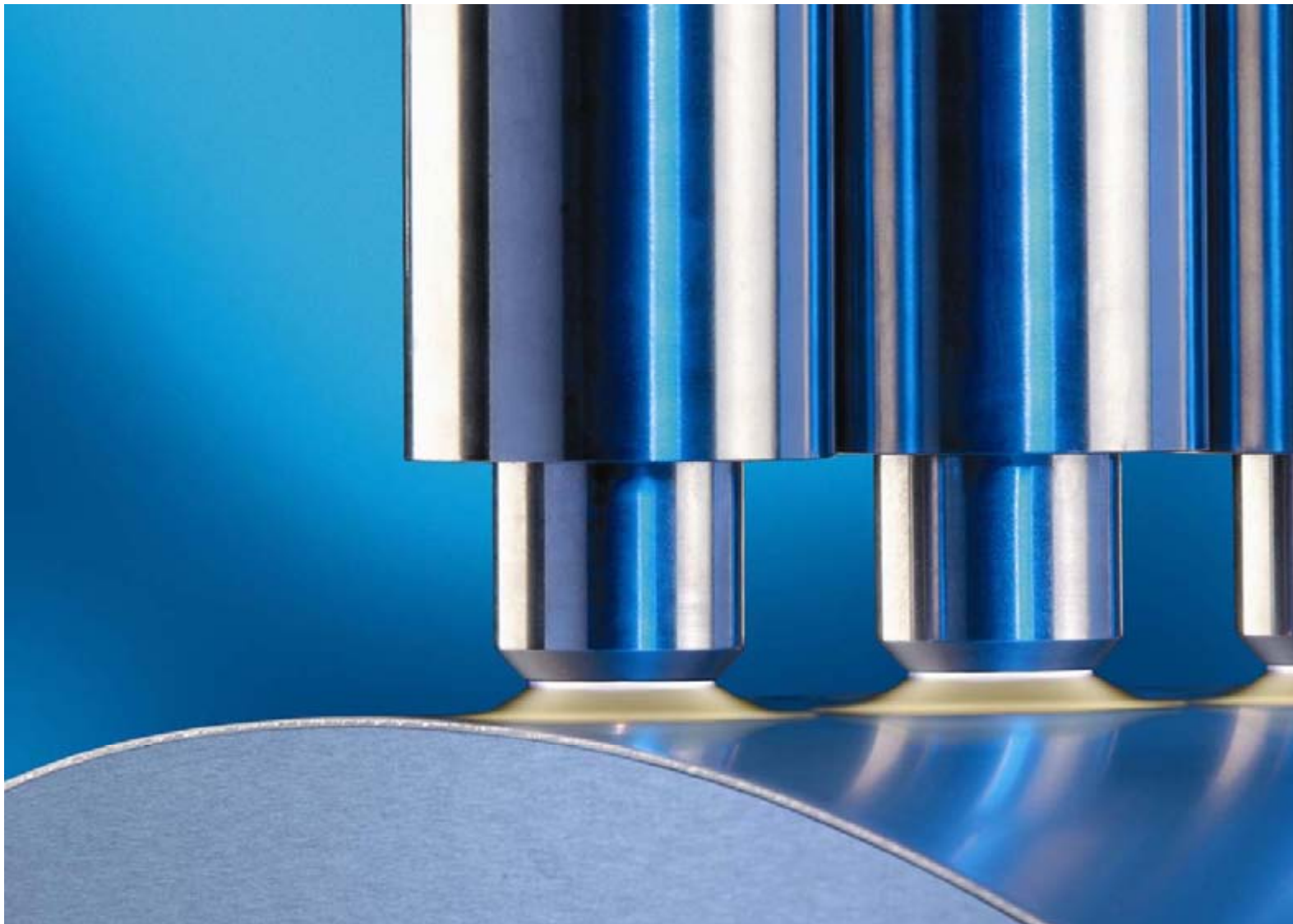
IT ALSO WORKS TO CONSERVE THE ENVIRONMENT

by Inès A. Melamies By means of a process unique anywhere in the world Openair atmospheric-pressure plasma technology has made the breakthrough of displacing any use of chemicals in the precleaning process for aluminium coil and in this way has performed an exemplary service to the environment.

Corrosive attack on surfaces, residual contaminants in rolling oils and the energy-intensive and environmentally polluting pre-treatment processes used up to now to address this situation are the most common problems in the processing of aluminium. By means of Openair atmospheric-

pressure plasma technology from the system developer Plasmatreat, Steinhagen, in collaboration with the Swiss company Griesser AG, Aadorf, and the research institute Nanocraft, Engen, a process was developed and put into operation for the first time whose use completely eliminates these problems. Plasma technology

brings about the microfine cleaning of aluminium coil prior to application of the conversion layer and the subsequent painting process. In doing so it completely replaces environmentally polluting wet-chemical processes in the precleaning operation. For this achievement Plasmatreat was honoured in December 2007 in the United

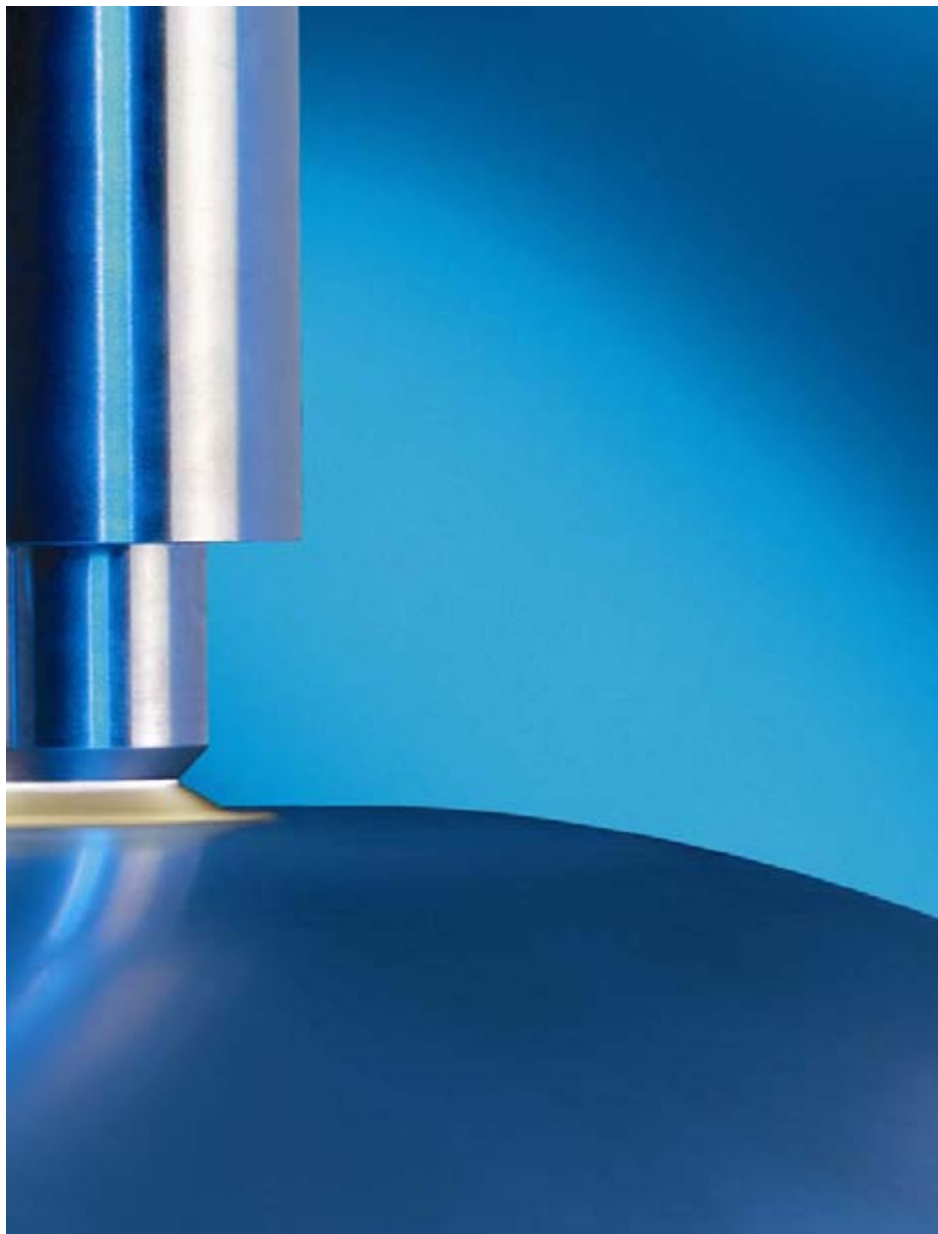


States by the FTM Innovation Award.

In one of the leading manufacturers of aluminium roller shutters in Europe, the Swiss company Griesser AG, Aadorf, the project leader in the coil coating division had dreamt as early as six years previously about the construction of a new environmentally friendly painting line which in addition should not only be faster than the old one but would also allow the cleaning of the aluminium coils in-line and so save a lot of space. Griesser was enthusiastic about the possibilities afforded by the relatively young Openair technology. In Christian Buske, Managing Partner and CEO of Plasmaclean, Griesser found an

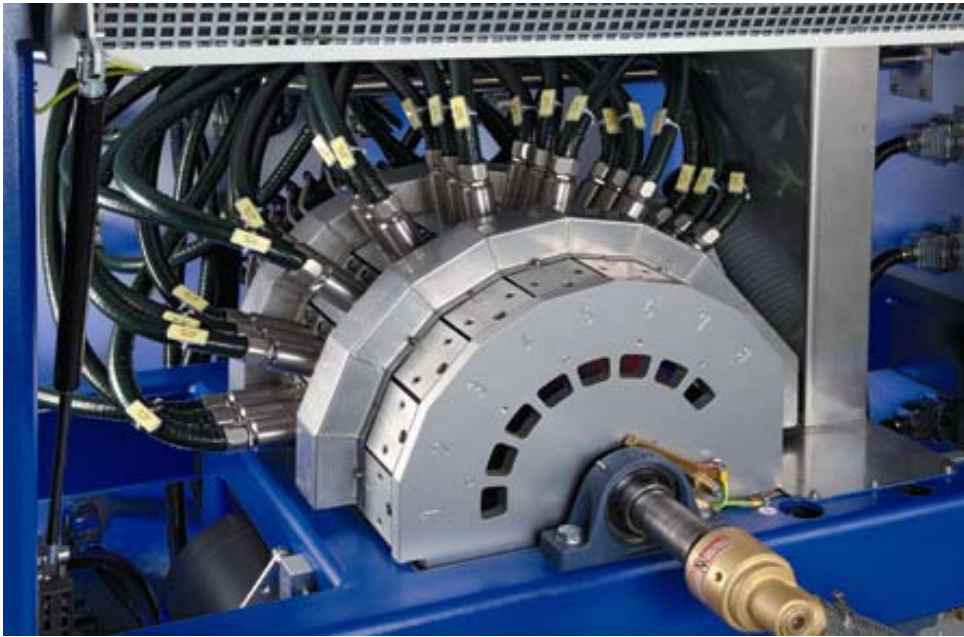
associate who was just as committed as they were and was immediately prepared to explore new territory and jointly investigate the integration of plasma pretreatment in Griesser's new painting line. Plasmaclean holds a patent for the process by means of which the customary cost-intensive chemical cleaning processes to free materials of oils and grease and hence ensure good adhesion of coatings are rendered unnecessary. The sheet metal webs are now cleaned not only in environmentally friendly manner but also very economically. All that is needed are air and electric power.

The plasma systems based on a jet principle operate at atmospheric pressure and with the aid of an electric arc ignited in the jet and the operating gas, air, generate a plasma which flows at zero potential onto the product to be treated. It contains particles that are sufficiently excited to initiate selective effects on the surface. The jets are operated by air – supplemented by a process gas if required – and by high voltage. A special characteristic is that the emergent plasma beam is electrically neutral which greatly extends and simplifies the range of applications.



In Plasmaclean's CEO, Christian Buske, Griesser found a man with the courage to undertake new enterprises.

In the aluminium coil precleaning process atmospheric-pressure plasma can now completely replace chemicals. The number of jets can be scaled up as required for large coil widths



Arranged in offset manner 24 jets per side of the coil achieve a hydrophilic activated surface having a wetting angle of 15 to 28 degrees and ensure microfine cleaning on both sides of the sheet aluminium.

The coils arrive at the double painting installation after application of the conversion layer and environmentally friendly precleaning by means of atmospheric-pressure plasma.

In the new 49 m long coil coating installation at Griesser the use of wet chemicals in the precleaning process was completely eliminated.



Its intensity is so high that treatment speeds of several 100 m/min can be achieved.

A distinctive feature of the system is its triple action: it brings about high activation of the surface by selective oxidation processes, simultaneously discharges it and effects ultrafine cleaning of metals, plastics, ceramics and glass.

By adding a precursor surfaces can additionally be coated in the nano range. The economic aspect here is that the user can always deploy the jet systems used in-line, that is integrated in the new or already existing production line.

Before the venture approved by Griesser could be implemented, however, there was still some research work to be carried out. A process had to be developed and refined before the plasma cleaning functioned at least as effectively as the chemical cleaning process employed previously. The same applied to reliable adhesion of the subsequent coats of paint.

Griesser decided to commission the contract research company Nanocraft to conduct a study on the subject of "Plasma-treated aluminium sheet". As an offshoot of the Max Planck Institute and independent provider of research services Nanocraft equipped with expensively developed methods in scanning probe microscopy is able to image surfaces both conventionally – that is topographically and elastically – and chemically with sensitivity down to molecular resolution. Nanocraft carried out the tests on the systems developed by Plasmatrete for cleaning and treating the aluminium coils at Griesser.



The use of plasma in the coil coating process is unique anywhere in the world. The plasma installation measuring only 2 x 1.5 m replaces a 21m long cleaning line.

The result was that under the leadership of Nanocraft Managing Director Dr. Sabari Akari the practicability of atmospheric-pressure plasma in series production and its effectiveness in pretreatment, i.e. the cleaning and activation of surfaces to be painted as in coil coating, was demonstrated.

In the tests conventional chemical pretreatment was used as a reference system. Taking account of the material-plasma parameters to be optimised (plasma focus, intensity/energy input) the plasma system proved to be distinctly superior to conventional pretreatment methods. The results obtained not only proved the applicability and high effectiveness of atmospheric-pressure plasma but also in all areas the plasma pretreatment achieved significantly better results than the chemical reference treatment.

Since the aluminium coils are components to be used later on the exterior facades of buildings they were exposed to a 1,000-

hour acetate salt spray test carried out in accordance with GSB under the leadership of Dipl.-Ing. Judith Pietschmann at the Forschungsinstitut für Edelmetalle und Metallchemie (FEM; Research Institute for Noble Metals and Metal Chemistry). After the test the plasma-treated coil exhibited neither infiltration of the paint nor any sign of corrosion.

At the end of December 2006 construction of the 49 m long coating line was started, and production began in June 2007. In the new plant 24 pairs of plasma jets clean the aluminium sheet on both sides over a width of 150 mm (300 mm in total) before the conversion coating is applied. The ultrafine cleaning and high activation of the aluminium coil by means of plasma give rise to a very low wetting angle. As a result of this the subsequently applied conversion layer can bind to the surface in optimum fashion.

The development lead time for the new plant costing 5 million Swiss Francs from the initial idea of running the cleaning installation in-line to start-up was about five years. At the same time due to the use of the Openair plasma process the speed of the plant has quadrupled in comparison with the old plant. Viewed in retrospect an astonishingly simple solution was found for the arrangement of the plasma jet: 24 jets per coil side arranged in offset manner achieve a hydrophilic activated surface having a wetting angle of 15 to 28 degrees.

The jet system can be used anywhere, even in large-scale plants. By multiplying the number of jets it can be used for any width of coil.

The use of atmospheric-pressure plasma technology in the coil coating process has a major impact on the conservation of the environment. The computer-controlled plasma installation measuring only 2 m x 1.5 m replaces at Griesser a 21 m long cleaning line. This means that, depending on the degree of soiling of the coils, 150 to 180 tons of chemicals and effluent can now be avoided.

The company processes more than 400 tons of aluminium coil per annum. To do this only two members of staff are needed to operate the entire plant. The enormous cost savings and conservation of the environment set the highest standards for the whole coil coating sector throughout the world. ✓

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