

Plasma replaces chemical precleaning

The number of jets or plasma jets
can be increased in modular fashion
for larger coil widths.

Atmospheric-pressure plasma technology
in the coil coating of aluminium

By means of a process unique anywhere in the world “Openair” atmospheric-pressure plasma technology has made the breakthrough in a Swiss coil coating plant of displacing all chemical precleaning processes. The process is employed for aluminium strip material in façade cladding construction.

In the processing of aluminium the most common problems arise in that the surface of the metal is often subject to corrosive attack or is contaminated by residues of rolling oils. The wet chemical pretreatment processes employed hitherto are moreover harmful to the environment and energy-intensive. By means of Openair atmospheric-pressure plasma technology from the system developer Plasmatreat based in Steinhagen near Bielefeld a process was developed for the first time whose application

completely eliminated these problems. Development associates are the

Swiss company Griesser AG and the research institute Nanocraft based in Engen close to Lake Constance. Plasma technology brings about the ultrafine cleaning of aluminium coil before application of the conversion layer and then the paint.

How it all started. In Griesser AG, one of Europe’s manufacturers of aluminium roller shutters, the project leader in the coil coating

division had dreamt as early as six years earlier about the construction of a new, absolutely environmentally friendly painting line. This should not only be faster than the old one and allow the cleaning of aluminium coils in-line, but also save a lot of space.

Griesser was enthusiastic about the possibilities afforded by the relatively young Openair technology. In Christian Buske, Managing Partner of Plasmatreat, Griesser found a committed associate. He was immediately prepared to explore new territory and jointly investigate the integration of plasma pretreatment into Griesser’s new painting line. In the process patented by Plasmatreat in 1995 the sheet metal webs are cleaned not only in environmentally friendly fashion but also very economically. All that is needed are air at normal pressure and electric power. The technique also activates the most

varied surfaces so that paints, inks or adhesives can adhere in optimum fashion.

As a result of the development and application of plasma jets it was possible for the first time to integrate the fourth state of matter, then scarcely used in industry, in-line in production process and to render it usable for the pretreatment of the surfaces of materials on a large industrial scale.

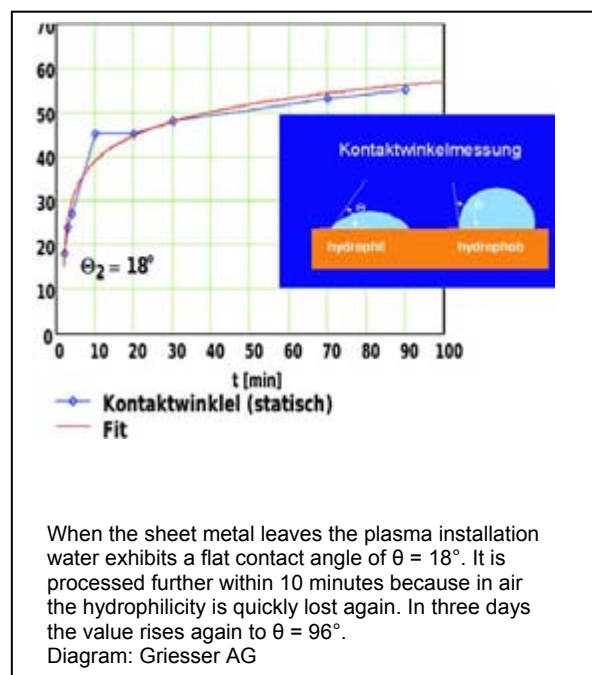
Zero potential plasma beam

The process which can be monitored in accordance with DIN ISO 9000 is based on a jet principle. The systems 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 onto the surface to be treated. It contains particles that are sufficiently excited to initiate selective effects on the surface. A particular feature is that the emergent plasma beam is electrically neutral which greatly extends and simplifies its possible applications. In summary the Openair process brings about the effects listed below.

- **Activation:** It activates the surface by means of selective oxidation processes and increases surface tension by a significant factor. The consequence is increased surface wettability and the formation of reactive surfaces. In this way many surfaces are first made receptive for process steps such as coating, printing or adhesion.
- **Discharge:** In technical terms a plasma state is described as an electrically conductive gas. When the zero-potential plasma beam strikes the surface the electric charge carriers on the electrostatically charged workpiece can flow



- to earth. In this way the surface is electrostatically discharged.
- **Cleaning:** The plasma flowing at high speed onto the surface brings about dedusting or degreasing, microfine cleaning and neutralisation of metals, plastics, ceramics and glass.
- **Coating:** By adding a precursor selective nanocoatings can be applied in-line. Individual adaptation of the surfaces to the requirements of the product properties needed later is made possible in this way.



Due to its broad application potential atmospheric-pressure plasma technology is one of the key technologies in surface treatment. The jets developed by Plasmatreteat can be employed on the most varied geometries. They are compatible with robots and can be integrated at any time into a new or already existing production line.

The venture that Griesser decided to embark upon, however, required some further research work. Thus, the process had to be developed further before plasma cleaning functioned at least as effectively as the chemical cleaning process previously used. The same was the case for reliable adhesion of the subsequently applied coatings.

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 for Colloid Chemistry and independent provider of research services Nanocraft is equipped with expensively developed methods in scanning probe microscopy. It is therefore able to image surfaces both conventionally, that is topographically and elastically, and chemically with sensitivity down to molecular resolution. Nanocraft carried out the testing of the systems developed by Plasmatreteat for cleaning and treating the aluminium coils at Griesser.

Under the leadership of its Managing Director, Dr. Sabri Akari, Nanocraft demonstrated that atmospheric-pressure plasma can be deployed in series production, brings about adequate pretreatment and so is suitable for



Altogether 48 plasma jets in the plasma unit measuring 2 m x 1.50 m clean the aluminium sheet material on both sides shortly before the conversion layer and paint are applied.
Pictures: Plasmatrete

cleaning and activating surfaces for coil coating. 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 or energy input level) 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 respects the process achieved significantly better results than the chemical reference treatment.

jets installed offset now clean the aluminium sheet on both sides. The contact angle of the hydrophilic and activated surface amounts to 15-28 degrees shortly afterwards.

Environmentally friendly plant technology

The development lead time for the plant costing 5 million Swiss Francs from the initial idea of running the cleaning installation in-line to start-up was about five years. Due to the use of Openair technology the speed of the plant has quadrupled in comparison with the old plant. The jet system may also be employed at any time in large-scale installations. By multiplying the number of jets it can in principle be used for any width of coil.

The use of atmospheric-pressure plasma technology in the coil coating process has a major impact on environmental conservation. The relatively small computer-controlled plasma unit measuring 2 m x 1.50 m replaces



Insgesamt 48 Plasmadüsen in der 2m x 1.50m große Plasmaanlage reinigen das Aluminiumblech beidseitig, kurz bevor Konversionsschicht und Lack aufgebracht werden.

Since structural elements for the exterior facades of buildings are later manufactured from the aluminium coils the Forschungsinstitut für Edelmetalle und Metallchemie (FEM; Research Institute for Noble Metals and Metal Chemistry) investigated the corrosion resistance of the finished parts in a 1,000 hour acetate salt spray test carried out in accordance with GSB. After the test the plasma-treated coils exhibited neither infiltration of the paint nor the least 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

at Griesser a 21 m long cleaning line. This means that, depending on the degree of soiling of the coils, 150 to 180 metric tons of effluent and chemicals could be avoided every year. The company processes more than 400 metric tons of aluminium coil per annum. To do this only two members of staff are now needed to operate the entire plant. The enormous cost savings and measures which conserve the environment set the highest standards for the entire coil coating sector throughout the world. *Inès*

Contact details

Plasmatrete GmbH
Tel. +49 (0)5204 9960-0
mail@plasmatrete.de
www.plasmatrete.de