

Aluminium

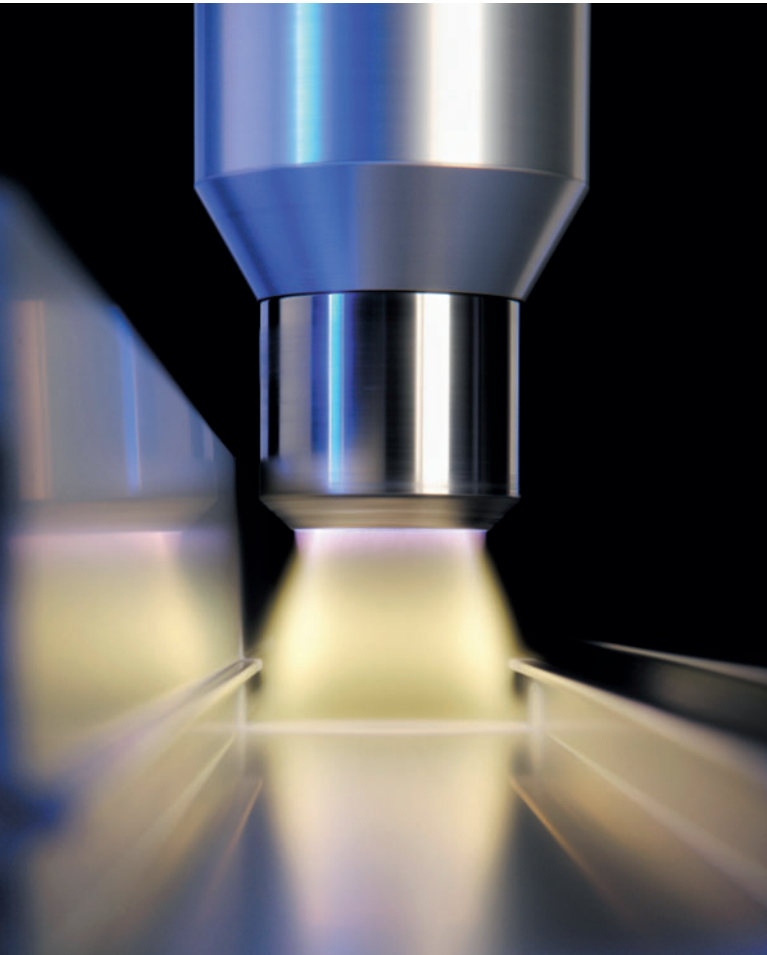
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● *Zeitung für
Bearbeitung & Anwendung*

Environmentally friendly pretreatment of aluminum with atmospheric pressure plasma

Chrome-free protection

There are alternatives to environmentally harmful, energy-intensive pretreatment processes in the aluminum processing industry. The use of atmospheric pressure plasma (AP plasma) is a particularly energy-saving option. Not only does this dry, rapid process achieve an exceptional level of microfine cleaning, activation and functional nanocoating, it is particularly environmentally friendly to boot.



Photos: Plasmattreat

Openair-Plasma removes all impurities and organic contaminants from aluminum surfaces in an environmentally friendly way creating the conditions for complete wettability with adhesives and paints.

Surface energy' is the holy grail when it comes to the subject of wettability and adhesion. Whether adhesives and paints achieve the desired level of adhesion to the substrate largely depends on surface energy. Good wettability is conditional on the material surface being ultra-clean and the surface energy of the solid material being higher than the surface tension of the liquid adhesive or paint. Various pretreatment methods are available to achieve these two conditions, with wet chemical sub-

stances still the most widely used. But there is constant and growing pressure to avoid or minimize the use of solvents, toxic materials and performance variations associated with manual operations on the production line. The Openair-Plasma and PlasmaPlus plasma technologies developed by Plasmattreat in 1995 and now used throughout the world show how things can be done differently. These atmospheric plasma jet technologies can completely replace pretreatment processes that are harmful to health or the environment and dramatically reduce energy consumption in the pretreatment process.

Pretreatment in an instant

Layers of dust deposits, grease, oils and other contaminants can often compromise the naturally high level of surface energy in aluminum, thereby impairing wettability. Openair-Plasma technology creates the critical conditions required to ensure the reliable adhesion of bonds and coatings as well as uniform paint distribution. In a matter of seconds, the plasma cleans and activates the metal surface only in places where treatment is actually needed – in other words, it is area-selective. Working at molecular level, the plasma removes all impurities and organic contaminants from the surface (photo left). The plasma effectively restores the original surface energy to make complete wettability possible. Where a highly adhesive oxide layer has already formed on the aluminum or complex geometries are involved, this technology enables the plasma to be combined with a laser jet to create a hybrid technology for the targeted removal of the layer.

PlasmaPlus is a coating technology which allows functional nanocoatings to be deposited with pinpoint precision under atmospheric conditions in continuous production processes. Today it is predominantly used in solar technology and vehicle manufacturing. It can be used to generate product-specific coatings for different materials and to deposit them on the surface in milliseconds, where they bond covalently with the substrate. As well as providing an excellent substrate for adhesives, these coatings confer long-term corrosion protection by forming an effective barrier against corrosive electrolytes – particularly relevant for the aluminum alloys used in the automotive industry (photo page 27, top).



The PlasmaPlus coating provides both an excellent substrate for adhesives and long-time stable corrosion protection for the aluminum alloys used in the automotive industry.

AP plasma applications

The in-line jet systems are computer-controlled, screen-monitored and fully compatible with robotic applications, while the processes themselves are robust and reproducible. The use of Plasmatreat processes enables conventional pretreatments such as solvent-based cleaners and primers or manual surface brushing and rinsing to be dispensed with entirely in most cases. Unlike wet-chemical pretreatment methods, this approach renders drying and interim storage unnecessary, so components can be processed downstream immediately after plasma cleaning and activation – saving users energy, time and disposal costs.

The main area of application for the plasma pretreatment of aluminum parts is the automotive industry. For example, in the construction of car engines, battery manufacturing or, as at TRW Automotive, for cleaning and then applying anti-corrosion coatings to motor pump housings for power steering systems. The solar industry uses the PlasmaPlus process to obtain stable corrosion protection for the aluminum profiles of solar modules. The following two examples illustrate the fact that plasma technology is also of great interest to other industry branches.

AP plasma in the aircraft industry

The aircraft industry still applies anti-corrosion primer to the interior surfaces of fuselages, reinforced wing structures and mounting parts prior to painting to ensure optimal corrosion protection. Chrome-based Cr6 primer systems are most commonly used. With the PlasmaPlus process, these primers can be replaced with non-toxic, dry-chemical plasma polymerization. Joining elements

can also benefit from plasma jet technology. Rivets made from titanium or aluminum alloys are subject to extremely tough corrosion protection requirements due to high air humidity and large temperature fluctuations. Even flush-riveted metal assemblies are often difficult to clean and pretreat. The edges of the rivets are susceptible to damage, providing an ideal entry point for corrosion. Since the process of applying plasma is contact-free, reliable coating adhesion can be achieved without damaging these very small, corrosion-prone areas.

Plasma in the coil coating process

The Swiss company Griesser AG, one of Europe's leading manufacturers of aluminum solar shading systems, has been using Openair-Plasma for more than 10 years in their coil coating process. It has entirely replaced the wet chemicals previously used for fine cleaning prior to painting. Instead of the previous 60m long cleaning line, Griesser now operates a 2m x 1.50m inline plasma unit equipped with 48 nozzles. This saves large quantities of chemicals and thousands of tons of waste water each year, depending on the degree of soiling of the strips. And since the pre-cleaning process no longer generates any waste, there is no need for the usual neutralization measures that would otherwise be required, i.e. wastewater treatment, which produced 20 tons of filter cake (hazardous waste) a year in the batch coating plant alone. According to Griesser, production volumes have doubled since the introduction of plasma treatment and the company is also benefiting from substantial energy savings and other reduced operating costs.

Conclusion

The pretreatment of aluminum with atmospheric pressure plasma is environmentally friendly, fast and cost-effective. Not only can the process eliminate process steps and significantly reduce energy consumption and operating costs, it can also substantially increase throughput and product quality. The plasma processes also benefit users by ensuring high process reliability and reproducibility.

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