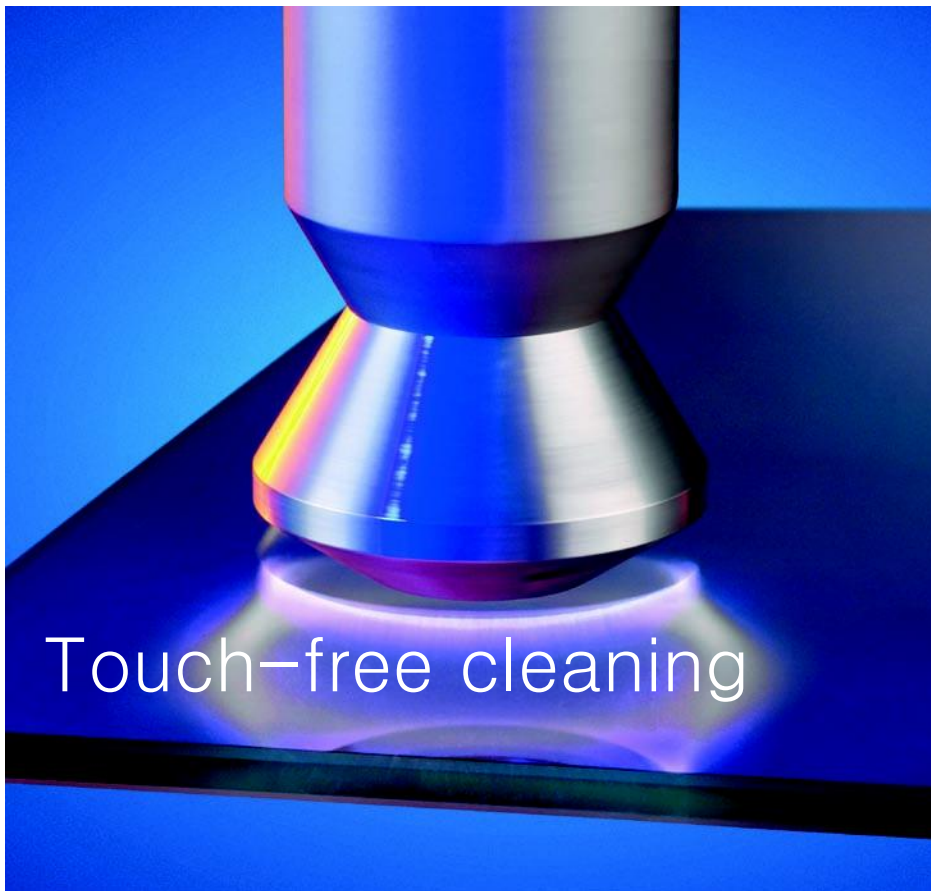


SPECIAL GLASS FINISHING



Plasma technology for the pretreatment of glass –

In order to ensure secure and durable attachment of adhesive bonds and coatings on glass proper pretreatment is essential. Openair atmospheric-pressure plasma technology is an environmentally friendly primer-free process that allows the ultrafine cleaning and activation of surfaces in-line at the highest level and in addition is particularly economical.

Touch-free, at almost the speed of sound the stream of atmospheric-pressure plasma hits the glass. Plasma technology allows ultrafine cleaning, high activation and selective coating or coating removal on the surface of the glass.

Any durable attachment of adhesives, seals, coatings or coats of paint requires optimum pretreatment, i.e. cleaning and activation of the surface of the glass. Grit and fine dust from the ambient air, moisture, greases or even a single finger print deposited on the glass can significantly impede or even totally ruin the desired adhesion.

Insufficient activation of a surface results in very low surface energy in the material which in turn gives rise to inadequate wettability when applying coatings. There are different chemical and physical processes

for solving these problems, the use primarily of solvent-based cleaners, primers and bonding agents being very common. But this can be done in a more environmentally friendly manner.

In the form of Openair atmospheric-pressure plasma technology a process has been developed whose use completely eliminates said problems. This

“The plasma process can be employed for the selective and dust-free removal of coatings on glass surfaces.”

technology brings about the ultrafine cleaning, high

activation and nano-level coating of the surfaces of materials and usually completely replaces wet chemical

processes in precleaning activities (Fig. 1).

What is plasma?

Plasma is based on a simple physical principle. By inputting energy the states of matter change: solid becomes liquid and liquid becomes gaseous. If further energy is now fed into a gas it becomes ionized, i.e. the electrons are given higher kinetic energy and leave their shells. Free electrons, ions and molecular fragments are produced and the gas passes over into the plasma state, also known as the “fourth state of matter”. Previously, however, because of its instability this state could be used only under very restricted conditions at normal atmospheric pressure.

The zero-potential atmospheric-pressure plasma technology known as Openair developed by Plasmatrete, Steinhagen, in 1995 opened up new possibilities. By developing and using plasma jets the company succeeded in integrating this state of matter, scarcely used in industry until then, into production processes. In this way plasma was rendered usable in industry under normal atmospheric conditions, that is to say without a costly vacuum chamber, for the pretreatment of glass, plastics, metals and ceramics in automated and continuous processes. In the patented process now employed throughout the world in practically all sectors of industry no environmental problems of any kind arise. All that is needed is air, as the process gas, and electrical energy.

Optimised production process

The requirement for sustainable and resource-conserving behaviour in industry is met by the glass industry in that, for example, old broken bottles are fed as raw material into glass furnaces. However, in the pretreatment of glass or the frame in which it is held prior to bonding large quantities of solvent-containing chemicals are still used. Due to their high VOC emissions (volatile organic compounds) they cause

significant problems for people in the workplace and for the environment. They are also very difficult to automate and afford little in the way of process reliability. These problems do not occur when atmospheric-pressure plasma is used.

Requirements in the flat glass sector are very similar in principle to those in the automotive glass industry. In both cases it is always important to clean and activate with the aim of ensuring the enduring adhesion of adhesives or coatings. The possible uses of this plasma technology in a double-glazed insulated window are shown in the three examples A, B and C in Fig. 2.

A. Coating Panes of glass are often provided with functional coatings, whether these are for an easy-clean effect, thermal insulation, shading against the sun, mirror effect, antireflection or other tasks. In such cases pretreatment is absolutely essential. Gentle cleaning by means of plasma removes extremely fine organic contaminants from the surface of the glass while simultaneously activating it. This ensures optimum surface treatment and the durability of the coating.

B. Plastic frame Plastic frames made from PVC are usually attached by hot

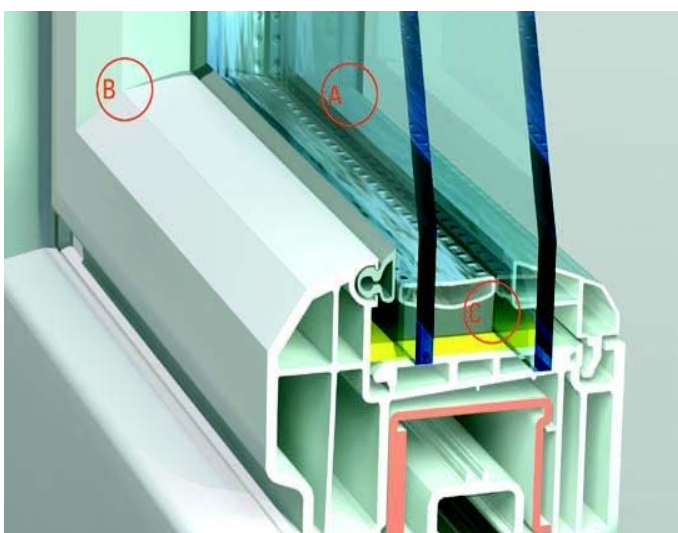
plate welding. (B). This is not possible, however, when other materials, such as polypropylene composites, are also used. Bonding by means of a preceding plasma treatment provides an economical solution here.

C. Coating removal If the pane of glass has already been coated and is then to be bonded, this will only work when the coating on the glueline is removed. This is done in a very expensive process since removal of a coating ensues in a usually mechanical process which also frequently causes production stoppages on account of the need for tool changeover. Apart from the constant possibility of mechanical damage, dust is the primary threat. In the course of machining this dust is deposited again on the glass so that it has to be cleaned again.

A working step can be eliminated

The plasma process can be employed for the selective, dust-free and completely risk-free removal of coatings. The system operates without making contact, that is without touching the sensitive glass surface. At the moment when the plasma strikes the glass and removes the coating with pinpoint precision the particles in the coating vaporise in the plasma. Since by this means dust just does not arise, the otherwise necessary washing operation is eliminated. This means that due to the use of Plasmatrete technology an entire working step is saved.

Said applications can be used equally well for many other glass bonding processes, whether in the manufacture of solar panels or in automobile glazing where the bottom edges of the wind-down side windows are adhesively bonded to what are known as "lift bars". Here the plasma is responsible for ultrafine precleaning while at the same time selectively removing any



Applications of Openair Technology

- A: for improved adhesion of functional layers,
- B: for frame treatment in the case of composite materials,
- C: for selective removal coatings prior to adhesive bonding.

coatings on the edge of the glass. In the production of shower cubicles or glass oven doors pretreatment is also necessary when the frame has to be bonded directly to the previously functionally coated glass. Other methods such as putting masking tapes into position are difficult to automate.

With the aid of Openair technology hinges can be bonded directly to mirror glass doors without drill holes and safety glass and without mechanical aids by means of plasma.

The contact-free system was specially developed for fully automated and continuous production. It is characterised by high process reliability and reproducibility and acts very gently on surfaces. The jets which can be used for the most varied geometries are compatible with robots and can be integrated at any time into new or already existing production lines. ■

The Openair plasma process brings about the following processes

- Activation: It activates surfaces by selective oxidation processes and increases surface tension by a significant multiple. The consequence is an extreme increase in surface wettability and the formation of reactive surfaces. In this way many surfaces are for the first time rendered receptive to process steps such as coating, application of print or adhesive bonding.
- Discharging: In technical terms a plasma state is referred to as an electrically conducting gas. When the zero-potential plasma beam strikes a surface electric charge carriers on the statically charged workpiece can flow away to earth. This brings about the static discharge of the surface.
- Cleaning: The plasma flowing at high speed onto the surface causes removal of dust or degreasing, ultrafine cleaning and selective removal of coatings on glass, metals, plastics and ceramics.
- Coating: By adding a precursor, selective nanocoatings can be applied in-line. This allows individual modelling of the surfaces according to the properties subsequently required of the product.

The Author

Peter Langhof is Market Manager for glass, electronics and photovoltaic systems at Plasmamatreat GmbH.
peter.langhof@plasmamatreat.de

Contact point

Plasmamatreat GmbH
33803 Steinhagen
Germany
Tel. +49 (0)5204 9960-0
www.plasmamatreat.de