

Environmentally friendly pretreatment

Plasma Technology instead of Solvents

A leading European semitrailer manufacturer is saving at least 20 tons of chemicals a year in the pretreatment of sandwich panels for large refrigerated trailers. Instead of environmentally harmful solvents, the company uses atmospheric pressure plasma to clean and activate the surfaces.

The sandwich panel construction of modern reefer semitrailers is entirely bonded nowadays, rather than bolted. This results in greater inherent strength and more durable joints whilst at the same time reducing production costs. An added benefit is the reduced weight, which in turn cuts down on fuel consumption and reduces CO₂ emissions throughout the vehicle's lifetime.

Schmitz Cargobull manufactures its container vehicles in Vreden in Westphalia. Here alone 15,000 new refrigerated semitrailers roll off the production line every year. For the environmentally safe production of the walls and roofs of the vehicles measuring 13.50 meters long, 2.60 meters wide and 2.80 meters high Openair atmospheric-pressure plasma technology is employed before structural bonding.

Pretreatment in a matter of seconds

This process developed by Plasmatrete, Steinhagen almost 20 years ago and used today in practically all sectors in industry worldwide for pretreating the surfaces of materials carries out some key tasks for Europe's largest trailer manufacturer. It allows the use of solvent-free adhesives and ensures particularly strong adhesion in bonded joints. This ensures that the con-



For the production of refrigerated semitrailers Schmitz Cargobull uses atmospheric-pressure plasma technology before structural bonding.

tainer structures built completely free of rivets withstand in optimum fashion the high demands on strength and constancy of temperature imposed on their freight spaces on their journeys between producers and customers. The Openair-Plasma process allows for microfine cleaning and simultaneous activation or for functional nano-coating of surfaces without interrupting the production process. The systems based on a jet principle operate in-line and can be integrated easily in any new or already existing production line. The treatment is carried out under normal air conditions and within a matter of

seconds. All that the environmentally friendly operation of the systems requires is electricity and compressed air. Also the systems are without restriction compatible with robots while the process is safe and reproducible.

Cleaning and activating in one step

„We became aware of Plasmatrete's technology first time at an international technical meeting some years ago“, reports Johannes Pierick, Head of Quality Assurance and Application Technology at Schmitz Cargobull in Vreden. „The capabilities of this pro-

cess exactly matched our expectations which we intended to incorporate into the construction of a new bonding plant.“ The trailer manufacturer’s primary goal was to eliminate completely the organic solvents used until now, of which there were at least one liter per finished container structure, and in this way to rule out from the outset any risk of environmental pollution. At the same time the manual surface cleaning and manual roughening carried out up to that point was to be replaced by an industrial process. Both requirements were to be performed by the plasma process in one single working step.

In collaboration with the University of Kaiserslautern a test phase lasting six months was launched. Apart from the interactions between atmospheric-pressure plasma, two-pack adhesives and the working material the level of any emissions were also tested since several plasma systems were to be used simultaneously.

Product rationalization

Following satisfactory test results, planning of the technology for the entire plant including the in-line plasma system and the coating process ensued. When the first large-scale plant with atmospheric plasma application for the structural bonding of refrigerated box superstructures was finally commissioned at Schmitz Cargobull, this new application resulted in important rationalization of production. While previously separate workstations were needed, it was now possible to combine pretreatment and adhesive coating in one operation since the plasma system was integrated into the frame of the adhesive mixing and metering unit. Pierick: „The special advantages of the atmospheric-pressure plasma system consisted not only in its space-saving method of application and the reliability of the process, but also primarily in that due to the ultrafine cleaning and high activation by the plasma both wet degreasing and roughening are eliminated and by substituting the use of solvent it was possible to achieve a higher degree of contentment among employees. Just a



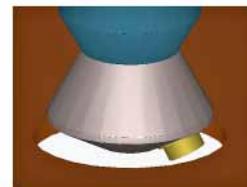
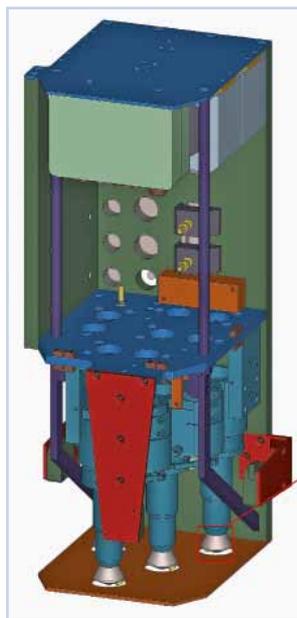
© Plasmatreteat

The plasma strikes the surface at almost the speed of sound and brings about its ultrafine cleaning and high activation.



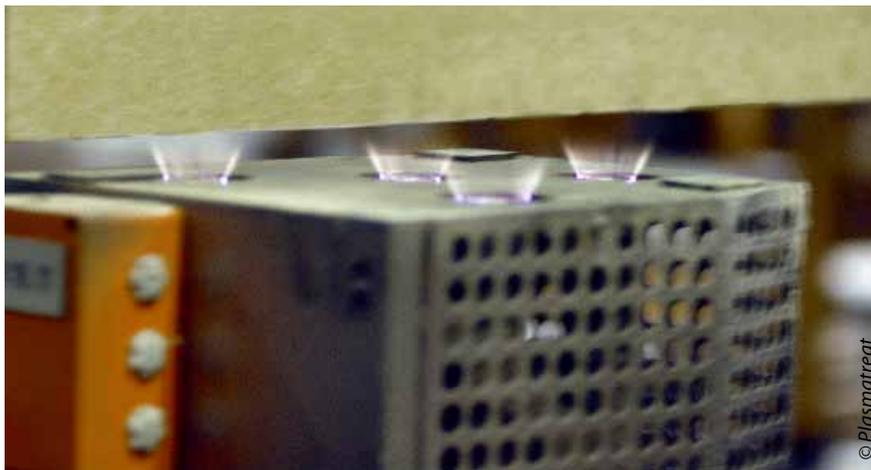
© Schmitz Cargobull

Up to 80 container structures are built every day at Schmitz Cargobull’s Vreden works.



© Plasmatreteat

Schematic illustration of plasma generator used at Schmitz Cargobull’s containing four rotary jets. The plasma strikes the surface to be treated at an angle of 45°.



Due to activation by plasma the plastic-coated sheet steel covering layers of the sandwich panels are given new surface properties amenable to adhesion.

year later we fitted out a second gluing station with plasma units.”

Plasma in large surface use

The refrigerated semi-trailers manufactured by Schmitz Cargobull are self-supporting systems whose modular structure is built completely free of rivets. The walls and roofs consist of a sandwich structure. This is a panel sealed against diffusion of water vapor having two sheet steel covering layers and an intervening high-density polyurethane rigid foam core. The self-supporting characteristic is obtained by adhesively bonding the large panels into aluminium angle rails. To ensure optimum durability, strength and imperviousness of the bonded joints the panels are pretreated in advance in the region of the bonding surfaces with plasma.

Of the two plasma treatment stations running today at the Vreden works one is used exclusively for the structural bonding of the side wall and roof panels. The triaxial installation containing the integrated plasma system and the mixing and metering head for the adhesive smear application runs completely automatically after being invoked by the machining program for controlling and adjusting the spacing relative to the object to be treated.

The plasma unit consists of two jet systems each mounted to the right and left on the outer edge of the same traversing unit on which the mixing and

metering head for the adhesive smear application is also seated. Each jet system contains four rotary jets arranged in offset manner. After a transport crane has set the panels down the axle with the now active plasma jets starts moving and travels at a speed of 20 m/min along the outer edge of a panel. The rotary jets, specially designed for large-scale treatment, spread the plasma at an angle of 45° over a treatment width of 47 mm per jet. Depending on the direction 150 – 180 mm of the surface can be cleaned and activated in this way in one pass.

Pierick: “The important objective here is to establish a reference standard set in advance by the pretreatment of the plastic-coated sheet steel surfaces since it cannot be ruled out that the parts exhibit fine impurities picked up in transport. If that happened, however, they would no longer meet the reference requirements. The coatings are mainly non-polar plastics (polyester coating), which due to the plasma activation are now given new surface properties amenable to adhesion.”

Pretreatment must take place over a minimum width of 300 mm along the entire length or width of the panel. This is the area on which immediately afterwards three beads of two-pack PU adhesive are applied. On safety grounds generous overlaps are allowed for in the pretreatment. In a total of three passes the plasma system travels over the areas to be adhesively bonded.

A second pretreatment station is available for ultrafine cleaning and activation of container fittings such as double-decker and load-securing rails. In the case of these parts also a fixed reference state is produced in advance by the pretreatment. In this way it is ensured in further processing that the flush joints on the panels reliably withstand all stresses.

Conclusion

The demands imposed on the bonded joints are correspondingly high and can only be met by means of reliable and reproducible pretreatment. In this field treatment with atmospheric-pressure plasma successfully replaces conventional pretreatment, i.e. mechanical roughening and activation by means of environmentally polluting solvents.

The contribution to environmental conservation that Schmitz Cargobull is making in the production of refrigerated trailers is impressive. At least 20 metric tons of wet chemicals are saved every year here solely due to the use of Openair technology. Moreover, the high-tech rotary plasma systems integrated into the process workflow allow not only a reliable but also an extremely effective and distinctly economical pretreatment of surfaces to be bonded.

Inès A. Melamies

Contacts:

Plasmamatreat GmbH, www.plasmamatreat.de
Schmitz Cargobull AG, www.cargobull.com