

adhäsion

**KLEBEN &
DICHTEN**

DAS FACHMAGAZIN FÜR INDUSTRIELLE KLEB- UND DICHTTECHNIK

BONDEXPO 2008:

Neu- und Weiterentwicklungen aus dem Applikationsbereich

MARKTÜBERSICHT:

Hersteller und Verfahren zur Oberflächenvorbehandlung

SCHÄUMTECHNIK:

Hotmelts höherer Qualität bei geringeren Kosten



Herstellung von Kühlkofferaufbauten

**Sichere Klebung dank
atmosphärischer Plasmatechnik**

TOPIC OF THE MONTH

EXAMPLE OF USE FOR ATMOSPHERIC PLASMA TECHNIQUE

Kept always

at the right temperature

In order to obtain extreme adhesion, particularly good leak-proofing and improved environmental conservation in production at Europe's leading manufacturer of lorry trailers, gigantic refrigerated container structures were pretreated with atmospheric-pressure plasma prior to adhesive bonding.

Inès A. Melamies, Leo Enneking

Whether it's summer or winter, they load up, drive off and deliver on motorways, country roads or in narrow town-centre alleys. They cover thousands of kilometres criss-crossing Europe. Regardless of whether the cargo is flowers, pig carcasses, mobile phones, computers or other delicate goods only one thing is important – the goods are kept always at the right temperature and must arrive safely at their destination in perfect condition.

Schmitz Cargobull manufactures its container vehicles in Vreden in



Photo Schmitz Cargobull

Westphalia. Here alone 15,000 new refrigerated semitrailers roll off the production line every year. Before the walls and roofs of the vehicles measuring 13.50 metres long, 2.60 metres wide and 2.80 metres high are

structurally bonded together. Openair atmospheric-pressure plasma technology is first of all employed (Fig. 1).

This process used today in practically all sectors in industry 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 container 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.

In-line application

The Openair systems based on a jet principle operate at atmospheric pressure. The process is without restriction compatible with robots and reliable. Furthermore, the systems employed require neither a chamber (vacuum) nor do they interrupt production processes. They are integrated in-line, that is to say directly in any new or already existing production line. The plasma brings about several effects simultaneously on the surface of the treated material. These are briefly described below.

- Activation. It activates the surface by selective oxidation processes and increases surface



Photo Schmitz Cargobull

Fig. 1 Up to 80 container structures are built every day at Schmitz Cargobull's Vreden works. The completely rivetless structure of the large panels is achieved by a structural bonding technique in which plasma technology is also employed.

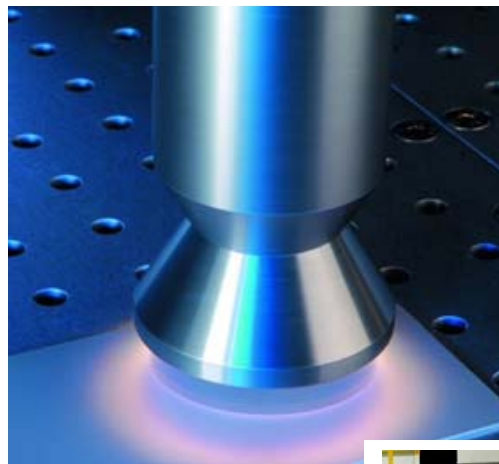


Photo Plasmatreat

Fig. 2 The zero-potential atmospheric-pressure plasma strikes the surface at almost the speed of sound and brings about its ultrafine cleaning and high activation.

Photo Plasmatreat

Fig. 3 The triaxial installation with the integrated plasma system and mixing and metering head for the adhesive smear application runs fully automatically

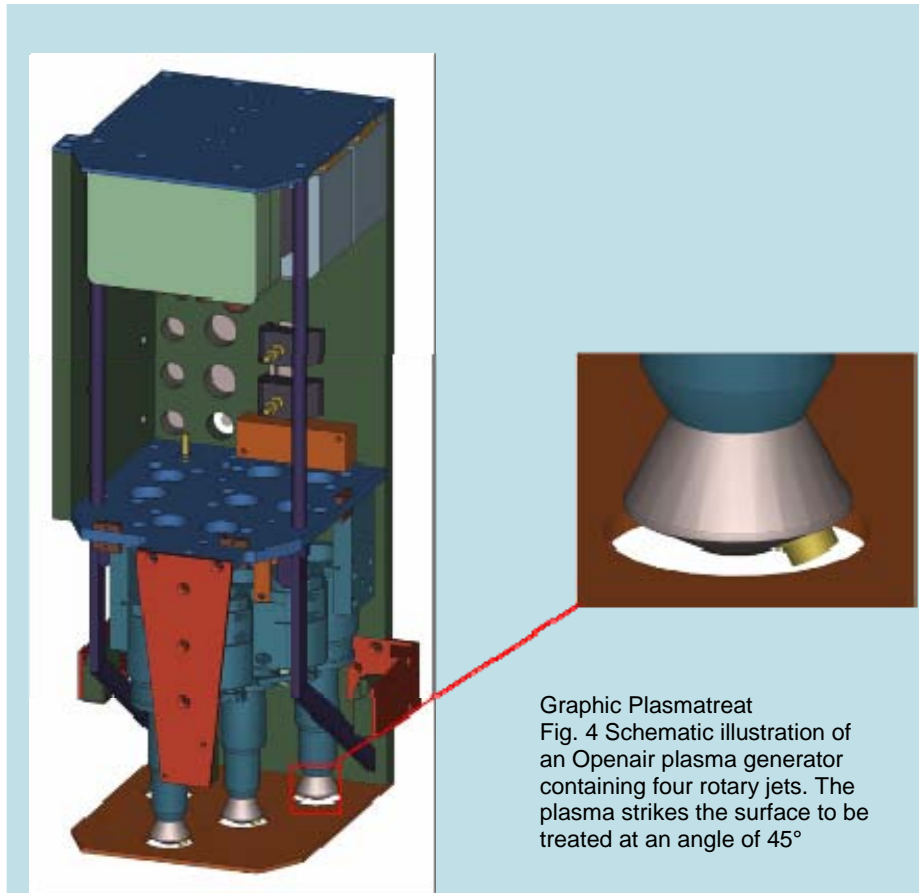


tension by a significant factor. By this means values over 72 mN/m are possible on many plastics.

- Discharge. When the zero-potential plasma beam strikes the surface the electric charge carriers on the statically charged workpiece can flow to earth. This results in the static discharge of the surface.
- Cleaning. The plasma flowing onto the surface at almost the speed of sound brings about ultrafine cleaning of the surface of the plastic (Fig. 2).
- Coating. By adding a precursor selective nanocoatings can be applied in-line. In this way individual adaptation of surfaces to the product properties later required is made possible.

Testing phase

Schmitz Cargobull took the decision in favour of atmospheric-pressure plasma technology in order to eliminate completely the organic solvents used hitherto, of which there were at least



Graphic Plasmatreat
Fig. 4 Schematic illustration of an Openair plasma generator containing four rotary jets. The plasma strikes the surface to be treated at an angle of 45°

Photo Plasmatreat
Fig. 5 Due to activation by plasma the plastic-coated sheet steel covering layers of the sandwich panels are given new surface properties amenable to adhesion.



Photo Plasmatreat
Fig. 6 Adhesive smear application: The surface is cleaned and activated in advance by atmospheric-pressure plasma over a width of at least 300 millimetres.



11 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.

In collaboration with the University of Kaiserslautern a test phase lasting six months was first of all launched because, considering their special requirements, large-area pretreatment with plasma and structural bonding were to a certain extent new territory for all concerned. 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.

Economization in production

Following satisfactory test results, planning of the technology for the entire plant including the plasma system and the coating process ensued. Finally, in 2003 Schmitz Cargobull started up their full-scale plant for the structural bonding of refrigerated container vehicles. The new application resulted

in important rationalisation 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. For the Head of Quality Assurance and Application Technology at Schmitz Cargobull, Johannes 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 microfine 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 year later the company fitted out a second gluing station with plasma units.

Plasma in large area application

The refrigerated 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 vapour 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 atmospheric-pressure 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 (Fig. 3).

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

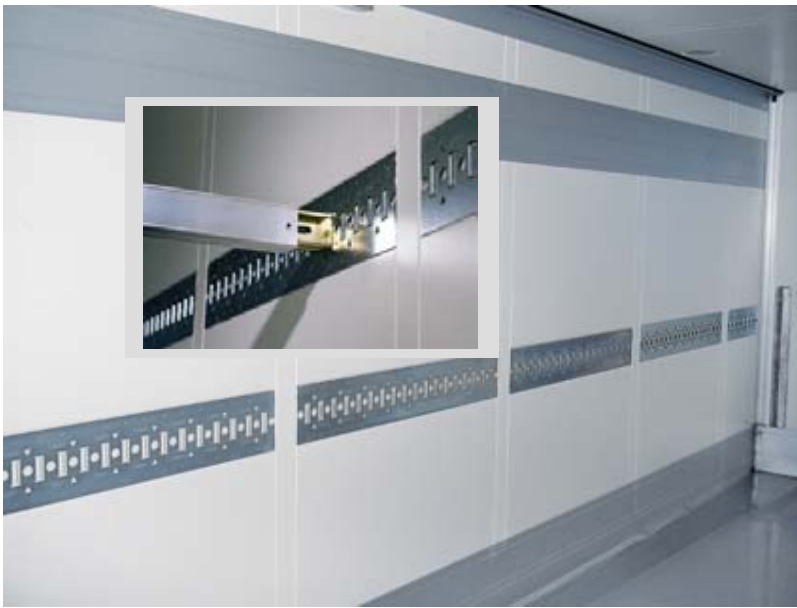


Photo Schmitz Cargobull
Fig. 7 Rail fittings bonded flush with the side walls are also treated with plasma in advance to ensure optimum adhesion.

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 jets spread the plasma at an angle of 45° over a treatment width of 47 mm per rotary jet (Fig. 4). Depending on the direction 150 – 180 mm of the surface can be cleaned and activated in this way in one pass.

An 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 (Fig. 5). If that happened, however, they would no longer meet the reference requirements. The coatings are mainly thermosets 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 (Fig. 6). 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 and 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 (Fig. 7).

Summary

The structure of modern refrigerated container units on trucks is completely bonded together by adhesives to ensure higher inherent strength and better durability of joints at lower production costs. As a result the vehicle construction industry is numbered among the largest buyers of structural adhesives. 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. ■

The Authors

Inès A. Melamies is a freelance journalist and proprietor of the Blue Rondo International Management Consultancy.

Leo Enneking is Key Account Manager for multicomponent injection moulding technology at Plasmamatreat GmbH, Steinhagen (+49(0)5204 9960-0, mail@plasmamatreat.de)