

Environmental protection is a key issue to transport companies. For Schmitz Cargobull, environmental protection already starts with the production of their trucks.

Photo: Schmitz Cargobull

Keep cool

Atmospheric plasma technique assures tempered transportation. For achieving extreme adhesion, extraordinarily tight sealing and improved environmental protection in manufacture, huge refrigerated box superstructures are pretreated with atmospheric plasma before bonding by Europe's leading manufacturer of truck semi-trailers.

No matter whether summer or winter: They load, drive, deliver. On highways, country roads or in narrow old town streets. Thousands of kilometers and all across Europe. No matter whether flowers or pork sides, mobiles, computers or other sensitive goods fill the technologically sophisticated semi-trailers – there is only one thing that is essential: The tempered freight, whether transported at minus or plus temperatures, must reach the destination safe and sound and in a perfect state. Schmitz Cargobull manufacture their box-type trucks in Vreden, Westphalia. Here alone, over 15 000 new refrigerated semi-trailers roll off the factory floor each year.

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For promoting environmentally friendly manufacturing of the 13.50 meters long, 2.60 meters wide and 2.80 meters high truck superstructures, the atmospheric Openair plasma technique is applied to the walls and ceilings of the vehicles before starting the structural bonding process. The plasma process developed by Plasmatreat, Steinhagen, and nowadays employed in virtually all industrial segments for the pretreatment of material

surfaces performs three essential tasks for Europe's largest trailer manufacturer: It allows the use of solvent-free adhesives and imparts particularly good adhesion to the bonding joints. In this way it is ensured that the box superstructures of completely rivet-free construction optimally fulfil the high requirements for strength and constant temperature of the load spaces on their trips between the producer's premises and the customer.

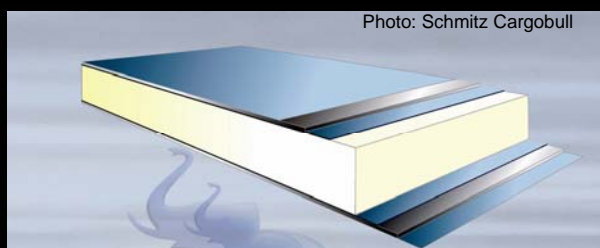


Photo: Schmitz Cargobull

Panel of Ferroplast brand: The uppermost and the lowermost blue layers are the polyester lacquer that is subjected to plasma treatment before the 2-component PUR adhesive beads are applied.



Photo: Schmitz Cargobull

Up to 80 box superstructures are produced per day in the Vreden-located factory.

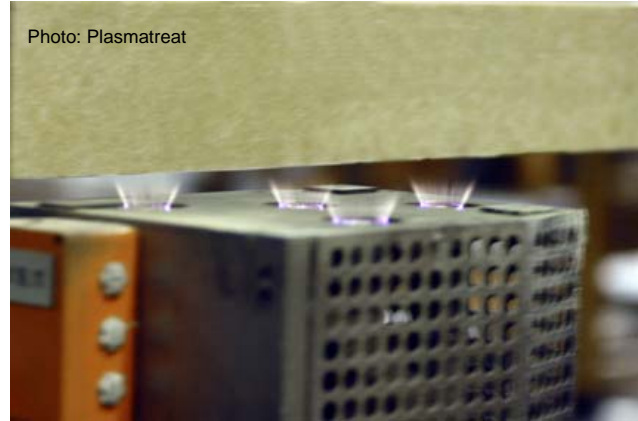


Photo: Plasmatreat

The plastic material coated steel plate surface layers of the sandwich panel are given new adhesive-friendly surface properties by the plasma activation.

Inline process

The nozzle-principle based Openair systems operate at atmospheric pressure. The process is environmentally friendly by requiring only current and air for operation. It is furthermore best suited for robotic application and process safe. The used systems neither require a chamber (vacuum) nor do they interrupt the production process. They are integrated inline, in other words directly, into the new or already existing production line. The plasma has a manifold effect on the material surface:

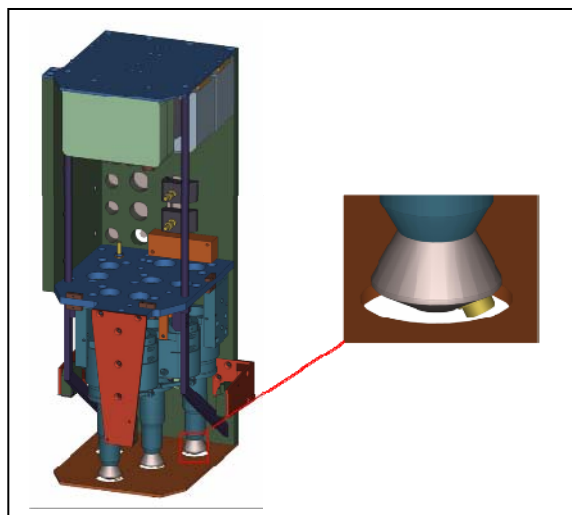
- **Activation:** It activates the surface by selective oxidation processes and increases the surface energy by a significant multiple. Values of over 72 mN/m become possible for most plastic materials.
- **Discharge:** When the potential-free plasma beam impinges on the surface, the electrical charge carriers of the statically charged workpiece can dissipate to earth. The surface is therefore statically discharged.
- **Cleaning:** The plasma flowing onto the surface at almost ultrasonic speed brings about a microfine cleaning effect of the plastic surface.
- **Coating:** Selective nano-coatings can be applied inline by the addition of a precursor. Individual modelling of the surfaces according to the requirements for the later properties of the product is therefore possible.

"We became aware of Plasmatreat's technology first time at an international technical meeting several years ago", reports Johannes Pierick, Head of Quality Assurance and Application Technology at Schmitz Cargobull in Vreden. "The capabilities of this process exactly matched our expectations which we intended to incorporate into the construction of a new bonding plant." The primary goal of the trailer manufacturer was to completely eliminate the previously used organic solvents, with a consumption of at least one liter for each box superstructure produced, during the bonding process and to exclude the potential risk of environmental pollution right from the start. At the same time the previously manually performed tasks of surface cleaning and roughening were to be replaced by an industrial process.

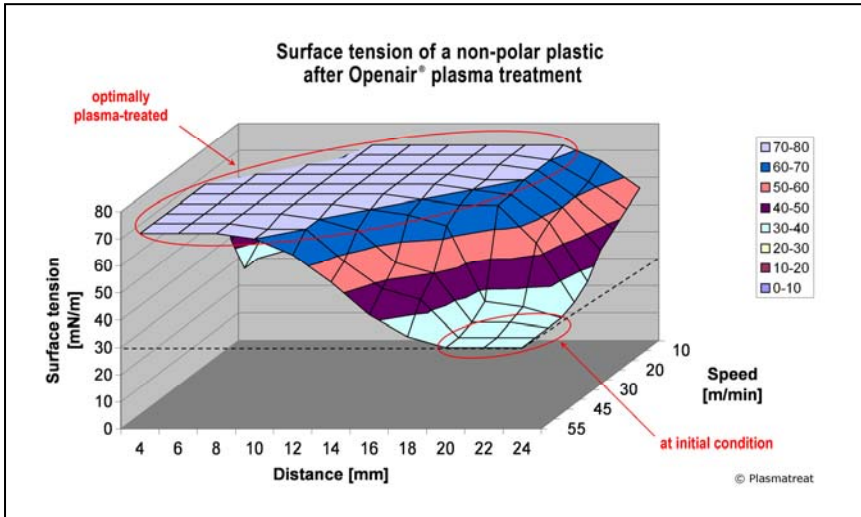
A six months test phase was

initially started in co-operation with the University of Kaiserslautern given that large-surface pretreatment with plasma and structural bonding according to the specific requirements was, strictly speaking, a new territory to all parties concerned. Apart from testing the interactions between the atmospheric pressure plasma, the 2-component adhesive and the material, the intensity of any emissions was also assessed since several plasma systems were to be put into service at the same time.

After promising test results, the complete plant technique including the inline plasma station and the coating process, was released for project planning. In 2003, 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 entailed an essential rationalization of the manufacturing process. Where separate workstations were required previously, pretreatment and



Schematic representation of an Openair plasma generator with four rotary nozzles. The plasma impinges at a 45° angle on the surface being treated.
Fig. Plasmatreat



A plastic surface that was pretreated with Openair plasma is shown in relation to distance and speed. The surface becomes polar after the treatment, and the surface tension increases to >72 mN/m with a large process window.

adhesive coating could now be combined into a single work step since the plasma system was integrated into the portal of the adhesive mixing and dispensing system. Pierick: "The special advantages of the atmospheric plasma system were not only its space-saving installation feature and its high process safety but above all the fact that, thanks to the microfine cleaning level and strong activation effect of the plasma, the tasks of wet degreasing and roughening are eliminated and, through substitution of the use of solvents, a higher satisfaction of our employees could be achieved. It was only one year later that we equipped a second bonding station with plasma systems."

Plasma in large surface use

The refrigerated semi-trailers produced by Schmitz Cargobull are self-carrying systems. The complete modular structure is free of rivets. Walls and ceilings are of sandwich construction. They are made of a vapor diffusion-tight panel with two steel plate surface layers and an interposed high-density polyurethane hard foam core. The self-carrying feature is created by the bonding of the large-size panel into angled aluminium rails. For achieving optimal durability, strength and tight sealing of the bonding joints, the panel is previously pretreated

with atmospheric pressure plasma in the area of the surfaces to be bonded.

Out of the two plasma treatment stations currently in operation at the Vreden-located factory, one is exclusively used for the structural bonding of the side wall and ceiling panel. The three-axle system – with the integrated plasma system and the mixing and dispensing heads for the adhesive bead applications – operates fully automatically once the processing program for controlling and regulating the



Adhesive bead application: The surface is cleaned to a microfine level and activated on a minimum width of 300 mm. Photo Plasmatreat

COST EFFICIENCY

Economical, process safe and environmentally friendly

Modern refrigerated truck superstructures are nowadays completely bonded in their structure in order to improve the inherent strength and durability of the bonds at less production costs. The requirements imposed on bonding are accordingly high and can only be met with a reliable and reproducible pretreatment. In this field, the treatment with atmospheric plasma successfully replaces the conventional pretreatment method, namely manual roughening and activation with environmentally damaging solvents. Thanks to the use of the Openair technology, Schmitz Cargobull saves at least 20 tons of wet chemicals a year. Apart from that, the high-tech rotary plasma systems integrated in the process operations do not only enable a process safe, but also a highly effective and highly economical, pretreatment.

distance from the object is called up.

The plasma station consists of two nozzle systems which are mounted each, right and left, on the extreme outer edges of the same positioning unit where also the mixing and dispensing heads for adhesive bed application are located. Each nozzle system consists of 4 rotary nozzles which are offset to each other. Once the panel is put down by a transportation crane, the axle with the now active plasma nozzles is set in motion and moves alongside the outer edge of the panel with a velocity of 20 m/min. The nozzles distribute the plasma at an angle of 45°, with a treatment width of 47 mm per rotary nozzle. In this way, 150 to

180 mm of the surface can be cleaned and activated in one pass depending on the direction.

"It is always a matter of creating a previously defined reference state through the pretreatment on the plastic material coated steel plate surfaces", says Johannes Pierick, "because it cannot be excluded that the components do show fine contaminations after transportation. In such a case, however, they would no longer comply with the reference requirements. The coatings mainly consist of non-polar plastic material (polyester lacquer) that is given new adhesive-friendly surface properties by the plasma activation."

The pretreatment must be executed on a minimum width of 300 mm over the entire length or width of the panel. This is the surface to which three beads of 2-component PUR adhesive are applied immediately thereafter. For reasons of safety, ample overlaps are provided for. All in all the plasma system makes three passes over the surfaces to be bonded.

A second pretreatment station is available for the microcleaning

and activation of box internals such as double deck and load securing rails. Also for these parts, a previously defined reference state is created by the pretreatment. In this way it is ensured in the course of further processing that the surface-flush bonding on the panels safely meets the requirements. ■

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