



PC-based control as flexible basis for fully automated plasma cells

Reliable plasma sealing protects hybrid composites in the injection molding process

Atmospheric-pressure plasma pre-treatment is one of the most efficient ways to clean, activate or coat plastics, metals, glass, recycling materials and composite materials. Plasmatreat, which is headquartered in Steinhagen, Germany, has developed a series of process cells which support various types of automation such as robotics and almost all plasma processes. PC-based control technology from Beckhoff makes this high degree of flexibility possible.

With the chemical-physical Plasma-SealTight process, functional nano-layers can be selectively applied within milliseconds to generate tight bonds between different materials.



The turnkey, fully automatic PTU1200 plasma cell executes the complete plasma process and can be connected to any commercial injection molding machine.

Plasmatreat GmbH, a maker of plasma equipment for highly efficient surface treatment and eco-friendly production processes, specializes in atmospheric plasma technology, a high-tech process for inline pre-processing and functional plasma-coating of surfaces under normal pressure, which the company implemented in the PTU1200, its proprietary automation standard for process cells.

Focus on flexibility and compact design

The main challenge in developing PTU1200 was the high degree of flexibility needed to support robot operation, a 3D-axis system, a linear system and conveyor operation as automation variants. In addition, a broad spectrum of plasma processes had to be accommodated.

With regard to the coating process, the main focus was on the compactness of the multi-component pre-processing system as well as its easy integration into a continuous production line, explains CEO Christian Buske: "With our fully automatic and ready-for-use PTU1200 plasma cell we have achieved all these goals. It can be adapted to any commercially available injection molding machine, and it establishes a process for the volume production of metal-plastic parts that's speedy and continuous. The cell features everything the process needs, from the generator and robot to the control technology to a plasma control unit (PCU) and the plasma jets to cables and consumables."

Plasma coating without a vacuum

The PlasmaPlus jet technology, which provides the basis for the sealing process, was developed by Plasmamatreat and the Fraunhofer Institute for Manufacturing Technology and Advanced Materials (IFAM) in Bremen, Germany. It is used to generate thin functional layers under atmospheric pressure and normal production conditions inline or externally, thus eliminating the need for a separate and expensive vacuum chamber. In addition, the dry and eco-friendly process replaces the cleaning and primer processes which are often used in hybrid injection molding. It also eliminates steps like intermediate storage or drying processes so that components can be processed immediately after coating.

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The microscopic image shows the clear separation between the plasma-coated corrosion-free metal surface (on the left) and the uncoated corroded surface (on the right).



Over time, corrosive media can intrude into the boundary area of a hybrid component and cause damage.

The plasma system itself consists of two separate plasma jets. A robot – or an X/Y axis system in two smaller models – moves the metal insert under the first plasma jet, where its surface is cleaned of all contaminants at the molecular level to achieve excellent wettability. Next, the second plasma jet applies the functional coating.

PC-based control as a flexible and open control system

According to Christian Buske, the PTU1200 system is predestined for automotive applications, particularly in the production of all kinds of sensors: “Common applications include microfine cleaning and coating before casting and isolation processes, as well as bonding and the sealing of housings. The high flexibility of PC-based control is important because we use 6-axis robots as well as 1-axis, 2-axis and 3-axis linear systems to move the plasma generators. In addition, the systems require conveyor belts, automatic and manual drawers or manual operations to load, handle and unload the components.” And since the systems can be used stand-alone as well as in line with injection molding machines,

printers, soldering machines, IR/UV driers and transport systems, their integration flexibility is equally essential, says Buske.

Plasmamatreat has used PC-based control technology from Beckhoff ever since it introduced its fully automatic process cells in 2016 because the systems require a control technology that can interface by default with robots and linear components, for example, and is widely accepted among machine manufacturers. Christian Buske explains the advantages of PC-based control: “Since Beckhoff offers proven components with open standards, our customers and partners can integrate the plasma cells via interfaces they are familiar with. In addition, Beckhoff components have an excellent reputation and stand for high quality and reliability. Beckhoff technology also made it easy to integrate the power electronics developed by Plasmamatreat.” Moreover, the continuous technological advances being developed by Beckhoff were another factor in the company’s favor. For example, Plasmamatreat plans to introduce in the fourth quarter of 2019 a new process cell version with the highly flexible XPlanar transport system.

At a glance

Solutions for the plastics industry

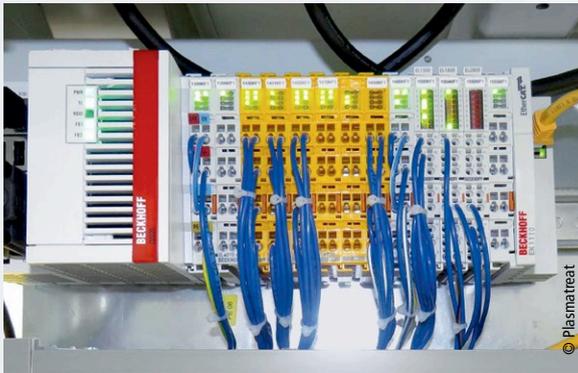
- control technology for fully automated plasma cells

Customer benefits

- compact systems with flexible configuration
- integrated and open control system
- easy integration of robotics

Applied PC Control

- CX5120 Embedded PC and CP3916 Control Panel as central control and operating components
- TwinCAT 3 software for PLC, visualization and OPC UA interface
- TwinSAFE for efficient, integrated safety technology
- EtherCAT Terminals for data collection and subsystem integration



Together with the EtherCAT and TwinSAFE terminals, the CX5120 Embedded PC forms a compact Beckhoff control platform at the core of the system.



Plasmatrete CEO Christian Buske: "The high flexibility of PC-based control plays an important role in the PTU1200 cell operations, because we employ 6-axis robots as well as 1-axis, 2-axis and 3-axis linear systems to move the plasma generators."

Automation structure of plasma cells

The PTU1200 uses a CX5120 Embedded PC equipped with an Intel Atom® processor as its central control unit. Its operator interface is a CP3916 multi-touch Control Panel with a 15.6-inch widescreen display. TwinCAT 3 automation software provides the PLC functionality, supports the visualization (via TwinCAT PLC HMI) and other application-related functions such as the OPC UA interface for transmitting process data to the machine end user.

Large volumes of I/O data are transmitted via the fast EtherCAT protocol. Ten compact EL1808, EL1809 and EL2808 HD EtherCAT terminals collect sensor data for purposes such as material recognition, as well as data acquisition from motors, contactors and valves. Analog motor controllers and regulators are each controlled via two EL3064 and EL4004 EtherCAT analog I/O terminals. Other benefits, according to Christian Buske, are the simple wiring and the ease with which a robot can be integrated via Safety over EtherCAT technology. The EL6751 CANopen master terminal for controlling Plasmatrete's proprietary

power electronics and the EL6631 PROFINET-RT controller terminal for linking customer-specific external interfaces provide an additional degree of openness.

The safety functions of the PTU1200 are implemented by means of the EL6900 TwinSAFE Logic terminal, comprising the emergency stop, safety doors and robotics integration via Safety over EtherCAT. Christian Buske: "Depending on the number of I/Os and the size of the system, the integrated safety technology reduces the wiring effort considerably and speeds up connections with external systems."

Further information:

www.plasmatrete.com

www.beckhoff.com/plastics