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AUTOMATED BONDING OF FIBER-REINFORCED PLASTICS

The use of fiber-reinforced plastics is rapidly gaining in importance for lightweight components in the aviation and automobile industries. However, the manufacturing costs for such components are still relatively high. The introduction of new production processes suitable for series production opens up new areas of use, as EACC has shown using an innovative, automated bonding process.

The use of fiber-reinforced plastics continues to be popular. Double-digit growth rates are being seen, but they have been limited up to now by the high production costs for lightweight construction materials. The high costs are due above all to low levels of automation and a lack of production processes for lightweight components suitable for large-volume production, and, particularly in automobile production, still represent a significant barrier.

Schmidt & Heinzmann

COMPOSITE EQUIPMENT & MACHINERY

AUTOMATED BONDING OF FIBER-REINFORCED PLASTICS WITH MACHINES FROM SCHMIDT & HEINZMANN

The requirements of automated production of FRP components

Euro Advanced Carbon Fiber Composites GmbH (EACC) is one of the pioneers for completely automated production processes for composite components. The subsidiary of the Japanese chemicals, fiber and textiles company, Toray Industries Inc., manufactures components from carbon fiber and glass fiber reinforced plastics for the automotive industry. Suitability for large-volume production is above all a question of economy and quality. The components must be able to be combined in exactly reproducible processes with the shortest possible cycles with millimeter accuracy. And all that with the lowest possible wastage. For example, EACC produces car trunk lids in glass-fiber reinforced plastic (Sheet Molding Compound – SMC).

As Class A components for painting, they are subject to particularly high demands on dimensional accuracy, surface properties and rigidity. After the outer and inner shells of the trunk lids are produced in a pressing process, they are assembled precisely with additional metal and fiber-reinforced inserts such as hinge reinforcement, light pods or lock plates. The components do not just have to be pressed and bonded very precisely. A high level of process stability is also required in automobile production.

Automated bonding process
EACC uses an innovative, automated bonding process for assembling car parts.

(Photo Schmidt & Heinzmann)

The selection of a bonding process suitable for series production

In the selection process, first the technical feasibility of the bonding process had to be tested. Components with complex geometries and multi-part/multi-shell components also had to be assembled in an automated process. When processing plastic parts, demands on the surface tension, the chemical reactivity and the process behavior had to be considered.

In the processing of components such as trunk lids, additional increased demands are made on the sealing and rigidity of the joins. In this respect, the use of different adhesives with various material and processing properties and viscosities had to be ensured. In the end, the production machines should achieve the shortest possible and thus most economical cycle times.

"With our new machine, we are pursuing a cycle time of under fifteen minutes for all of our five trunk lid versions to be produced. And that with an assembly precision in the tenths of a millimeter range,"

says Stephan Roßner, Vice President at EACC for Development, Production and Quality, naming the two main advantages of the investment, and confirming that EACC had found no comparable machine in the selection process. The technology developed by Schmidt & Heinzmann sets new standards with respect to efficiency and precision. This is achieved with the use of many innovative components. These include the articulated arm robots integrated into the machine and the portal-guided adhesive mixing heads.

A further efficiency factor is the sophisticated technological interplay of all machine components. This is provided by the machine control systems.

Bonding machine for fiber-reinforced plastics
The machine for automated assembly of fiber-reinforced plastics with a two-component adhesive provides products with consistently high quality due to stable processes.

(Photo Schmidt & Heinzmann)

Many challenges in the bonding process

The whole process of creating the machine right up to the production processes implemented are intensively supervised by the team from Bruchsal. This involves the identification and specification of decisive production and machine parameters, the reproducible process control and checks, and appropriately qualified training of the EACC employees.
With the machine from Schmidt & Heinzmann, the bonding process at EACC has been automated and made ready for series production. The outer and inner shells to be processed as well as multiple attachments such as reinforcements, lock plates and light pods are laid individually, positioned exactly, adhesive applied and held in position until the conclusion of the assembly process.
The challenges here included the simultaneous assembly of multiple components in an optimized cycle time. The time needs to be as short as possible (economy) and still sufficiently long (necessary curing time for the adhesives). In the limited time window, the adhesive must remain reactive, it must be applied in the correct amount and not cure too early or too late.

With the use of flexible, 5-axis, articulated-arm robots integrated in the machine, it is possible to process multiple components simultaneously and precisely in an automated process and in the smallest possible space. As the individual bonding processes are no longer carried out in sequence but in parallel, the cycle time is reduced.

With the use of articulated arm robots and portal systems produced by Schmidt & Heinzmann instead of individual industrial robots, the challenge of having to lay multiple hoses in a restricted space no longer applies. In the end, the highly maneuverable robotic arms allow more freedom of movement, offering access to the adhesive surfaces of complex part geometries. The individual arms can undertake different feeding, positioning and holding tasks in parallel. The control of the robots in the form of an electrical cam plate has been improved. The robotic arms can also be individually programmed with a joystick in an intuitive teach-in process.

A portal system is also integrated in the machine with two adhesive mixing heads for different adhesive systems. The reactivity of the adhesive is accelerated by heated tools so that short cycle times can be adhered to.

A further EACC requirement of the machine is the flexibility to make rapid changes or to make fast production start-ups for new products. There are often design changes in the geometries right up to the start of series production. Then, based on the changed CAD data, the parts must be repositioned and the adhesive tools and adhesive application adapted. The high flexibility of the machine has a positive effect here.

5-axis robots
With the use of a flexible, 5-axis robot it is possible to process multiple components simultaneously and precisely in an automated process and in the smallest possible space.

(Photo Schmidt & Heinzmann)

Precision and repeatability

The adhesive machine is equipped with extended setting possibilities to meet the increased quality demands of automotive parts. Here the machine control systems take on decisive control tasks. In this way, the positional accuracy of the parts are checked before the adhesive process by multiple sensors. If the actual values deviate from the target specifications, the control system provides exact information to the machine operator. The homogenous temperature control of the production tools, the adhesive parameters and the cycle times are also checked throughout the process and documented by part. In this way, the specifications can be adhered to, defective parts prevented and quality checks reduced.

The machine control systems also provide monitoring of the course of the process. For this purpose, high-resolution camera systems produce images of every adhesive application and record the production data in a log file. Each part then receives a QR code to ensure traceability of the process parameters.

"The adhesive machine fulfils the high series demands of automotive parts. Due to the complete automation, the exact assembly part positioning with innovative articulated arm robot technology, reproducible adhesive application using a portal system and the very low level of production wastage, the production of FRP parts and assemblies will be much more economical,"

is how the EACC Manager, Stephan Roßner, summarizes the experiences.

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