Trends in Composite Manufacturing

The Demand for Composites Will Keep Growing in the Future

Press manufacturer Wickert currently sees four trends in system engineering. These include the increased use of automation solutions for gains in productivity and additional injection units for flexible, broad-scoped manufacturing. The machine manufacturer also anticipates a future rise in thermoplastic processing as well as growth potential in the use of natural fibers and natural resins.

Composite press for research: for scientists at the Chemnitz University of Technology, Wickert developed a highly flexible four-column upper piston press which offers a high level of freedom and diversity in application © TU Chemnitz

In the medium and long term, the growth prospects for composites are encouraging. This is how Steve Büchner, Sales and Project Manager at the press manufacturer Wickert in Landau/Pfalz, Germany, assesses the situation: "The present Corona crisis will only cause a temporary slowing. Generally speaking, I believe the market potential for our high-performance material and for us as a machine manufacturer is just as great as before." The company from Landau now offers its services as a development partner to engineers, technicians and practitioners who wish to develop new and powerful composite applications. "Our days of being merely a press manufacturer are long behind us and we now offer a much wider range of services", the sales and project manager stresses. "As early as component development, we are able to offer valuable advice thanks to our experience in manufacturing." (**Fig. 1**)

Services range from concept and feasibility studies to the overall planning of entire composite production plants and high-performance turnkey sol- »

Fig 1. Steve Büchner, Sales and Project Manager at press manufacturer Wickert in Landau/Pfalz, Germany © Wickert

utions as well as general contracting for complete production lines. The press systems are then usually manufactured as customized machines in Landau.

Increasing Demand for Automation Solutions

"In plant design, we are seeing an increasing interest in automation solutions for boosting productivity", Büchner comments. Wickert has been prepared for this trend for some time: their own development department designs concepts for individual automation and customized solutions. The degree of automation ranges from classical, manual solutions to full automation. Some tasks, such as component transport, feed and discharge operations at the press, tool changing and the entry of release agents, can often be performed unmanned.

And there is still many more opportunities for further automation. If desired by the customer, Wickert presses can be fully fitted with sensors and actuators and are then able to record a wide range of data. These include information about the actual state of machine wear, for the purpose of anticipatory maintenance, as well as data on production and processes and the quality of the workpieces. "Concepts such as the Smart Factory call for the intelligent networking of our presses and peripheral components with other parts of the system and the primary process control systems. In this way we can create fully automated production concepts for highly productive composite manufacturing", Büchner explains.

Flexible All-Round Press for Series Production of Structural Components

To illustrate the trends he has been speaking about, Büchner describes a composite press which Wickert supplied to the Institute for Lightweight Structures (IST) at the Chemnitz University of Technology (**Title figure**): "It combines a high degree of flexibility and particularly wide range of applications in manufacturing with numerous options for automation."

The press is being used in a research project for thermosetting composites and for hybrid materials made from fiber-reinforced plastic and metal. The objective is to develop mass production processes for manufacturing light-weight components for electromobility.

For the scientists here, Wickert developed a four-column upper piston press which can generate a pressing force of 25,000 kN in less than one second. Such great dynamism is occasionally necessary for processing materials such as glass-mat-reinforced and long fiber-reinforced thermosets. These materials sometimes need to be heated to 230 °C in a preheating station and then processed immediately under high pressure and at a temperature of at least 190 °C.

Greatest Possible Versatility thanks to Additional Modules

For broad-scoped research activities, the system offers a high degree of freedom and wide range of applications. The scientists are able to integrate other processes at any time and automate the processes as required. For this purpose, Wickert installed robot handling and integrated a number of additional interfaces in the machine control system (**Fig. 2**). This means that with just a few modifications, an RTM injector (Resin Transfer Molding), a polyurethane unit, additional injection units, further temperature conditioning units and a reading device for tool sensor technology can be added.

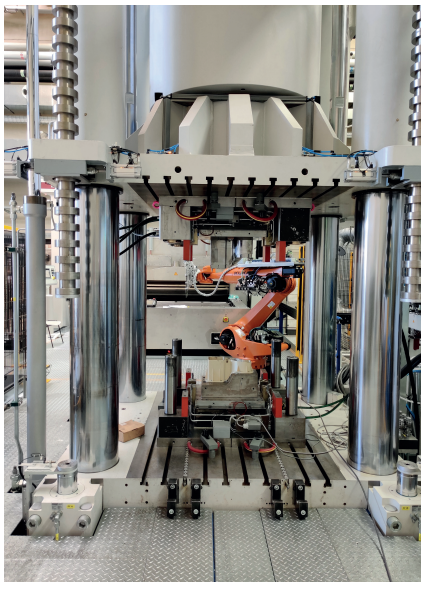

Fig. 2. The scientists are able to automate the processes at any time as required. For this purpose, Wickert installed robot handling and integrated a number of additional interfaces in the machine control system © TU Chemnitz

All production processes are monitored in full to ensure that the manufacture of automotive structural components is tested in close-to-production conditions. This allows the processes to be adjusted quickly and comprehensively. The press is also characterized by its high precision: thanks to the active hy-

Company Profile

Wickert Maschinenbau GmbH is a medium-sized, family-owned company based in Landau/Pfalz, Germany. It develops and manufactures hydraulic presses and fully automated press systems. All machines and systems have a modular structure and feature pressing forces of between 20 and 100,000 kN, with a customer-specific layout in each case. The provided systems are used to process elastomers, composites, plastics and powder materials for the production of brake and clutch linings as well as grinding disks, as fixture hardening systems, and in research and scientific laboratories.

Hans-Joachim Wickert and Stefan Herzinger are the partners and managing directors of the family business that was founded in 1901 and exclusively manufactures in Landau/Pfalz, from where it supplies its customers in Europe, the Americas and Asia. In 2020, 172 employees generated a turnover of around EUR 40 million.

↘ www.wickert-presstech.de

draulic parallel positioning, the configured deviation to the parallel position during the pressing process is a mere 0.05 mm – even with eccentric loads.

Thanks to their modular design, hydraulic composite presses from Wickert can be customized to meet virtually all customer-specific requirements. Processing temperatures up to 500 °C and pressing forces between 20 and 100,000 kN are just as possible as plane parallelism up to 0.025 mm/m. The dimensions of the presses and their precision heating plates with extremely homogeneous temperature distribution can be freely selected. Diverse options for automation and networking as well as the integration of further production processes such as RIM and RTM injection ensure a high level of productivity and versatility. In addition, there are numerous other components available for individual press concepts, including infrared heating and highly efficient heating/cooling systems. If required and approved by the customer, it is also possible for selected data to be transmitted to Wickert in Landau, Büchner explains.

Fig. 3. Organo sheets are turned into 3D components at the research institute Neue Materialien Bayreuth (NMB): composite press for high-performance thermoplastics with processing temperatures of up to 450 °C
© Wickert

Thermoplastic Composites for Mass Production are on the Rise

Even though 85 % of long fiber-reinforced and continuous fiber-reinforced composites are still processed by thermosetting, Büchner sees a growing interest in the use of thermoplastic matrix systems. An example of this is seen in the research department of the Neue Materialien Bayreuth GmbH (NMB), Bayreuth, Germany. In the fall of 2020, the institute commenced operation of a 600 t press for temperatures of up to 450 °C, with the purpose of manufacturing lightweight construction pieces made from thermoplastic composites and sandwich structures (**Fig. 3**). Here, tailor-made organo sheets are heated up to 450 °C and then fed into the machine within just a few seconds. Büchner remarks: "The thermoplastic forming of organo sheets is gaining more and more supporters. This is because high-precision, mass-produced parts can be manufactured in stable, fully automated processes – and with significantly shorter cycle times than with thermosetting."

The hardening time of composite elements made from organo sheets, multi-layer semi-finished products with high-performance carbon, glass or aramid fibers in a thermoplastic matrix is just three minutes. By contrast, it can take up to three hours for a thermoset aircraft door to harden.

Natural Fibers Have a Lot of Potential Given Adequate Customer Acceptance

The composite expert also sees potential in the use of natural fiber-reinforced plastics (NFRP) using fibers such as flax, hemp, jute, sisal and kenaf as well as natural resins such as bio-based epoxy resins with vegetable oil basis.

NFRPs have a lower density than glass fibers or mineral fillers and are therefore lighter. However, as they are natural products they are also subject to variations in quality. Furthermore, their mechanical properties cannot match those of artificial fibers. One important advantage of natural materials, in addition to their unlimited availability, is their excellent compostability in comparison with glass or carbon fibers. Their prices are also pretty stable and do not fluctuate like those of materials produced with crude oil.

Fig. 4. Roof linings for passenger cars are produced on Wickert presses like this WKP 1500 S, in some cases also using composites which include natural fiber-reinforced plastics (NFRP) © Wickert

Typical elements that are partly made from NFRPs are interior trims, parcel shelves and dashboards in automotive construction. In the furniture industry, they are used for the production of molded parts, for example as tool or seat shells, wall or ceiling elements (**Fig. 4**). Production residues from natural materials can even be recycled, Büchner reports.

He believes that the success of NFRPs will depend, above all, on how they are accepted in everyday use by customers. "The systems necessary for production are not a problem, as it is already possible to process natural materials in presses from Wickert." ■

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