

From 0 to 25,000 in One Second

Processing Glass-Mat and Long-Fiber-Reinforced Thermoplastics in a Hot Press

Researchers at the Institute of Lightweight Structures at the Chemnitz University of Applied Technology now use a versatile and high-precision composite press from Wickert, whose pressure is available from 0 to 25,000 kN within one second.

At the Institute of Lightweight Structures (IST) at the Chemnitz University of Applied Technology, researchers – in some cases with partners from the automotive industry – develop large-series-capable processes for manufacturing lightweight parts for applications in electromobility. For researching processing technologies for thermoplastic composites and fiber-polymer composite – metal hybrids, they required a hot press for processing glass-mat-reinforced and long-fiber-reinforced thermoplastics. Consequently, it is advisable to produce even large structural parts for vehicles directly at the institute. “For near-series part development and cooperation with industrial partners, it is essential to be able to monitor and influence all processes for manufacturing realistic 1:1 parts,” says the Deputy Head of the Department of Lightweight Structures and Polymer Technology, Prof. Dr.-Ing. Wolfgang Nendel, justifying this step.

Rapid Build-Up of Pressing Pressure

In a specification, the researchers required very dynamic performance data, a high degree of freedom and versatility, high precision and a high degree of safety. “A press force of 25,000 kN and a rapid build-up within a second were the crucial factors for us,” says Nendel, who supervised the procurement. Both are essential prerequisites for processing particular materials. “For example, we have to be able to process mats of glass-mat-reinforced thermoplastics, which are heated to 230°C in a preheating station, immediately in the press at high pressure and at least 190°C.

The fully hydraulic composite WKP 25000S press from Wickert Maschinenbau, Landau, Germany, which the re-

searchers opted for, is capable of rapid pressure build-up thanks to a hydraulic accumulator, which is continually supplied with oil whenever the machine is operating at low load. The oil is then pre-stressed at a pressure of 250 bar. When needed, it can deliver 270 kW power to the hydraulic drive for building up the pressure. The principle is similar to that of a pumped-storage power plant, in which water is pumped into a higher-level reservoir at times of low current demand in or-

With other processes, the same result can be achieved in half the time, “however, the presses are two or three times as expensive,” Herzinger continues.

Design Simplifies Installation

The specification also required that the footing at the installation location should be subject to minimum loads and that no pit could be installed in the hall floor. Hot presses therefore do not come into con-



WKP 25000S: The composite press is accessible all round and can be operated from two sides

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der to provide energy rapidly when required.

“A pressure build-up of 25,000 kN within a second represents the limit of the technically feasible with this technology,” explains Stefan Herzinger, who, together with Hans-Joachim Wickert, heads the company as a partner and director.

sideration, since they require a pit. The WKP 25000S is a downstroke press that can be installed on a level surface and whose fully hydraulic clamping unit is moved via four columns. The table size is 1500 x 2000 mm.

The press reaches opening and closing velocities of 300 mm/s, a press ve- ➤

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Company Profile

The **Institute of Lightweight Structures (IST) at the Chemnitz University of Applied Technology** is the top performer in the first and only Germany-wide Lightweight Construction Federal Excellence Cluster of the German Research Association ("Technology Fusion for Multifunctional Lightweight Construction Structures – Merge") and "Merge Europe", the Internationalization Concept for this. Moreover, IST is a member of the European Lightweight Construction Alliance and Prof. Kroll is Head of the Stex project group (systems and technologies for textile structures) of the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz, Germany.

Wickert Maschinenbau GmbH develops and manufactures hydraulic presses and fully automated press systems. All the machines and systems are modular in structure, with press forces between 20 and 100,000 kN, and are customized to specific demands. They are used for processing elastomers, composites, plastics and powder materials, for manufacturing brake and clutch linings, as well as abrasive discs, as fixture hardening systems and in research and science laboratories. Hans-Joachim Wickert and Stefan Herzinger, as partners and managing directors, head the family-owned company, which was founded in 1901 and only manufactures in Landau, Germany, from where it supplies its customers in Europe, America and Asia. In 2016 it achieved sales of about EUR 30 million with 150 employees.

Service

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Engine mount of glass-mat-reinforced thermoplastic in combination with thermo-prepreg, which can be manufactured at the IST, thanks to the rapid pressure build-up in the press

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locity of 10 mm/s and an opening force of 1000 kN. Like all presses by the manufacturer, it is a custom construction that is specifically configured for the order based on a modular system of components produced in Germany. The SME machine manufacturer counts over two dozen universities and research institutes among its customers in the science field.

The hydraulics was also required to provide freely preselectable force and velocity for all operating functions, and should also be usable with tools in which each half weighs up to 12,500 kg. These requirements emerge from the overall situation of press, process conditions and installation location. In addition, the press should be accessible and operable from several sides for flexible deployment. Frame presses therefore do not come into question because of their restricted accessibility. "Thanks to their column design, the Wickert press can be operated from left and right, and we can approach it from three sides," explains Prof. Nendel. "In addition, its principle is easy to understand for our industrial partners from the automotive industry, who predominantly come from sheet metal forming."

Precision thanks to Constant Press Forces

The IST makes strict requirements on the press precision, so that even complex parts, some made of hybrid materials, can be manufactured repeatably at any time. "Integrating different materials, such as thermoplastics and metals, with different functions in one part and producing them in one step" is the aim according to Prof. Dr.-Ing. Lothar Kroll. "In the long term, we want to manufacture, for example, engine hoods and mudguards in

original size and equip them with nano- and microelectronics systems." Thanks to an active hydraulic parallel positioning with four counterpressure cylinders against the moving pressure plate, the maximum plane-parallel deviation during pressing is 0.05 mm. The press also has an additional position measurement directly at the tool. The high precision of the press is necessary for integrating sensors precisely in the parts and thereby avoiding displacement in the region of the part.

In addition, the isoforce function developed by the machine manufacturer ensures that the power stroke takes place with constant, and therefore reproducible press forces. This achieves a uniform injection pressure during pressing – irrespective of whether the piston acts in the material or not. "Other hydraulic systems generally have a sawtooth function around the actual specified value during the power stroke, which leads to inhomogeneous material flow and limited reproducibility," says Herzinger. Depending on the material and process, the function can be freely connected.

Integrated Automation Interfaces

Prof. Kroll stresses that a press for research purposes ought to offer the greatest possible freedom for a wide range of applications. Among other things, the scientists wanted to keep open the possibilities of combining processing with other processes and of automation. The press is therefore equipped with additional interfaces integrated into the machine control system for an RTM (resin transfer molding) injector, a polyurethane unit and temperature-control equipment, as well as an interface for reading mold sensor data. ■