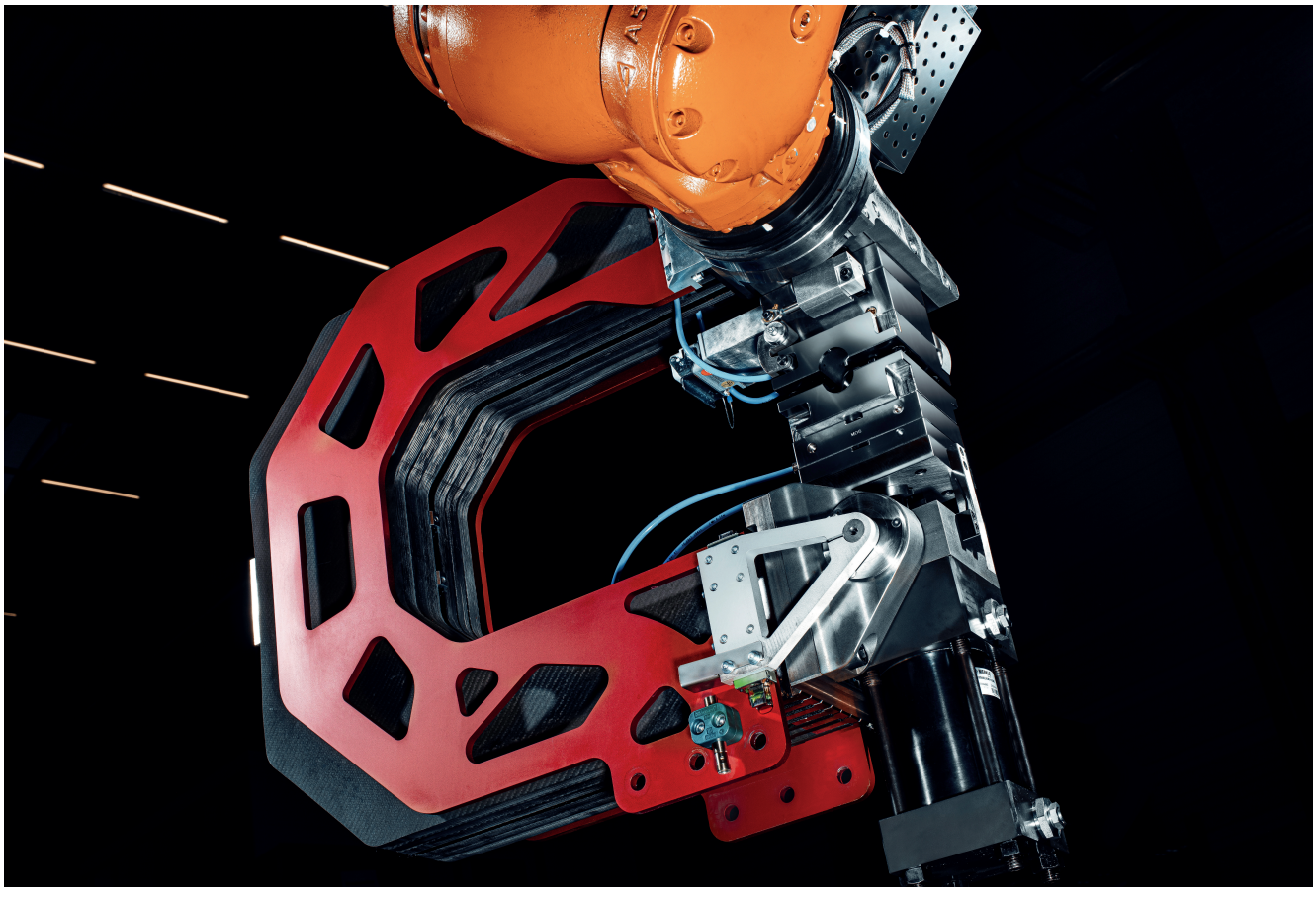

The Robin injection molding system can be swiveled freely on the arm of a six-axis robot to the particular application points. © Anybrid

Automated Lightweight Module for Functionalization and Hybridization of Components

Injection Molding on the Fly

Anybrid GmbH has succeeded in transforming the usually rigid injection molding machine into a mobile machine that can move freely in the room and can be used to overmold profiles, etc. The company is thus serving a steadily growing market for the production of hybrid components. For the first time, the advantages of plastics processing are combined directly with the flexibility of robotics. In close cooperation with Rehau, extensive studies on an extrusion line were recently successfully completed.

The principle of Robotized Injection Molding (Robin) is very simple. With a weight of approx. 140 kg, the compact injection molding machine is so light that it can be mounted on classic industrial robotics (**Title figure**). This disrupts the classical functionality of the stationary injection molding process by allowing it to take place at almost any position in space. Especially for overmolding other semi-finished products and components, this opens up a completely new way of thinking in product and process design. Thus, the developers of Anybrid take injection molding out of the center and use it as an addition to classic processing methods. Besides processes from plastics processing, these are also processes for metal, wood or textile processing in particular.

In order to achieve the low overall weight of Robin, a closing system using carbon fibers was developed over several years of development. This not only maximizes the degree of lightweight design, but also achieves a large projection of the C-frame. Nevertheless, this clamping system can transmit between 60 and 120 kN clamping force, depending on the configuration. This results in ideal accessibility for overmolding large-area components or even entire assemblies with complex geometries. For plastics processing, the young Dresden/Germany-based mechanical engineering company relies on piston injection units,

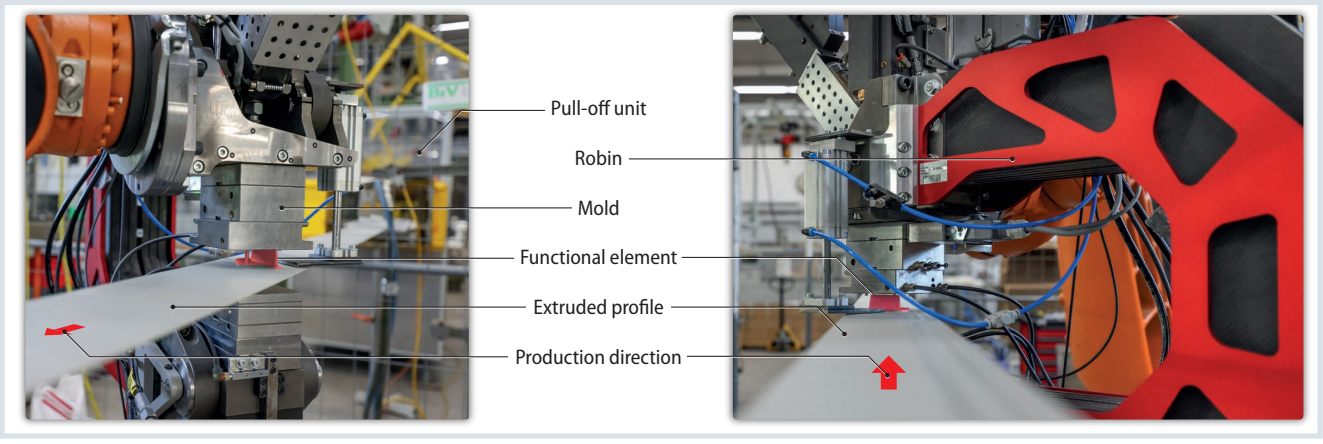

Fig. 1. The Robin module is used in the Rehau pilot line for functionalizing profiles.. © Rehau / Anybrid

which on the one hand are suitable for the implementation of small injection volumes (up to 50 g) and on the other hand contribute to the low overall weight by avoiding a plasticizing screw.

Applied in Extrusion

Thanks to the exceptional mobility of the Robin system technology in combination with the necessary automation, it is now possible for the first time to integrate injection molding into continuous process lines. For example, technical profiles can be functionalized inline directly during extrusion. For this purpose, the machine moves to the profile dock and moves along in the direction of the extrusion while the element is being overmolded.

In cooperation with the innovation group of Rehau Industries, several pilot tests have been carried out in recent months. For example, the new technology was integrated directly into a production line in the Rehau Technical Center for the first time. Functional elements were applied to an extrusion profile at regular intervals (**Fig. 1**). The particular challenge here was to bring together the parameters from extrusion with those from injection molding. It is essential here to match the line speed of the profile with the process cycle and, in particular, the necessary cooling time of the overmolded functional element. The feasible process window depends on the required distance between the functional elements. However, if higher productivity is required, there is the option of using several Robin systems simultaneously in the line.

Finally, the tests with the pilot line made it possible to qualify various materials or material combinations with regard to their adhesion. For example, it was shown that good bonding strengths can be achieved with various types of plastic such as HDPE, ASA, ABS, TPE, PC and PVC, both as mono-material systems and in various combinations. This means that the entire range of outdoor and indoor applications can be covered. By implementing mono-material systems, a high level of recyclability can also be achieved, which is not possible with alternative joining processes such as adhesive bonding.

Fig. 2. Various profile materials, such as aluminum, wood or composites, can be combined with functional plastic elements. © Anybrid

Saving of Assembly Steps

Due to the short cycle times in injection molding with the Robin module of sometimes significantly less than one minute, assembly steps that would otherwise be necessary can simply be eliminated. Furthermore, due to the shaping diversity of injection molding, there is the possibility of integrating additional functionalizations in addition to the connection of the joining partners. These can be applied variably depending on the product requirements and also enable high-quality recycling at the end of the service life through the use of thermoplastics of the same type.

Compared to the conventional production of comparable products, for example on stationary injection molding machines, the application of mobile Robin technology is characterized above all by the significantly lower investment costs. Thus, large and expensive molds can be avoided and production time can be saved due to the absence of logistics that would otherwise be required to transfer the profiles to the injection molding machine. In addition, inline functionalization allows a much greater variability in terms of the distances between the applied functional elements. All in all, the application of the Robin system in extrusion lines such as those at Rehau can therefore reduce costs, increase productivity and increase the flexibility of production considerably. »

Fig. 3. When functionalizing components made of porous aluminum, the plastic melt enters the surface layer.
© Anybrid / Automoteam

The cooperation between Rehau and Anybrid will be expanded in the coming months to implement various applications for the use of the new technology. Due to the broad portfolio of Rehau with products in a variety of industries, there are many points of convergence, even beyond extrusion.

Functionalization of Wood and Metal

In addition to the overmolding of plastics, the functionalization of other materials such as wood, metal or composites also has enormous potential. Especially in the production of furniture and construction goods as well as for the functionalization of various industrial semi-finished products, the use of Robin opens up a wide range of new process and design options (**Fig. 2**).

Even Anybrid cannot beat physics, which is why the greatest challenge is still to achieve sufficient adhesion between the different material classes. In addition to numerous pre-treatment methods or adhesion promoters, there is also the option of mechanically bonding the joining partners to each other. For example, grooves or holes and the filling of undercuts can be used to create a form-fit connection.

In this context, the overmolding of porous aluminum also offers great application potential. For this purpose, Automoteam GmbH has produced tubes, rods or plates with variable internal structure from aluminum in permanent mold casting using NaCl. This porous aluminum was then overmolded using the "flying" plant technology. This showed excellent mechanical bonding because the polymer melt entered the near-surface area of the semi-finished products (**Fig. 3**). In this way, plastic elements can now be applied locally and novel components with high functional integration can be produced.

When functionalizing wood, the natural porosity of the natural material can also be used to create an interlocking joint. For example, elastic elements made of a thermoplastic elastomer (TPE) can be variably applied to different positions of a wooden panel and can thus be used in the furniture industry as spacers or elastic buffers.

Fig. 4. The backpack buckle is one of the first application examples for the processing of recycled material. © HolyPoly

Declared Goal: Sustainable Process Chains

Founded in 2020, Anybrid GmbH emerged from an "Exist" research transfer at the Institute for Lightweight Engineering and Polymer Technology at TU Dresden, Germany. With the development of Robin, the four company founders have succeeded in transferring expertise in the implementation of lightweight structures to the design of machine and plant technology. With this, they now want to broaden the perspective on conventional plastics processing and make hybridization in the injection molding process useable in other process chains as well.

One of Anybrid's main principles is the sustainability of the realized process chains. Thus, it is a declared goal that the recyclability of the products as well as the use of recycled materials are taken into account at an early stage in the product development process. In initial tests together with HolyPoly GmbH, the high-quality circular processing of plastics has already been implemented and the first products based on recycled materials have been manufactured **(Fig. 4**).

After the successful tests in several pilot applications, the company will already accompany the production of the first serial products in 2022. The goal is to complete the certification of the machinery and deliver the first Robin system as early as this year. ■

Info

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