

From Versatile to Highly Efficient

Fakuma 2017 Offered a Wide Range of Solutions for Flexible Automated Production

Anyone looking around Fakuma could discover automation solutions to suit any budget and applications of any complexity. The forerunners of Industry 4.0 were also to be seen.

Arburg, for the first time, presented a manufacturing cell for tension straps, in which various features, such as length, color and types of the end pieces can be individually adapted to the customer's wishes from shot to shot. "With this turn-key system, we are demonstrating that overmolded inserts can be mass produced 'on demand' in a wide range of variants, but still economically," says Heinz Gaub, Managing Director for Technology at Arburg, talking to **Kunststoffe**. "The practical example illustrates how customers' wishes can be integrated online into the running injection molding process. In industrial practice, such an application is predestined for uses such as cable assembly in the automotive industry.

Customized Mass Production

In the trade show application, visitors could choose between 40, 60 and 80 cm long tension straps in three columns, and between three possible combinations of end piece, consisting of a hook and eye, and enter their desired model directly at a terminal. The order is transferred directly via the OPC UA communication protocol to the central Selogica machine control. Whereupon the system, based around an Arburg 375V vertical injection molding machine, produces the desired profile to order (**Fig. 1**) – thanks to well thought-out product and mold design, and some Industry 4.0 modules, entirely without retooling.

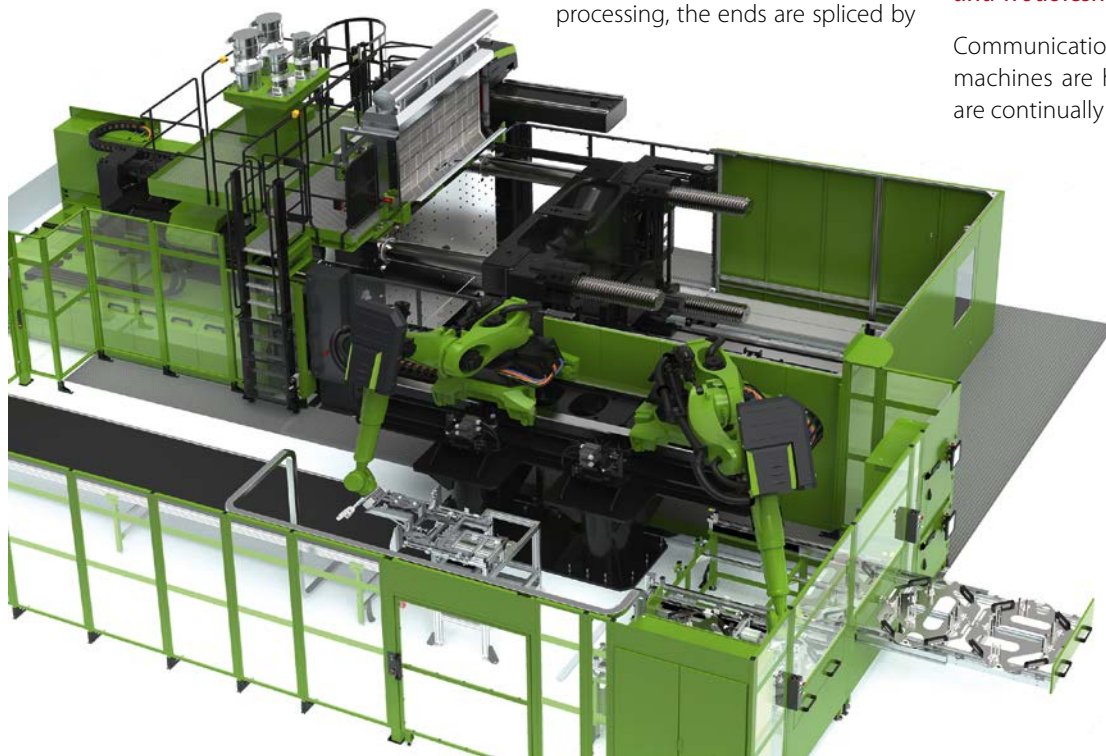
First the strap is cut from the roll to the chosen length. Before further processing, the ends are spliced by

plasma treatment. The limp inserts are handled by a Kuka six-axis robot, which is compactly arranged within the machine footprint area, and reaches into the mold from behind.

The 4-cavity mold has two cavities each for the hook and eye. The cable ends are placed in the cavities according to the order. In the next step, both ends are drilled with a pin, so that the plastic (PP-GF30) can be stably anchored. During overmolding of the inserted strap, the two cavities used in this cycle are actuated by means of hot-runner nozzles. At the end of the cycle (after about 40 s), the robot removes the final tension strap and ejects it from the system.

Apps for Optimizing the Robot Cycles and Troubleshooting

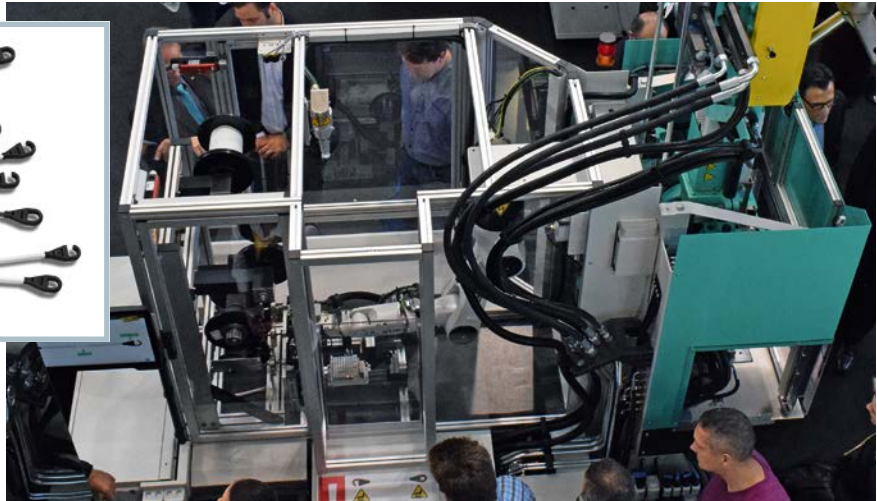
Communication and interfaces between machines are high on the agenda. "We are continually talking about Industry 4.0



The complexity of automation projects is increasing. Often several robots of different types are integrated (© Engel)



Fig. 1. Industry 4.0 for series production “on demand”. A turnkey system produces elastic tension strap to customers’ requirements – in different variants from shot to shot (© Arburg, Hanser/Y. Schwab)



and the factory of the future,” says Jean-Michel Renaudeau, CEO of the Sepro Group. “However, we are convinced that connectivity between systems is only the first step in a much bigger challenge. For Sepro, Industry 4.0 means that humans, machines and companies must be networked in a significant way, if they are to unfold their full potential.” Renaudeau calls this philosophy “Open 4.0” and considers it firmly anchored in his own company.

At the trade show, Sepro presented two apps on the topic of robot connectivity and control. The first application (“OptiCycle”) supports users in fine tuning robot and machine cycles, in order to exploit the productivity reserves (Fig. 2). According to the manufacturer, the cycle times of existing robot programs can typically be shortened by up to 40% and typical injection molding cycles by up to about 5%. The second app (“Live Support”) provides Sepro customer service with precise robot data in real time as it connects it to the customer, thereby allowing online troubleshooting in order to minimize down times. The new apps are part of “Open 4.0”, Sepro’s long-term initiative for implementing an open, transparent and universal platform for next-generation robots and control systems.

As regards the hardware, the French manufacturer presented three new small six-axis “Universal” articulated robots of the 6X Visual series, which had been developed in partnership with Yaskawa-Motoman. They are designed for use on injection-molding machines with 200 to 5000 kN clamping force and use the Visual3 control system for programming and

integration. In addition, two articulated robots from the cooperation venture with Stäubli are used.

Efficiency Potentials in the Human-Robot Interplay

Manufacturers currently report increasing demand for complex automation cells for highly integrated manufacturing processes (Title figure). “In a current project, we are integrating nine robots of different types,” reports Walter Aumayr, Head of the automation and ancillary equipment division at Engel Austria. The system supplier used Fakuma to show its e-pic robots in an integrated version for the first time. In the integrated solutions, the CC300 control unit of the injection-molding machine becomes the centralized control panel for the entire manufacturing cell. That means common management of part data and alarms, additionally, the uniform operating logic simplifies commissioning, programming and control, both of the robots and of the entire manufacturing cell.

Engel offers the e-pic small robots in two variants: as pick-and-place linear robot (e-picZ) and as servo sprue picker (e-picB). The special feature of the e-pic series is that, instead of a classical x-axis, the robots have a pivot arm of lightweight design. These innovative kinematics increase the dynamics and energy efficiency, reduce the maintenance costs, while also permitting a compact arrangement of the injection-molding machine. In the direction of both the stationary and moving mold halves, the pivot arm requires less space than a linear axis. The



Fig. 2. The fine tuning of robot and machine cycles per app coaxes out the last productivity reserves (© Sepro)

pivot arm can easily and quickly move around obstructions such as fittings on the mold. At the same time, the e-pic is no more difficult to operate than a linear robot. The control system computes the rotational movement into a linear movement.

Engel has recently started equipping the e-pic robot with “efficiency control”. With the aid of the software, the robots adapt the speed of their movements to the cycle of the injection molding process, which reduces the energy consumption and the lifetime of the mechanical components. In the viper linear robots, the software already has a proven track record of several years, according to Engel. And this robot type, too, saw a premiere. The new viper20 speed offers removal times significantly below 1s. This new performance class is the result of more powerful servoelectric drive technology, as well as the reduced intrinsic weight of the robot axes. The model is claimed to be suitable for the medical and packaging sectors; top-entry ro- ➤



Fig. 3. The four-axis robot from Igus is an inexpensive handling solution for many tasks (© Hanser/ C. Doriat)

bots generally offer particularly high flexibility here.

Automation as Standard

Customers' increased interest in attractively priced, versatile automation solutions has been noted by Alfred Schiffer. "The increasing individualization of the parts and shrinking batch sizes additionally require multifunctional injection molding machines. Cost effectively making automation the standard, so to speak. I see this as an important component for realizing Industry 4.0," says the Managing Partner of Dr. Boy.

As an example, the SME demonstrated the use of an Igus four-axis robot on a Boy 35VV (Fig. 3). "The compact unit is less expensive to purchase than the handling units of many competitors, but can still be used for a wide range of tasks," says Schiffer. In the trade show applica-

tion, the robot, mounted on the rear machine table, took freshly molded silicone baking forms out of the open mold with a 3D-printed gripper hand, and placed the hot forms on a conveyor belt as cooling zone.

Boy also recently introduced its own handling unit with three servomotor linear axes into its sales program. The LR5 linear robot, which is available in various sizes, is the company's own development and was to be seen on several exhibits. The Procan LR5 control system of the handling system works hand-in-hand with the control system of the injection molding machine via a Euromap interface.

IML System for Small Parts

A highly dynamic system for IML decoration of top-quality coffee capsules of PP with an aroma-protecting EVOH barrier layer was developed by Beck Automation (Fig. 4). "The challenge of such a small package lies in the precision of insertion. We are talking about very small labels and ultra-lightweight parts with extremely high production levels," explains Nino Zehnder, Marketing Manager at Beck Automation.

The part weight of the co-injection-molded coffee capsules is 1.35 g. The trade show exhibit, a cooperation with the Swiss machine manufacturer Netstal and

the mold maker Fostag, is a 4-cavity system. According to Zehnder, even higher numbers of cavities are possible. Beck Automation has already commissioned systems for 32+32-cavity stack molds. Cycle times of less than 5 s are said to be achievable, because the servoelectric-operated production machine Elion, with its high shot-weight precision, rapid closing movements and reproducibility is perfectly matched to the IML unit. In addition the system also includes a quality assurance module from IMDvista for testing the barrier.

Small Robots Control their Own Vacuum

The vacuum monitoring of the new LRX small robot generation allows part removal to be performed more energy efficiently, according to KraussMaffei. The vacuum monitoring is completely digital and includes the three functions, air saving, leak detection and blow-off. "With the air-saving function, the automation only generates as much vacuum as is required for the current cycle," explains Thomas Marufke, Managing Director of KraussMaffei Automation. In total, this could save up to 95% of the compressed air demand. The control system switches off the vacuum generation once a preset limit has been reached. If the vacuum level falls during



Fig. 4. With IML decoration of coffee capsules, the insertion precision of small labels at high speed is crucial (© Beck Automation)

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Fig. 5. The Wemo Tandem Concept includes two robots on a linear axis (© Wemo Automation)



the residence time, the set value is restored by a short pulse.

The leakage detection registers irregularities in the automatic start-stop function and reports them immediately back to the MC6 control system. The control system signals leaky vacuum circuits or defective suction cups at an early stage. "The vacuum monitoring acts as an additional prewarning system and supports the predictive maintenance of the system," says Marufke. The blow-off function assists the controlled deposition of small parts on the conveyor belt by selective blow-off. That in turn increases the efficiency in the production cycle and optimizes the automation process.

The new LRX50, LRX100 and LRX150 from KraussMaffei, according to the manufacturer is characterized by its progressive design with decentralized switch cabinet concept and freestanding X-axis. They offer high flexibility for retrofitting sensors or extending media circuits. Rack drives instead of toothed belts additionally offer high precision for rapid movements of all axes.

Tandem Robot on One Axis

The cost-effective design of production often requires additional sequences outside the injection molding machine. Examples of this are the assembly, testing and packaging of components. For these applications, the movements of the robot

can be an obstruction to achieving the desired cycle time. As a solution to this, Wemo presented a tandem concept. This consists of two robots on the same basic axis (Z-axis), which share the necessary process steps (Fig. 5). In comparison with other solutions, for example with robots set up in the cell, valuable space is gained in the limited production area.

With Wemo Connect (WIAP4.0), the Swedish automation specialist permits a software module to be easily connected to the robot or the injection molding machine via an internal WLAN connection or a 3G/4G network. For example, the current availability status can be read out, as can the number of articles produced or the interruptions that have taken place. The aim is continuous monitoring and direct control of production to improve the user's competitiveness. At Fakuma, all Wemo robots were connected to mobile phones and tablets for presentation purposes.

Pressure-Tight Hybrid Component with 57 Inserts

Even without robots at the trade show booth, there were impressive exhibits, whose manufacturing processes would be inconceivable without automation – often at unprepossessing booths of processors, the biggest group of exhibitors at Fakuma. As one of (according to the exhibitor directory) roughly 400 compa-

nies that are involved in manufacturing technical parts, semi-finished products and reinforced plastic products, Huonker GmbH presented a hybrid component of plastic and metal. 57 Inserts are embedded in a black plastic housing with standardized screw thread (Fig. 6).

The challenge in the manufacturing process is that all 57 inserts, comprising three different variants and being fed as bulk material, must be placed in the correct position in the injection mold. For this purpose, three "pick and place" units equip a template in the automation with a cycle time of less than 1s per contact. The pre-equipped template then transfers all 57 contacts in an ordered manner to a robot, which in turn equips a linear handling unit. The latter is precisely oriented with respect to the mold with sensors before it inserts the metal contacts into the mold in one stroke. The correct positioning of the inserts is monitored with a camera.

At the start of the project, the first series parts are produced still as manual inserts with semi-automatic processes. "Due to the multistage automation, we can adjust the production rate flexibly to satisfy increasing numbers of customers," explains Project Manager Dirk Wehrle. The further requirements, too, are remarkable. For example the hybrid part can be pressure-tight up to 58bar, and can therefore be used for electrical rotary drives in explosion-protected zones. ■

Dr. Clemens Doriát, Editor



Fig. 6. 57 metal contacts are positioned precisely in the mold before overmolding

(© Huonker)