TECHNICAL PAPER
Altdorf/Landshut - Germany, August 2019

Efficiency and quality gains through automation

While actually up to about 90 percent of the moldings made of plastics are produced in a fully automatic process, including the parts handling and postprocessing, the production of moldings made of elastomer materials lags far behind, albeit with a strong upward trend. The driving factors for the catching up of the elastomer sector is, on the one hand, the steadily increasing know-how with gripping and manipulating elastically evasive parts, and on the other hand, the price pressure with simultaneously increasing quality demands. LWB-Steinl took this trend into account in 2017 by founding "LWB Automation GmbH". There, the agendas were transferred from the parent plant and expanded by their own competencies.

The elastic reaction of a molded part on the force of grippers, suckers or compressed air and the high temperature level of rubber parts during the demolding process are challenging conditions for the handling of elastomer moldings. Nevertheless, small parts such as O-rings or sealing washers hardly pose any problems for the automation engineer. They are manufactured on small to medium-sized horizontal machines with multi-cavity tools and are demolded using automatic brushing devices with rotating roller brushes. This has been the general standard for many years and no longer needs a deeper description.

Different is the production of larger and more complex molded parts. Here, the automated handling is still far from a comprehensive application. Mainly because, and there is no difference to plastic injection molding, any automation equipment pays off only on a certain minimum lot size, which is often not achieved. And: The layout of handling devices for up to around 180 °C hot rubber parts requires much more unconventional approaches than comparatively dimensionally stable and cooler plastic parts. Nevertheless there is a growing number of innovative concepts to drive to increase the competitivity and constancy of rubber parts productions. But, an analysis of such projects shows that the key to success is the close cooperation of all project partners, from the compound manufacturer to the part design engineer, the machine or tool manufacturer to the part producer. But all cooperation would be nothing, without the flexibility of the partners, getting involved in the ideas and experiences of the other side and being ready to adapt their project share.

The following the injection molding machine manufacturer LWB-Steinl presents four examples out of his plant engineering giving insights into the technical status and the already existing possibilities for handling automation for elastic molded parts.

Application example 1:
32 precision rubber tubes, produced and postprocessed in 180 seconds

As mentioned above, an automation system pays off only based on a certain minimum production volume. It is determined by the unit cost, the required part quality and the planned output per cycle.

For the high-volume-production of 30 cm long precision rubber tubes with a 32-cavity mold including by a series of post-processing operations, it was obvious that with the cycle time of 180 seconds this capacity level could only be achieved by automating the part manipulation. The solution was a dedicated manufacturing cell. The basis for this was a vertical injection molding machine with an injection mold, in which the 32 tubes are arranged in 8 rows of 4 cavities. The vertically oriented pipes are injected via a 32-fold cold runner injection system feeding 32 gate distributors at the upper pipe ends. For demolding the lower mold half is moved out laterally from the vertical machine. There a 32-fold take-over-head on a linear handling device grips the 160 ° C hot moldings on the sprue-sided ends of the moldings protruding from the mold cavities. The in eight rows on the gripper head hanging tubes are then removed step-by-step a four parts each by a pick-and-place-handling and placed on a clocked conveying line. On the conveyor they pass a cooling section to stabilize and solidify their length and the sprue end. This creates the condition for a clean sprue separation for cutting with a guillotine (Fig.1, 2 and Fig.3a + 3b).

Photo: LWB-Steinl

Fig. 1: 32-fold gripper head with 3 clamping prisms per cavity for removing tubular rubber parts from an injection mold.

Photo: LWB-Steinl

Fig.2: 32 rubber precision tubes are removed from the injection mold by means of a transfer head. From this, a pick-and-place handling takes in a step-by-step mode each four pipes and places them on a cycle conveyor for post-cooling.

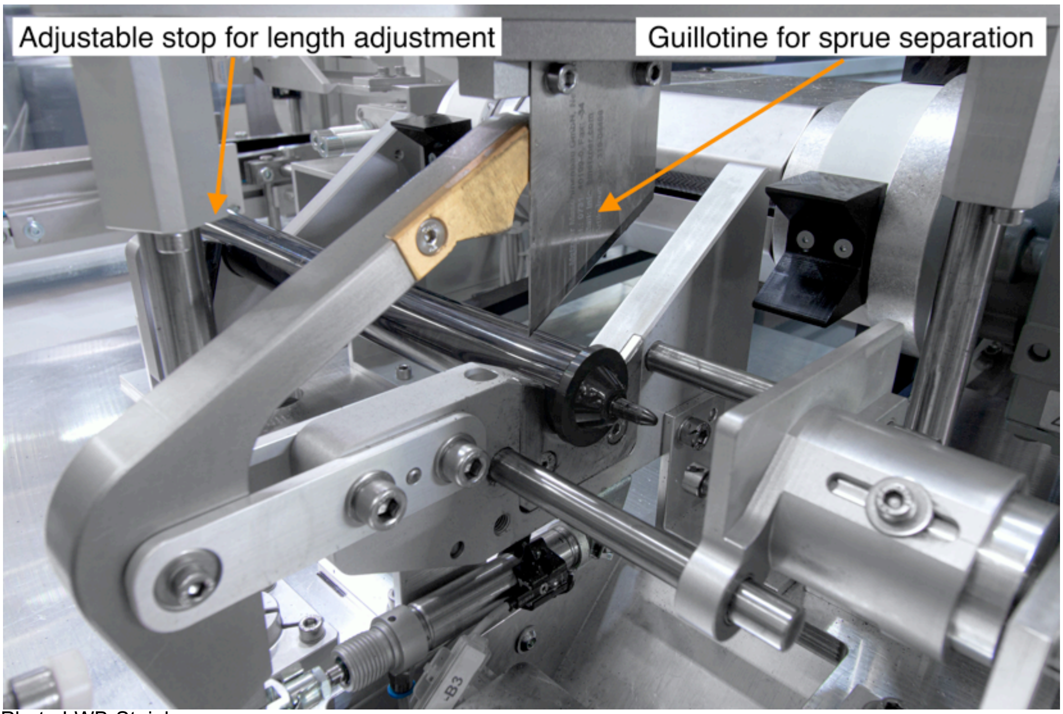


Photo LWB-Steinl

Fig.3a: Rubber tube in length measuring and alignment station with attached guillotine sprue cutting device.

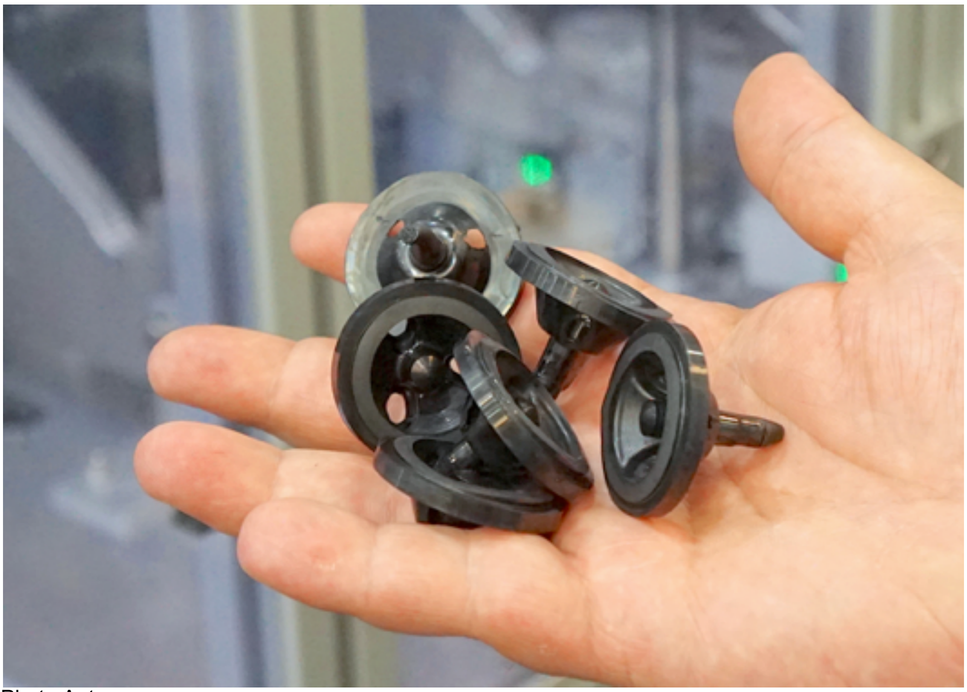


Photo Autor

Fig.3b: Sprue caps, separated by a guillotine knife

Subsequently, another small-scale handling transfers each molded part individually to a conveyor belt with which it is passes an ink-jet printing station for adding a product identification and finally is transferred to a finished parts container (Fig. 4 and 5).

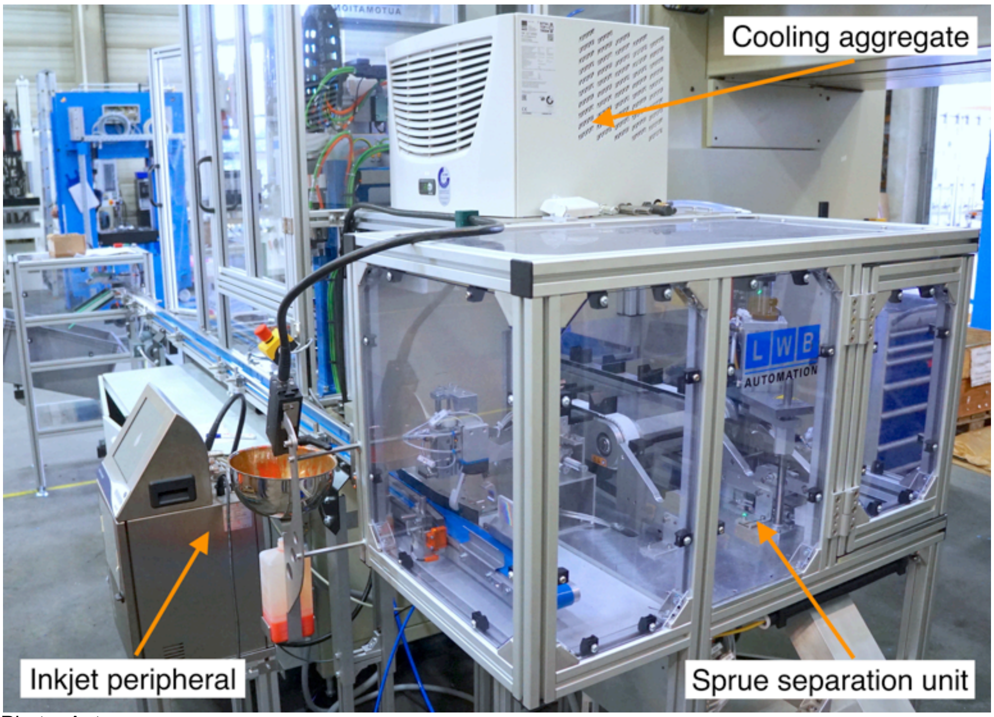


Photo: Autor

Fig.4: Air conditioned processing station for spue separation and ink jet printing on moldings

Photo LWB-Steinl

Fig.5: The automation cell requires only slightly more footprint than the vertical machine and is combined with this in a compact unit.

Application example 2: 48 rubber plates automated demolded

That even higher output numbers per cycle can be handled proves the next example, which shows the large-scale production of base plates for the roof mounting of solar modules with an 48-cavity mold. This, because from the beginning the maximum possible reduction in production costs was prioritized. Therefore, it was decided not to cover the required production capacity by four 12-fold or two 24-fold injection molding units, but by a 48-fold production unit. It was clear from the outset that the resulting parts quantities could not be handled manually, not least because of the resulting large tool size.

The fact that the automated alternative could be realized surprisingly simply despite the large number of moldings per shot is shown in Figures 6, 7, and 8a   b. The key idea was to place the moldings in the tool in eight rows of six moldings each "standing" and thus maximally space-saving. Another trick was to design the cavities in such a way, that at the opening of the injection mold, the rubber moldings protrude so much from the side cores cavity inserts of the base tool, to allow the gripping by the transfer head. After gripping the moldings, the side cores are opened and the mold base is lowered, so that the gripper head can be driven out of the mold area. The gripper head is moved on a carriage on a support construction horizontally mounted on the back of the machine frame. On that the gripper head it is moved in shuttle mode between the machine and the finished parts drop-off area.

Photo: LWB-Steinl

Fig.6: Handling automation on a vertical machine with tie bar unit for removal of 48 EPDM shims for solar modules via a linear handling designed in frame construction.

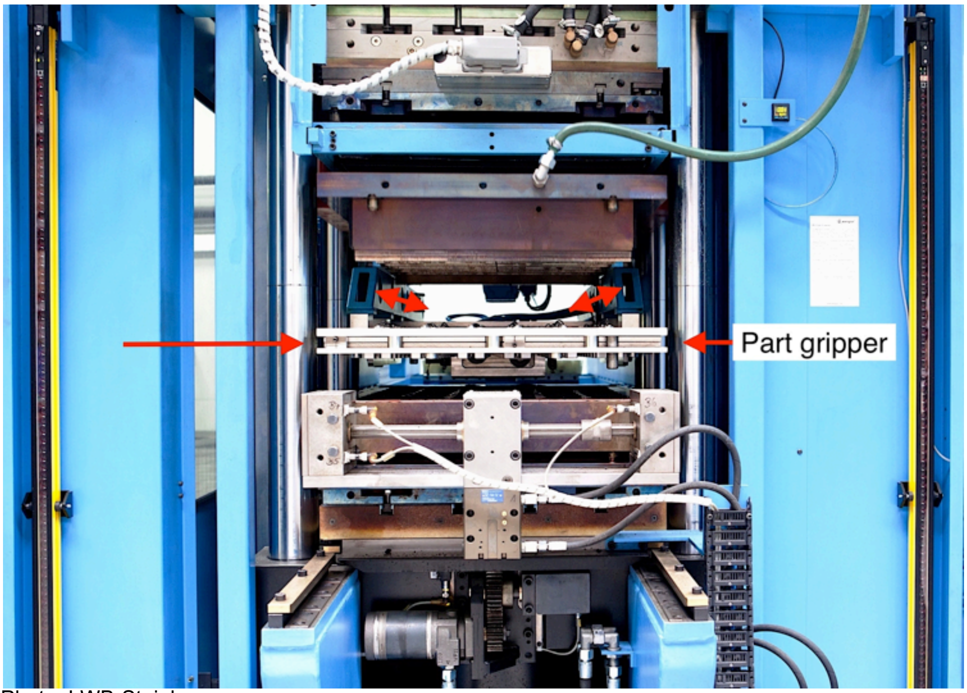
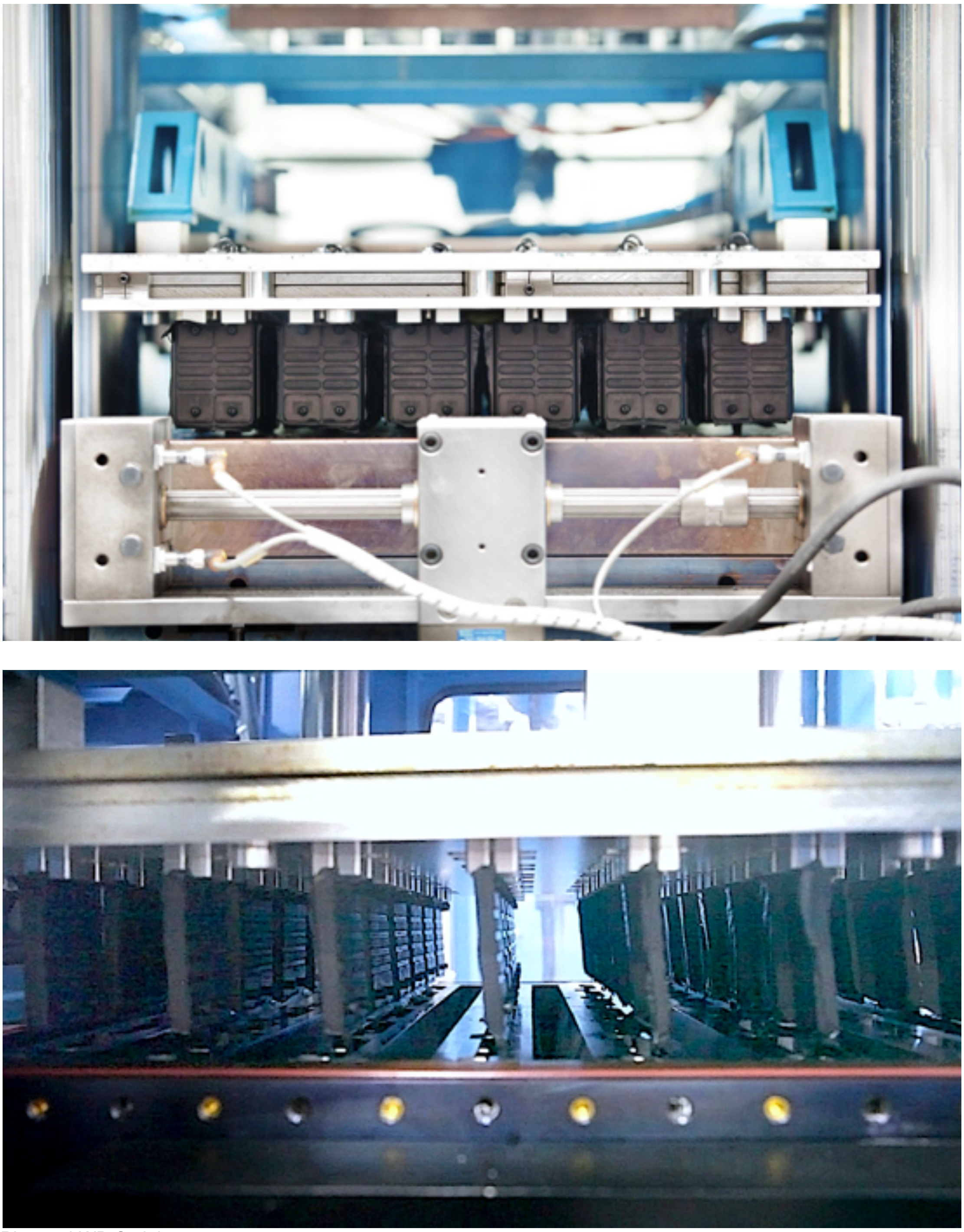


Photo: LWB-Steinl

Fig.7: Detail view of the gripper frame in the forward-position between the mold halves.



Photos: LWB-Steinl

Fig.8a + b: Detailed views of the frame gripper head for removing 48 moldings arranged in eight rows of six each. Each row of fittings is gripped on the edge protruding from the top of the cavity inserts. Then the mold inserts are opened and lowered the injection mold. Then the gripper frame with the moldings moves horizontally out of the machine and drops it over a container.

All in all, the very "lean" and nevertheless functionally reliable automation for a large-scale production is a prime example of the aforementioned need for an interdisciplinary coordination between all project partners involved.

Application example 3:
Metal / rubber composite parts fully automatic produced

A no less demanding automation task is the production of metal / rubber composite parts, such as conventional shaft seals, vibration dampers or engine mounts. For their production, vertical machines with tie-bar-less C-frame clamping units offer the best ergonomic conditions for co-working with a handling robot because no tie-bar has to be by-passed. As a result, the handling robot used for the part transfer between the inserts supply and the finished parts storage buffer station can be executed as a simple linear device. It can be attached to the fixed upper machine plate and protrudes laterally over the peripheral stations (Fig. 9).

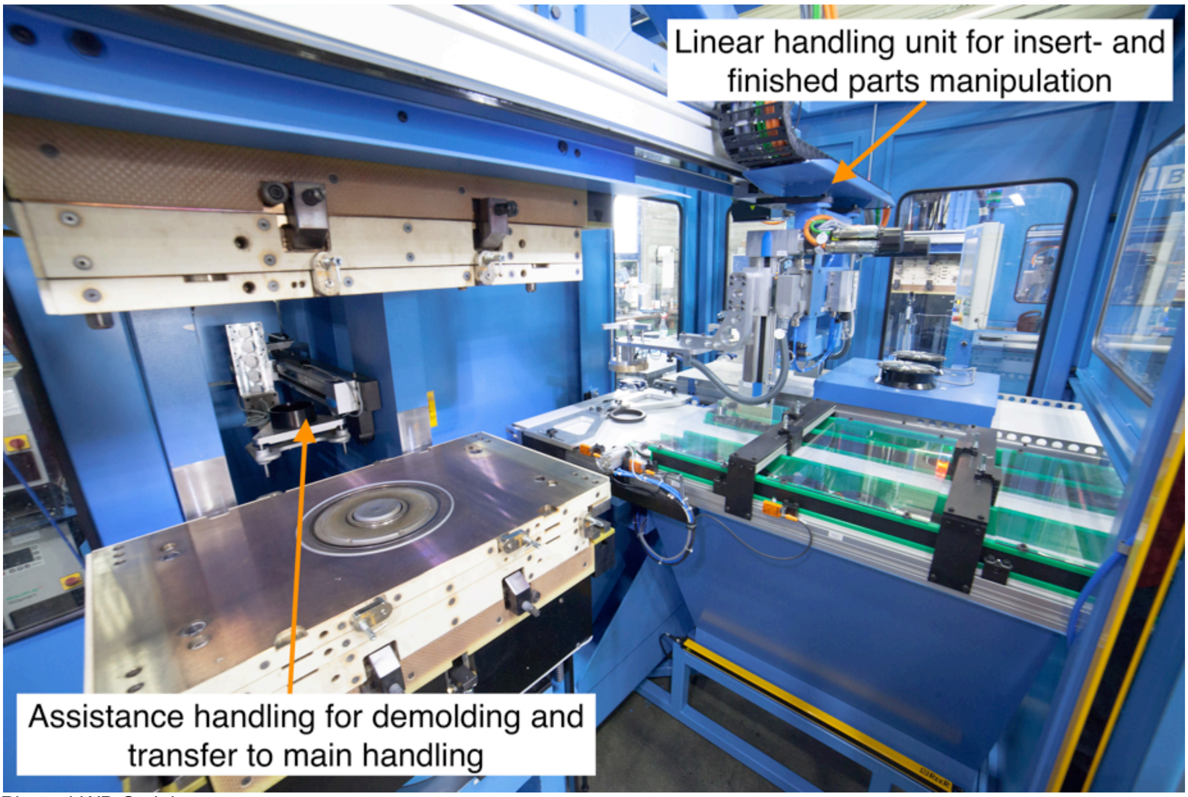


Photo: LWB-Steinl

Fig.9: Automated insertion of metal rings and take-out of finished parts by a linear robot on a vertical C-frame injection molding machine.

The linear handling device is equipped with two gripper heads. One to pick up the metal parts from the supply station and insert them into the injection mold, the other to take over the finished parts and place them on a post-cooling resp. an inspection station (Figure 10). Following the customer's request, the metal-ring feeding-task should be executed manually. In order to allow a multi-machine operation there had to be integrated buffering lines for insert part and finished parts had to integrated. This was solved by the addition of adjustable buffer conveyors. In order to keep the feeding of the inserts as simple and flexible as possible, at the loading positions replaceable contour templates were provided. They ensure the correct orientation of the metal inserts (top / bottom) (Fig.11). The finished parts are also stored on a timed conveyor. They pass on the way to the unloading position a cooling tunnel. There they are manually inserted in logistics boxes resp. stacked there. Alternatively to the manual operation, automation devices could be also added for both the insert task and the finished part removal.

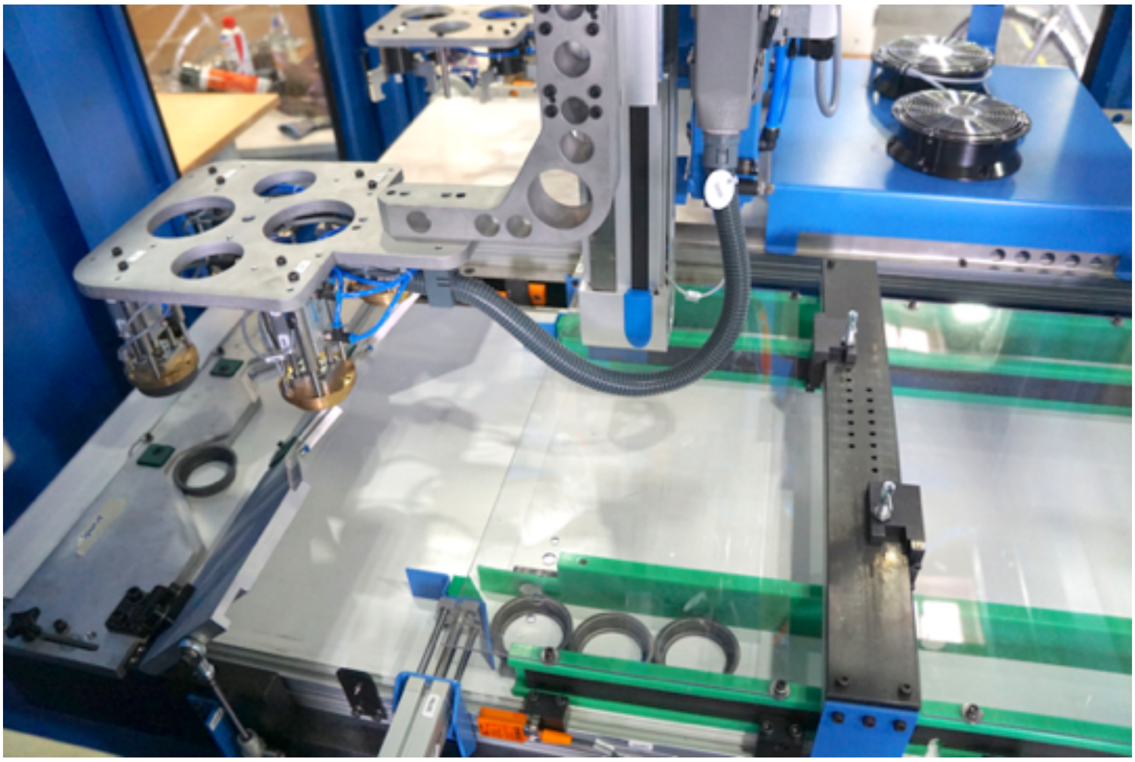


Photo: Author

Fig.10: Detailed view of the timed conveyor station for the provision of metal rings (in the foreground), followed by the finished parts area with post-cooling station.

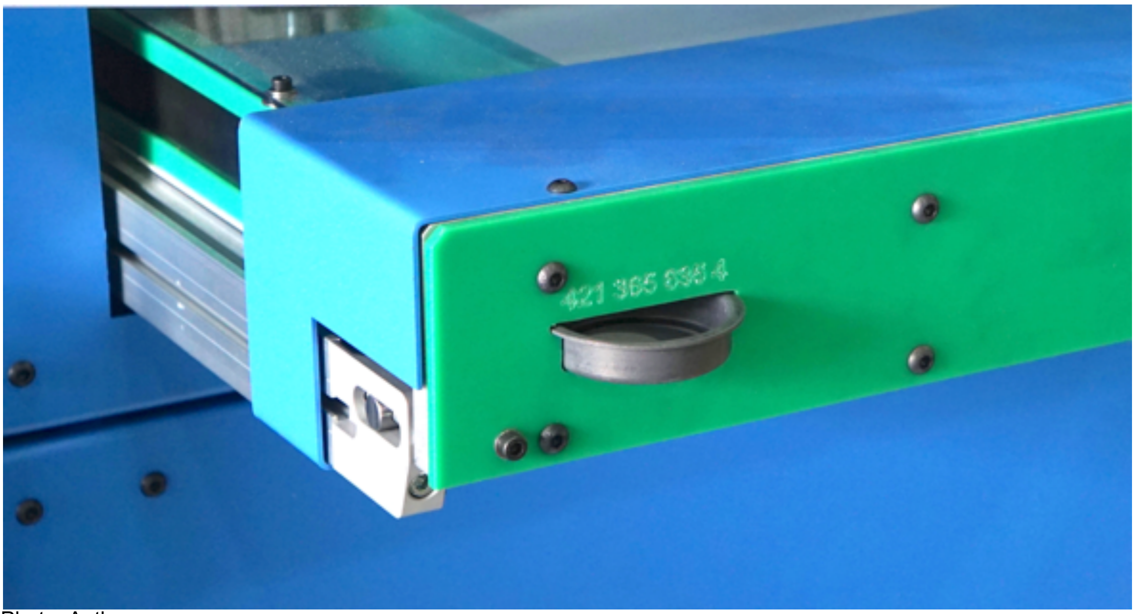


Photo: Author

Fig.11: Insertion interface for the metal ring of a shaft seal for an automotive engine. By changing the silhouette-pattern and the width adjustment of the following buffer line the conversion from one product dimension to the other can be made quickly and with little effort.

A second linear handling, installed in the passage between the two C-frame elements, assists with the press-out of the finished parts from the cavity and the subsequent transfer to the main handling.

Such production cells are available in a full range of designs, from flexible, easily convertible to highly specialized, single-purpose designs. All systems are "all-in-versions" with the machine and the periphery in a protective housing (Fig.12).

Photo: LWB-Steinl

Fig.12: Shaft seal manufacturing cells for production with 1-, 2- or 4-cavity injection molds.

<u>Application example 4:</u>
Fully automatic production cell for plastic/elastomer-2-component shaft seals

As a pilot project with future potential, LWB-Steinl presented at the K-2019 an enhanced version of its two-machine-production-cell for the fully automatic production of a novel, metal-free 2-component shaft seal, designed in cooperation with the LWB-Automation subsidiary. The new shaft seal consists of a housing ring made of glass fiber reinforced PA 6.12, replacing the traditional metal version of the outer ring, and an injected-onto elastic ring profile made of EPDM 70 Shore (Fig. 13).

Photo: LWB-Steinl

Fig.13: 2-component shaft seal consisting of an outer ring made of a glass fiber-filled PA 6.12 and an inner ring made of EPDM rubber.

The Polyamide-ring molded on machine one is removed by robot, then placed in a surface activation station and after that inserted into the elastomer injection molding machine. The EPDM is injected from the center via an umbrella sprue, which is to be removed afterwards. For this purpose, after passing a cooling section, the 2-component part is inserted by robot into a subsequent mechanical processing station (parting station). On its way from the cooling station to the take-over interface the shaft seal passes an inkjet printer for adding a QR code identification. After the sprue has been "cut off", in a second milling operation the contour of the sealing profile is finished to a precision dimension (Figs. 14 and 15).

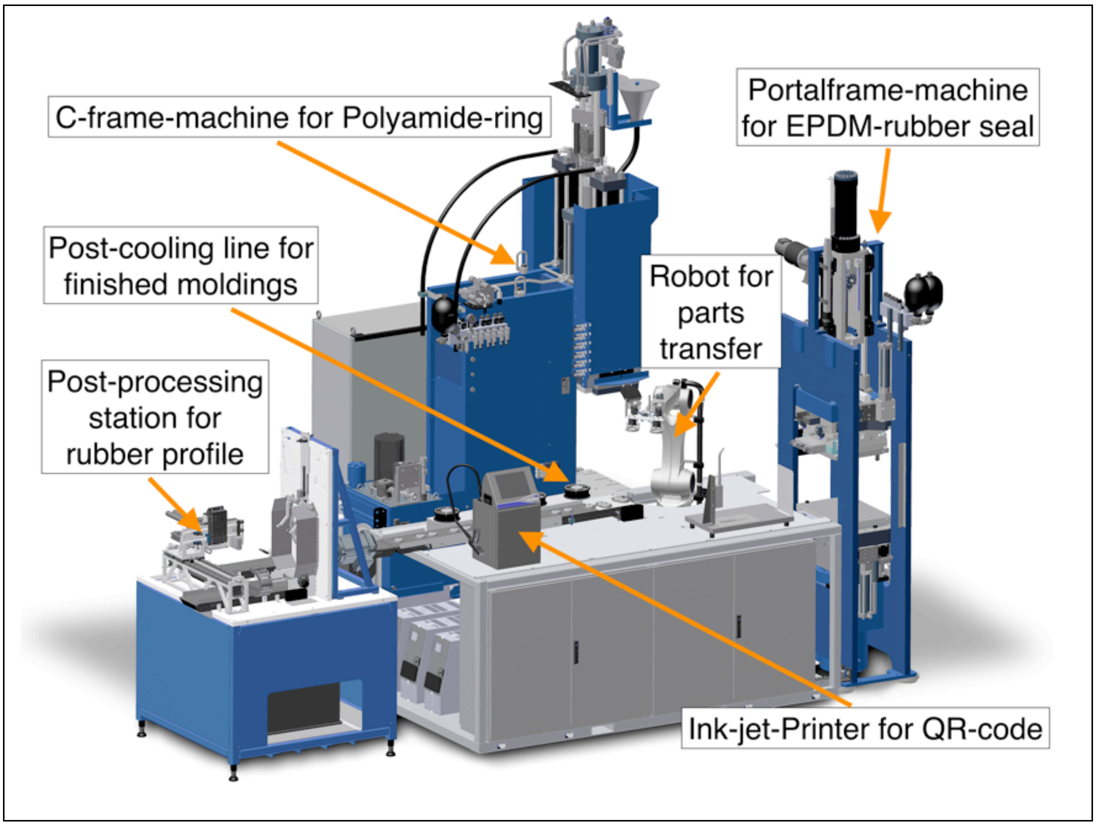


Photo: LWB-Steinl

Fig.14: Production cell for the production of a plastic/rubber shaft seal.

Photo: LWB-Steinl

Fig.15: Total view oft he interlinked production plant in which a VCRS 500/115 C-frame machine with thermoplastic injection unit in combination with a VRF 1100/160 portal frame rubber injection molding machine fully automatically produce a plastic / rubber composite part.

Since the entire system is consistently modular, it is not limited to this one machining task, but can flexibly take on a whole range of post-processing tasks (Fig.16).

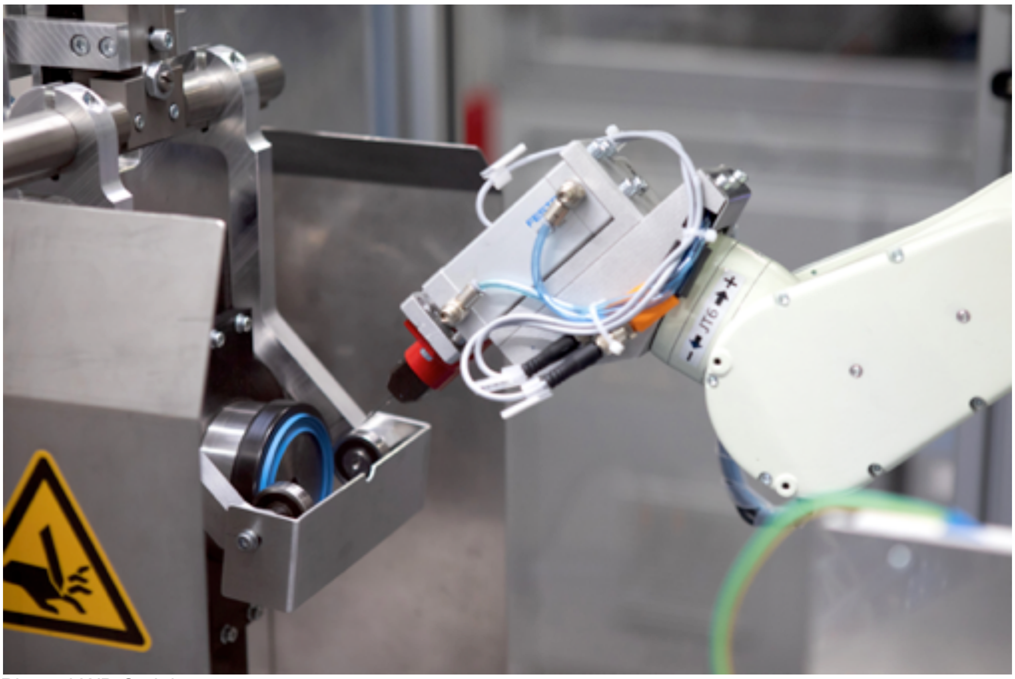


Photo: LWB-Steinl

Fig.16: Fully automated "cutting off station" for re-working the EPDM sealing profile (blue component).

Efficiency Potential "Rubber Production Automation"

Peter Radosai, Sales Manager of the rubber injection molding machine manufacturer LWB-Steinl in Altdorf / Landshut sums up his visions about the future of for elastomer parts production: "Driven by increasing international competitive pressure we are confronted with a steadily increasing demand for automation solutions for rubber parts production. This motivated us to found the "LWB Automation GmbH" in Weinheim, which focuses exclusively on automation tasks. We believe that elastomer injection molding will see the same degree of automation in the near future as in today's plastic injection molding industry. And we have already today suitable solutions and equipment, which we are constantly expanding."

■■■

About the Steinl-Group

Founded in 1962 by Alfred Steinl, the family-owned company is today one of the world's leading manufacturers of rubber injection molding machines. At the headquarters in Altdorf near Landshut approx. 250 machines are built each year by round-about 250 employees.

The product portfolio covers the comprehensive range of rubber and plastic injection molding machines, from vertical C-frame machines to vertical 4-column or plate-frame machines, to horizontal, tie-bar and C-frame machines. In addition, "batch-off systems" are also manufactured for production-compatible storage of rubber compounds.

Altogether, the Steinl Group currently consists of eight companies, which are clustered in four divisions. The largest division is mechanical engineering, consisting of the LWB elastomer injection molding machine construction, the conveyor belt vulcanizing machine manufacturer Vulctech, the LWB automation, the batch-off cooling line manufacturer Prodicon Ind. Srl and the injection molding machine manufacturer URP (United Rubber & Plastic Machinery Ltd in Langfang / China. In the stamping division STG-Carrier GmbH manufactures metal scaffolding strips for automobile door profiles. The third division is sealing and bonding technology with Dreibond GmbH, a manufacturer of adhesive systems and the consequent application technology. The fourth division is biomaterial production with the company Biofibre.

Technical Details
Peter Radosai – Sales Manager for Europa
E-mail: peter.radosai@lwb.de.com

Press Contact
Christina Lebeus – Marketing
E-Mail: christina.lebeus@lwb.de.com

Author:
Reinhard Bauer – TECHNOKOMM
E-Mail: office@technokomm.at