

The Injection Molding Machine 4.0

Efficiency through Networking: The Injection Molding of Tomorrow

As the leading international trade fair prepares to open its doors, the plastics industry has armed itself for the future with a host of novelty developments and technological innovations. The focus of many innovations is the “Internet of Things”. Injection molding machine makers, especially, are pressing ahead with the various aspects of “Industry 4.0” and implementing them in new series, peripherals and controllers.

The Author

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The injection molding machine is a key element of many production lines and is increasingly interacting with various upstream and downstream production steps. The resulting increased demands on machine, peripherals and networking can only be met by innovative, practical solutions. For continued economical production into the future, existing machine designs need to evolve and new developments must be forthcoming. This is the only way for manufacturers

of injection molding machines to prevail in the face of national and international competition in the years ahead.

Once again, all leading injection molding machine manufacturers will themselves be exhibitors at the K show. The following represents a cross-section of the pre-announcements made by the main sector protagonists. This year, most suppliers at the trade fair will be concentrating especially on issues such as Industry 4.0 and production efficiency.

Sumitomo (SHI) Demag Fast, Faster, Fastest

The booth of Sumitomo (SHI) Demag Plastics Machinery GmbH, Schwaig, Germany, will feature two high-performance El-Exis SP machines for packaging applications. By virtue of its “speed compression” – compression at the highest speed of mold and injection movements – the El-Exis SP 420 (**Fig. 1**) will show that efficiency gains can still be made even in the extreme thin-wall sector. The machine will produce four polypropylene trays per cycle in a 2+2 stack mold. This is accomplished by means of the injection compression function in which the melt is introduced into the cavity before the mold is fully locked. The clamping movement of the machine promotes distribution of the melt in the cavity, reduces the demand for injection pressure and hence for clamping force while ensuring uniform pressure distribution and lower residual stresses in the finished part.



Fig. 1. An El-Exis high-speed machine produces trays by high-speed injection compression

(© Sumitomo (SHI) Demag)

An El-Exis SP200 will produce four decorated cups in a cycle time of less than 2s in a 4-cavity mold. Sumitomo (SHI) Demag believes that the two exhibits will be the fastest machines for producing decorated cups with injection compression function at the show. Current El-Exis SP models are available in clamping forces ranging from 1500 to 7500 kN and all are equipped with an OPC/UA interface for connectivity in accordance with the standards of Industry 4.0.

In addition, an all-electric IntElect 450 will produce crystal-clear polycarbonate headlight covers in a highly efficient production cell. The exhibit is intended to highlight the benefits of all-electric concepts for injection molding larger parts and is seen as confirming the “Automotive Goes All-Electric” trend. The smaller 500 kN IntElect will be unveiled for the first time at the trade fair, with an as-yet unpublished innovation.

➤ **Hall 15, booth D22**

**Arburg****Flexible Manufacturing Systems**

With twelve machines on its own booth and 15 others on partner booths, Arburg GmbH + Co KG, Lossburg, Germany, will be demonstrating innovative applications, processes and turnkey solutions. Aside from injection molding machines, the company will be presenting its own automation solutions, with a focus on efficient production of plastic parts, consistent lightweight design and Industry 4.0. Specific sector solutions for the packaging industry and medical technology are intended to reveal the potential of the company's latest developments.

Current machines already operate at a very high level of efficiency. So, to boost efficiency, injection molding machine makers, such as Arburg, are restructuring production by developing the so-called "Smart Factory" in which flexible production systems are networked together (**Fig. 2**). The Black Forest-based machine maker will be demonstrating the potential of Industry 4.0 with an application (details of which have not been released) comprising an vertical Allrounder 375V networked to an additive-manufacturing machine (type: Freeformer).

With its Golden Electric product series, launched just six months ago, Arburg has achieved substantial advantages in the cost of producing the machines by using standardized components with a fixed combination of clamping surface, clamping force and size of the injection unit. This all-electric entry series is available in the four sizes 370, 470, 520 and 570, with clamping forces ranging from 600 to 2000 kN. At K2016, an Allrounder 470E Golden Electric with 1000 kN clamping force and a 290-size injection unit will produce a technical part.

At the K show three years ago, Arburg marked its entry into industrial additive manufacturing of plastic components with the launch of the Freeformer. This year, practical developments, such as an improved air and temperature control in the build chamber will illustrate the increasingly exploited potential of plastic freeforming.

» **Hall 13, booth A13**



Fig. 2. Arburg develops flexible manufacturing for networked production in the smart factory

(© Arburg)

Engel

Machines with High IQ

Industry 4.0 is all about the smart factory, in which the various production machines and their components communicate with each other and continuously optimize themselves. The outcome is marked increases in productivity, efficiency, and quality and flexibility of production. Under the banner "Inject 4.0", Engel Austria GmbH, Schwertberg, Austria, will be focusing on three areas: smart machine, smart production and smart service.

Self-adjusting, decentralized systems composed of smart machines boost process capability, without the operator having to acquire additional specialized knowledge. The iQ software solutions make it possible to detect deviations in critical process parameters and to actively compensate before scrap is generated. While "iQ weight control" keeps the injected melt volume and viscosity constant throughout the injection molding process, including the holding phase, "iQ clamp control" monitors mold breathing and continually adjusts the clamping force automatically. Even if the environmental conditions should change or the pellet quality vary, these software solutions keep the process constant and ensure consistently high product quality.

Engel will also present a development of its Engel e-floMo electronic temperature control water manifold, which selectively controls

the flow rate or, optionally, the temperature difference. The new "iQ flow control" software automatically adapts the pump speed of the temperature control device to current needs. While e-floMo increases process stability, the automatic speed control reduces the power consumption of the temperature control.

With its "smart service" module, Engel has tackled the issue of predictive maintenance that is a typical challenge for injection molders. The Austrians have developed a measurement system for plasticizing screws so that wear parameters can be determined during operation. The measurement takes just a few minutes – in the past, checking of large molding machines would have taken two working days of downtime to remove, clean and measure the screw.

The "Engel e-connect.monitor" also monitors machine components which have not been a focus of maintenance up until now. Consequently, the user can at any time check the condition of spindles that actuate the axial movements in electric machines. On request, the software can be programmed to automatically trigger an order for a spare part and to book a service technician to deal with a critical situation.

As for machine-side innovations, the system provider will be demonstrating seven



Fig. 3. The MES "e-factory" enables process and status data to be monitored at any time and to get the best use out of available machinery (© Engel)

highly integrated and automated production cells. All cells are networked using Engel e-factory (Fig. 3), Engel's own MES (Manufacturing Execution System). This makes it possible to view the status and process data and to compare them against quality or business metrics. QR codes afford a way of tracking individual quality variables and product-specific process data. To this end, plastic parts injection molded on the stand will be given an individually generated QR Code, which will enable visitors to get information via the Internet about the process conditions in which the molded part was made.

➤ **Hall 15, booth B42 and C58**

Ettlinger

Maximum Filtering Effect, Minimum Melt Loss

Efficient production of large moldings requires both melt filters for efficiently removing contaminants and energy-optimized injection molding machines. Ettlinger Kunststoffmaschinen GmbH, Königsbrunn, Germany, supplies its srm two-platen injection molding machines (Fig. 4) in a clamping force range of 2000 to 30,000 kN and shot volumes of 5000 to 160,000 cm³. The structural separation of melt compounding and injection unit is more conducive to energy-efficient operation than is possible with machines of conventional design.

Designed for parts weighing upwards of 1000g and wall thicknesses of 2mm and more, typical applications include the production of pallets, fittings and manhole and sewage systems made from new, regenerated or regrind materials. Thanks to a combination of compact plasticizing unit and short

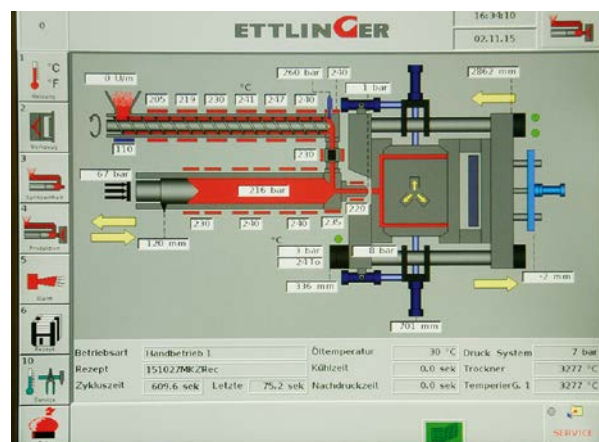


Fig. 4. All processes of the srm injection molding machine are controlled and visualized via a high-performance touchscreen controller (© Ettlinger)

clamping unit, the machines take up relatively little production space. Increased productivity and significant cost savings can be achieved when processing highly contaminated melt into large, heavy yet high-quality

moldings by installing an ERF melt filter (also from Ettlinger) after the plasticizing unit and before the injection unit of an srm-molding machine.

➤ **Hall 9, booth E24**

**Dr. Boy****Process Data on Cell Phones**

Dr. Boy GmbH & Co. KG, Neustadt-Fernthal, Germany, believes that standard machines with multifunctional features – some with tailored automation solutions or packages for optimizing setup times – are the focus of customer interest. The company is also addressing current topics, such as the Internet of Things and machine networking. Applications featuring multi-component technology, injection blow molding and medical technology will also play a role.

Two robots collaborating in a production cell will make the human-machine interface an exciting experience for visitors. A Boy 35EVV will produce transparent glasses which will then be removed by a robot, individually labeled with a name and filled. A second robot will hand the beverage to the trade-fair visitor. A special feature of this type of collaborative robot technology is the omission of hitherto obligatory safety fences.

The current possibilities of machine networking and data availability will be demonstrated with the aid of an app developed by Boy (**Fig. 5**). The data from the trade-fair machines will be collected and sent to a server via an internet connection. The Status app (<http://status.dr-boy.de>) will enable users to view the current machine data of the exhibits on online mobile devices – in real life: this would be the current status of machines in its factory. Data transmission here is made possible by the Procan Alpha controller of the injection molding machine, which has a digital output to the online world.

To illustrate its expertise in micro-injection molding, a Boy XS will produce parts of a micro rotary engine with a shot weight of only 0.08 g. The small screw diameter (8 mm) supports shorter dwell times of the material in the plasticizing unit and faster flow rate of the material (following the first in/first out principle). As a result even heat-sensitive materials can be processed.

In a nod to the ongoing strong trend toward product customization, Boy will be making 3D mold inserts by additive manufacturing. Printed in just a few



Fig. 5. An app allows visitors to retrieve machine data uploaded by Boy to a server (© Dr. Boy)

hours, the inserts support the production of different geometrical components in the downstream injection molding process. The technology utilizes Boy's own tool-changing

system, which is now also available for the Boy 25E and 35E series. This system allows for the inserts to be changed within few minutes.

➤ **Hall 13, booth A43**

Haitian

Versatile Standards

Haitian International is concentrating its product portfolio on dedicated solutions that extend the capabilities of standardized processes and optimize the price-performance ratio. Frequent mold or color changes, increasingly short product life cycles and small "on demand" batches require even more flexibility from processors and greater ability to respond at competitive machine-hour rates. Haitian will address this with three exhibits.

A Zhafrir VEI3000/1700P integrated into an automated cell by the two French specialists Sepro Robotique and Machines Pagès will produce IML cups in 4.4 s. The all-electric machines from the Zhafrir Venus II series have been specially adapted for packaging applica-



Fig. 6. The Zhafrir Zeres series combines the all-electric Zhafrir Venus II series with the advantages of servo-hydraulic drives (© Haitian)

tions with cycle times over 4 s. The machines have been designed with a square-shaped platen geometry to give more room and a modified machine bed for more stability in the case of heavy multi-cavity molds.

The Zhafrir Zeres series (Fig. 6) adds an electric machine with integrated servo hydraulics. The range is therefore suitable for

complex parts made in molds with core pulls. Otherwise identical with the series Zhafrir Venus II, the Zhafrir Zeres series is a combination of hydraulic and electric standards. At the K show, a Zeres with 3000 kN clamping force will produce medical pipettes in a 192-cavity mold in 9 s.

➤ **Hall 15, booth A57**

Negri Bossi

Toggle Levers with Effect

With the Project ELE all-electric injection molding machine, Negri Bossi SpA, Cologno Monzese, Italy, will be unveiling new opportunities in packaging and medical technology. The technical performance of the injection molding machine and a new control system have been the focus of its ongoing development work.

The new "smart flex 2" clamping unit has been specially modified with a toggle geometry for electric drives and optimized for appli-

cations that require rapid movement and high reproducibility. There are eleven models available in clamping forces ranging from 500 to 6500 kN. The Tactum multi-touch control offers new, integrated features. In addition to industry-standard remote access, the multi-touch display supports a built-in camera and new gesture control. This allows totally new control operations, which can be implemented across the various series.

On display will be two "X concept" clamp units, an 8500 kN clamp unit with hydraulic actuation and a 7200 kN unit with electric actuation. The locking concept is designed to combine the characteristic advantages of toggle levers with the space-saving design of 2-platen machines. The injection molding machine with 8500 kN unit will showcase technologies and developments that will occur in future series.

➤ **Hall 15, booth B22**

Husky

Bottle Closure Lines from a Single Source

Husky Injection Molding Systems Ltd., Bolton, Ontario, Canada, has taken its products to a new stage of development. Through special designs of injection molding machines, molds, hot runners, auxiliaries and control software, the system provider claims to have increased productivity while reducing energy consumption. Here, Husky is exploiting the fact that all these components for a functional production cell are developed and manufactured in-house.

With the development of HyCap 4 (Fig. 7), a system for producing bottle closures that will be premiered at K, the manufacturer has slashed energy consumption by 40% compared with the machines in the existing series. This saving has been achieved through the use of servo drives as well as the imple-

Fig. 7. The new HyCap 4 produces bottle closures while consuming 40% less energy (© Husky)



mentation of an electric clamp unit and energy recovery during the clamp stroke. At the same time, performance has not been sacrificed at all.

The new HyCap 4 offers built-in features that are designed to simplify operation of the injection molding machine, so that the skill levels of all individual operators can be accommodated. For example, ejector control

has been improved and sensor-driven, automatic mold alignment to reduce mold wear has been implemented. Further information on mold maintenance, process set-up and operation for each start-up is provided by Husky's patented Mold ID Technology, and will make daily life a lot easier in many injection molding firms.

➤ **Hall 13, booth A61**

KraussMaffei

Intelligent Machine Functions

The injection molding machine market is about to experience a further increase in energy efficiency. KraussMaffei Technologies GmbH, Munich, Germany, will be presenting its redesigned hydraulic concept for the

Under the clamping unit, the CX has space for peripheral devices and all kinds of demolding systems. KraussMaffei will be stressing the advantages of the 2-platen machine with the aid of special automation solutions, such as the

countermeasures automatically. In addition to melt processing, the expanded APC feature is now suitable for multi-component injection molding and processing of silicone.

Seamless traceability of components is also a focus of current applications at KraussMaffei. The company will illustrate this in a FiberForm application, which stores all quality-oriented process data (e.g. organic sheet heating curves or injection pressure curves). These are recorded in a database and individually documented on the component using QR codes.

The in-house DataXplorer, developed by KraussMaffei, is a new option for increasing productivity in plastics processing. This open system for detecting, analyzing and documenting comprehensive process data in injection molding and downstream stages can reduce the duration of system downtimes while improving quality and providing documentation at the same time, according to the manufacturer.

The methods of the fourth industrial revolution are also being brought to bear on service. Via a new interactive service platform based on the master computer interface Euro-map 77 and OPC UA, the user can retrieve all relevant machine data at any time. The user can access the current machine and production data at any time via the live-monitoring feature.

➤ **Hall 15, booth C24 and C27**

Fig. 8. Energy savings of over 10 % are now possible with the CX series in the clamping force range of 2000 to 4200 kN
(© KraussMaffei)



high-precision 2-platen CX machines in the clamping force range of 2000 to 4200 kN (Fig. 8). The manufacturer claims to have boosted the energy efficiency of the basic version by 10%. The clamping movement offers potential savings of 40% after a redesign of the flow dynamics in the clamping block. Further energy-savings potential of between 10 and 40% is also provided by the BluePower Servo Drive. A positive side-effect of this energy optimization is a roughly 25% extension in the oil service life. The reduction in damage to the oil has been by converting to a bypass oil filter/cooling system.

inclusion of a conveyor belt within the machine housing. This saves a considerable amount of production space and thus basic costs.

Furthermore, KraussMaffei is playing a key role in implementing the principles of Industry 4.0 and has pooled its activities in relation to intelligent machines, integrated production processes and interactive services under the concept of "Plastics 4.0". One example is the expanded APC Plus feature. Introduced at Fakuma 2014, the APC feature (Adaptive Process Control) detects process fluctuations that can be caused by changing environmental conditions or fluctuating viscosity, and takes

LWB Steintl

Vertical Machine with Small Footprint

In line with the trend toward increasingly complex injection and compression molds, LWB Steintl GmbH & Co. KG, Altdorf, Germany, has increased the mounting space of their vertical machines with C-frame and tiebar-clamping units. The outcome of this is the "Performance" series. These vertical tiebar machines are notable for their innovative clamping system. This is characterized by a low working height, without the need to use a den with the machine. Machines with 4-tiebar-

clamping units are available in a clamping range of 1600 to 8000 kN. Two 3000 kN machines fitted with different accessories will be in operation at the booth.

The C-frame series has also been revised, with a clamping range up to 1600 kN for the top-closing unit and up to 2500 kN for the bottom-closing unit. The top-closing C-Class Performance model will be displayed as an example.

The machine presentation will be rounded off by the smallest

vertical machine from the LWB-Steintl program. This is a micro injection molding machine with a 100 kN C-frame clamping unit and 10 cm³ injection volume (Fig. 9). The injection weight has a repeatability of ±5 mg. As the clamping unit is based on the tiebarless C-Series, there is plenty of scope for attaching automation equipment. The footprint of just roughly 1 m² not only includes the machine itself but also two temperature controllers.

➤ **Hall 14, booth A68**



Fig. 9. The "Micro Class" micro injection molding machine has a footprint of just approx. 1 m²

(© LWB Steintl)



Netstal

Benchmark for Thin Walls

Netstal-Maschinen AG, Näfels, Switzerland, has its sights set squarely on the market for thin-wall packaging. Over the eight days of the trade fair, an Elios 7500 fitted with a 24+24 stack mold will produce over 43,000 round lids with a part weight of 2.8 g per hour – in a cycle time of 4 s. In its Elios 7500 high-performance machine, Netstal has succeeded in producing a 7500 kN clamping unit with electrical movement for the thin-wall packaging sector. Here, the centrally aligned 5-point dual toggle lever ensures optimum introduction of force into the center of the mold installation space and thus uniform distribution of the clamping force. The large pillar distance and generous opening stroke facilitate the installation of stack molds or simple molds with large cavities.

The Elios 7500 marks the beginning of a new series of machines that will shortly be supplemented by other variants with lower clamping forces. The hydraulic injection axis is driven by means of two highly dynamic servo valves that guarantee high acceleration values, injection capacities and precision control characteristics during the injection and holding pressure process. The two-valve technology supports a flow rate of up to 2 x 550 l/min, with a maximum response time of 11 ms. With injection speeds of up to 2200 mm/s and acceleration values of up to 20 G, the Elios delivers impressive specification values. However, these dynamics do not entail a loss of precision: the finely tuned digital controller ensures high positioning accuracy and shot weight consistency.

» **Hall 15, booth D24**

Sacmi

Extreme Productivity

The innovations from Italian machine manufacturer Sacmi Imola S.C. are aimed at boosting effi-

ciency. Among other things, the company will unveil a new machine technology for the production of plastic containers and plastic caps (**Fig. 10**). A compression molding system with 24 cavities and a cycle time of 1.4 s will produce 1000 bottle closures per minute – and has the lowest

power consumption in the industry, claims the manufacturer. Current applications will appeal



Fig. 10. This compression molding machine from Sacmi raises the productivity bar to a higher level (© Sacmi Imola)

ciency. Among other things, the company will unveil a new machine technology for the production of plastic containers and plastic caps (**Fig. 10**). A compression molding system with 24 cavities and a cycle time of 1.4 s will produce 1000 bottle closures per minute – and has the lowest

especially to the pharmaceuticals and cosmetics sector, where vast quantities have to be produced in a short time. Sacmi will also present a PET preform production line which optically monitors the quality of the preforms.

» **Hall 13, booth A63**

Wittmann Battenfeld

2-Component Micro Injection Molding with Conductive Materials



Fig. 11. The new Unilog B8 controller will be available for all machines after K2016

(© Wittmann Battenfeld)

Wittmann Battenfeld GmbH, Köttingbrunn, Austria, will present a high-speed, all-electric machine in the guise of the new EcoPower Xpress, which primarily addresses the needs of the packaging industry. Its highly dynamic drive axes for injection, closing and opening are designed for fast movements and ultimate control accuracy. The provision of servo drives ensures that a high degree of energy efficiency can also be achieved.

At the K show, an EcoPower Xpress 400/1100+ will be on display in a classic IML application, producing polypropylene lids in a

cycle time of 4.7s in an 8-cavity mold (from Greiner Packaging). A W837 side-entry robot from Wittmann inserts the IML films, removes the labeled lids, presents them to an integrated camera for testing and then separates the good parts from rejects.

In addition, the visitors will be able to view the MicroPower 15/10H/10H, the first 2-component model in the company's MicroPower series specially designed for injection molding of nano and micro parts. This machine, equipped with two parallel injection units and rotary disk, will produce a 2-component plug inside a sound recorder head made of PC and modified, electrically conductive PC. It is equipped with an integrated camera system and a W8VS4 Scara robot from Wittmann for fully automated quality control and parts removal.

A SmartPower 350/3400 fitted with a mold supplied by Haidlmair will produce a shopping bag made of TPE, which can be provided with a personalized imprint. A terminal will be provided where visitors can enter their names. To collect the bag with the personalized imprint, they will be given a printed QR code, which can be read in at the delivery station. After the QR code has been scanned, the next bag produced will be separated and transferred to a station where it will be laser-printed. The production data for the "personalized bag" will be valid for a fortnight after the fair during which time they can still be retrieved by scanning the QR code.

The trade fair presentation by Wittmann Battenfeld will be rounded out with the Uni-

log B8 control system, which will be on display on every single machine at the K in Düsseldorf (Fig. 11). The new control generation differs from the previous version in offering additional features and greater ease of use. Via an attractively designed, pivotable 21.5" "full HD multi-touch screen", the process functions can be retrieved by gestures (zooming/wiping), while selected operating functions are operated with the aid of tactile keys mounted in the machine's central console. This makes it possible to address frequently used functions directly.

Visualization and operation of the machine run under the new Windows 10 IoT operating system, which enables easy integration into the open world of Windows applications. A split-screen display allows simultaneous visualization of two different functions. This is a special advantage as, thanks to "Wittmann 4.0" technology, it has now become possible to visualize and operate machines and peripheral appliances in parallel on a single monitor screen. Assistance and help systems enable the operator to adjust the machine settings during optimization of operational processes.

» **Hall 16, booth D22**

Conclusion

The latest developments from machine manufacturers reflect current trends in the plastics processing industry. The ever-increasing demands for greater energy efficiency and economy are being met through technical innovation and standardization. Furthermore, there are signs that machine makers have commenced implementation of the fourth industrial revolution, which has its roots in K2013.

The entry by leading injection molding machine makers into additive manufacturing and in-house developments in master computers constitutes only a small proportion of the various innovations. To a greater degree, it is becoming apparent from the systematic upgrading of existing technologies to new, complex systems under the mantle of "Industry 4.0" what the success factors are for integrating injection molding machines into efficient production processes in the future.