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innovations

Techniques – Markets – Trends *Volume 15 – 2/2021*

Know-how without the knowledge gap!

Battenfeld

WITTMANN innovations (Volume – 2/2021)

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Editorial

Michael Wittmann

Dear Reader,

At a time when the Corona pandemic is still rampant, I can hardly describe the mood in our company without mentioning the virus situation and the way it affects our Group. In fact, the COVID-19 virus is still keeping us on the go every day. But now in a different way. About a year ago, we felt the effects of the first global lockdown. Today, a year later, the economic situation has experienced a complete turnaround. Industry is now operating at full swing in many areas, and the current concern about Corona in our Group is about how to keep running at the highest possible level while simultaneously observing all necessary hygiene and safety precautions. No easy task. Having to work under such conditions for any length of time is not a desirable state. But the realistic prospect of an end to this pandemic and a return to more normal life (even though delayed again and again) makes the situation somewhat more bearable.

At any rate, we are very fortunate in that we have virtually unlimited possibilities to pursue our professional goals. In this issue of *innovations* we are presenting to you another interesting range of future-oriented, innovative technologies. Such as the condition monitoring system (CMS) for our injection molding machines. Our CMS offers condition-oriented servicing and thus a higher standard of failure safety than regular servicing at fixed intervals or a preventive maintenance system. The aim is to minimize loss of earnings due to production standstills and costly maintenance work. CMS is becoming more and more significant and interesting for many processors especially when working at full capacity.

Moreover, we deal with the special challenges of automation in handling injection-molded micro parts, in particular their insertion. Many molded parts are constantly becoming smaller and more compact from one product generation to the next, until they ultimately reach micro sizes (part dimensions below 3 mm or weights down to or less than one gram). Micro parts are not only installed in cell phones, but generally in products of the electronics industry, for example plugs, as well as in medical technology. Such small plastic parts enable extremely compact and lightweight finished products, but they present processors with huge handling problems. Our *MicroPower* injection molding machines and our automation expertise provide the means to create optimized turnkey systems.

This issue of *innovations* is rounded off by highly interesting customer reports from Germany, Slovenia and from India. I wish you great enjoyment in reading it.

Sincerely, Michael Wittmann

Content

Leading Slovenian manufacturer benefits from use of WITTMANN Group equipment

For over 45 years, TEM Čatež d.o.o., located in the eastern part of Slovenia, has been producing and offering its clients easily adaptable, technologically innovative and aesthetically pleasing electric switches and sockets for a variety of living and working spaces. With the delivery of the first SmartPower 110 multi-component injection molding machine in 2017, a fruitful cooperation between TEM and ROBOS (the Slovenian/Croatian WITTMANN Group agent) came into life. The cooperation has continued to this day, with many completed projects – and lots of upcoming projects for the future.

Peter Zajc

TEM Čatež d.o.o. truly is the regional leader in the production of a comprehensive selection of switches and sockets for both simple and more demanding installations.

Over the years, TEM has successfully promoted its brand and achieved wide recognition for its products. The company concentrates the entire technological and production processes in one place – that is the own production plant located in Velika Loka.

It is important that every product is recognized by TEM's customers and that new products are constantly developed. The main customers for the business are specialized distributors of electrical equipment and electrical installation materials. TEM's switches and sockets are sold in a total of 25 European countries. In recent years, the company had grown by more than ten percent per year on average.

The company was founded in 1973. Over the decades, various modern technological and manufacturing processes have been introduced, including: stamping, turning, Bakelite injection, multi-component injection, assembly and other processes. Thus, TEM was always equipped to control all manufacturing in-house.

TEM as WITTMANN BATTENFELD customer

In the year 2017 – due to the growing demand for their products –, TEM ordered the first injection molding machine from WITTMANN BATTENFELD: a specially colored *SmartPower* MC 110/350H-60S B8 with rotary table and a PRIMUS 16 WITTMANN robot that was fully integrated in the B8 machine control. This machine replaced the previously system of overmolding parts using two other machines.

This change led to significant energy-savings, as well as a reduction of the total cycle time and to the redeployment of labor.

After the first project was successfully completed, a discussion began with regard to a centralized material handling system. This project was finally realized in 2018, with the opening of a new production facility. Equipment from WITTMANN was chosen, because the technology offered the best price/performance ratio in line with the needed solution. The material handling system was installed using different models of WITTMANN material dryers: 2 ATON basic G70-100-M, 2 ATON basic G70-200-M, 1 ATON basic G120-300-M with controlled vacuum take-off adapter. The existing DRYMAX E60 drying equipment was also integrated into the new system.

TEM also acquired and deployed FEEDMAX G206-50 and FEEDMAX G203-50 loaders, all equipped with swiveling IMM hopper adapters. The system also featured an XMB Filter Station, a CODEMAX Coupling Station, and was equipped with a WITTMANN TEACHBOX basic control.

Shortly thereafter, TEM ordered another injection molding machine: a *SmartPower* 90-210 B8 with special options such as HiQ Flow®, measuring the resistance of the melt flow during a specific phase of the injection process. This special functionality compares the actual value with a previously set value, and adjusts the holding pressure parameters (change-over point) within the respective cycle. The benefit for the customer is a greatly increased quality of injection molded parts, and therefore much less production waste. This machine was also automated using a WITTMANN PRIMUS 16 robot.

In addition, some of TEM's existing injection molding machines were equipped with new WITTMANN robots (mostly PRIMUS 16 and PRIMUS 14), and also with new TEMPRO primus C90 mold temperature controllers. Within the scope of a test phase, there is also a variothermal temperature controller in use. This is being used to check whether the technology may be effective in the production of parts with optically challenging surfaces, perhaps even improving the impression of the parts in this regard.

The basis of a good and successful industrial partnership always lies in providing great sales support and technical support in all aspects of plastics processing technologies – especially with regard to a newly-won customer. WITTMANN Group and ROBOS are very mindful of the dynamic involved and quickly rose to this challenge, providing quick and effective response to all customer concerns and laying the groundwork for further successful cooperation. ◆

***Peter Zajc** is Managing Director of ROBOS d.o.o. in Ljubljana-Črnuče, Slovenia, the WITTMANN Group Agent for Slovenia and Croatia.*

Right page: MODUL modular system of switches and sockets in Line, Soft and Pure design lines.

BILORA utilizes Insider solution with integrated auxiliaries

Since March 2019, BILORA Kunststofftechnik GmbH in Germany has been operating two injection molding machines with Insider solution from WITTMANN BATTENFELD. These machines recommend themselves by their compactness, reliability and efficiency.

Gabriele Hopf – Michael Müller

SmartPower 60 and SmartPower 90, equipped as Insider cells.

The origins of BILORA now date back an impressive number of 111 years to 1909, when Metallwarenfabrik Kürbi & Niggeloh was founded in Barmen-Rittershausen. Then, this company manufactured tubular tripods, pendant luminaires, music stands and other metal goods. Today's corporate headquarters in Radevormwald were built and officially opened in 1911. In 1956, the company's production output exceeded 1 million cameras.

The first plastics injection molding machine was purchased in 1961. The management had recognized the advantages of this new technology, and at this point the potential inherent in these materials originally frowned on as "cheap plastic" had already long been realized. Plastics were now able to compete with metals.

Engaging in plastics injection molding resulted in numerous advantages, such as low-cost production of individual parts, virtually complete elimination of downstream finishing, perfect surfaces, light part weights and dispensing with numerous steps in assembly work. In 1994, the new company KÜRBI & NIGGELOH BILORA GmbH was founded, which now exclusively engaged in manufacturing plastic products. In 2016, this company was renamed BILORA Kunststofftechnik GmbH.

Today, BILORA produces a wide range of different parts made of engineering plastics by mono- and two-component injection molding in both small and large-production lots, using 40 injection molding machines with clamping forces from 150 to 2,000 kN.

BILORA's product portfolio also includes metal/plastic composites, such as are used, for example, in the automotive industry. Many of the molded parts undergo further

WITTMANN TEMPRO plus D temperature controllers integrated in Insider cells.

processing, including pad and screen printing, assembly of components (as well as functional tests if desired by BILORA's customers) or shelf-ready sales packaging. Plastic parts for machine construction are frequently subjected to mechanical downstream finishing at BILORA, since the small numbers of units that are produced would not justify a considerable investment in elaborate molds. The use of ERP and MES systems ensures complete traceability of every single batch.

For its in-house mold-making shop, the company has invested in a CNC machining center and a wire EDM machine. The company also operates its own design department supported by CAD/CAM applications.

BILORA and WITTMANN BATTENFELD

The cooperation with WITTMANN BATTENFELD started several years ago with the installation of a special parts removal technology. BILORA invested in various WITTMANN robot systems from the W8 and W9 series, which were retrofitted to existing injection molding machines. BILORA produces its own parts removal grippers equipped with security query systems and some additional functionalities. Convenient facilities for easy integration and control of the removal grippers by the robot's control system ensure optimal utilization of the available options. The reliability of the equipment and the good support provided by WITTMANN BATTENFELD were the decisive factors prompting BILORA's subsequent decision to acquire WITTMANN single- and dual-circuit temperature controllers (for water with temperatures up to 160 °C), as well as DRYMAX dryers and DOSIMAX dosing systems.

In March 2019, two servo-hydraulic *SmartPower* injection molding machines from WITTMANN BATTENFELD, with 600 kN and 900 kN clamping force respectively, were installed at BILORA – both models designed as Insider cells. An Insider cell comes with an integrated handling system for the molded parts, including a transfer conveyor belt, as well as a protective encasement firmly connected to the machine.

Parts depositing by WITTMANN robot.

From the left: Jörg Schröer, WITTMANN BATTENFELD Sales, Michael Müller, Managing Director of BILORA.

Compared to conventional systems, these integrated fixtures reduce the work cell's footprint by up to 50 %. BILORA appreciates the machines from WITTMANN BATTENFELD for their integrated auxiliaries as well as their compact design, moreover, they have also proved extremely reliable and efficient. Michael Müller, Managing Director of BILORA, comments: "The Insider machines from WITTMANN BATTENFELD recommend themselves primarily by their space-saving design, the good balance between mold space, clamping force and injection units, as well as CE compliance without any need for additional protective devices outside the machine, full integration of the robots, and last, but not least, the excellent user-friendliness, which we have already come to know and appreciate from the previously installed robot systems. With these solutions, WITTMANN BATTENFELD is helping us to continue manufacturing our products efficiently and with a high quality standard." ◆

Gabriele Hopf *is the Marketing Manager of WITTMANN BATTENFELD in Kottingbrunn, Lower Austria.*
Michael Müller *is the Managing Director of BILORA in Radevormwald, Germany.*

Condition Monitoring: keeping you informed about the condition of your machines

CMS sensor systems for condition monitoring (CMS = condition monitoring system) have been in use in large-scale production plants for many years to minimize profit losses through downtimes and maintenance work. Application examples are rotary kilns in cement plants, conveying systems in mining, pipe-jacking machines in tunnel construction, power plant turbines or wind power stations. Thanks to recent progress in sensor technology and increasing availability of high-speed data networks, CMS systems are now becoming interesting also for injection molders. Here, WITTMANN BATTENFELD has blazed the trail and offers CMS equipment for its machines.

Reinhard Bauer

Fig. 1: A condition monitoring system for condition-oriented scheduling of maintenance work increases plant availability in a demand-oriented "just-in-time" supply chain. *(Foto: Reinhard Bauer)*

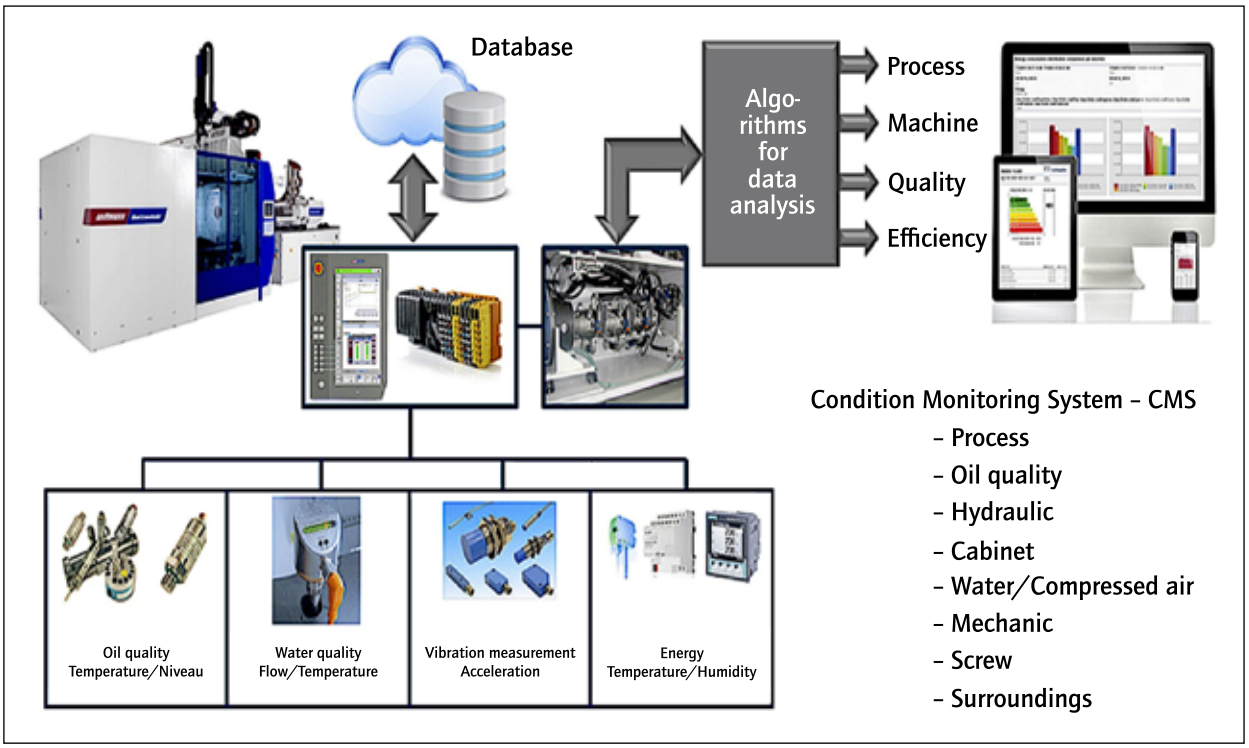


Fig. 2: The WITTMANN BATTENFELD CMS concept of condition data collection by sensors and subsequent data processing as the decision-making basis for maintenance work.

In contrast to time-oriented maintenance (preventive maintenance), where machine parts are replaced at fixed intervals regardless of their actual condition, condition monitoring (CM) is based on continuous observation of the parts' condition (predictive maintenance). The latter approach offers the advantage that replacements depend exclusively on the actual degree of wear and functionality of the parts.

The superiority of condition monitoring over preventive maintenance is inherent in the method itself. For any damage occurring in the course of a maintenance interval normally remains undetected and may therefore even lead to a total breakdown, while the problem could often be remedied at little expense if it was detected in time. The costs for unplanned repairs incurred in this way and the loss of profit caused by the machine standstill are generally higher than the costs of a condition monitoring system. This is all the more important, the more closely the production is linked to a just-in-time supply chain, as is the case, for example, in injection molding production for automotive suppliers (Fig. 1).

Comprehensive CMS package available

At the "K 2016", WITTMANN BATTENFELD introduced a condition monitoring system (CMS) which is available as an optional equipment package for injection molding machines. It accesses the values measured by already existing as well as additional sensors installed for this purpose and passes on these data to a recording system. The CMS system actually monitors the following (Fig. 2):

- In (servo-)hydraulic machines, the drive function of the hydraulic system (vibrations in the pump drive, current consumption, system pressure).
- In (servo-)hydraulic machines, the quality of the oil (temperature, number of particles in the oil and water content), in all-electric machines, the quality of the gear oil.
- The "climate" existing inside the electric cabinet (temperature, atmospheric moisture, possible smoke formation).
- The capacity of cooling water and air supply (flow quantity, pressure, temperature).
- The mechanical parameters of the clamping unit (pressures in the pads of *MacroPower* injection molding machines, vibrations and torques in servo-electric drives).
- The mechanical parameters of the plasticizing unit and/or injection unit (vibration, plasticizing torque, screw stroke, closing behavior of the check valve). One possible cause of the development of vibration may be a loose screw in the screw coupling which, if it remains unnoticed, may lead to major consequential damage (Fig.3).

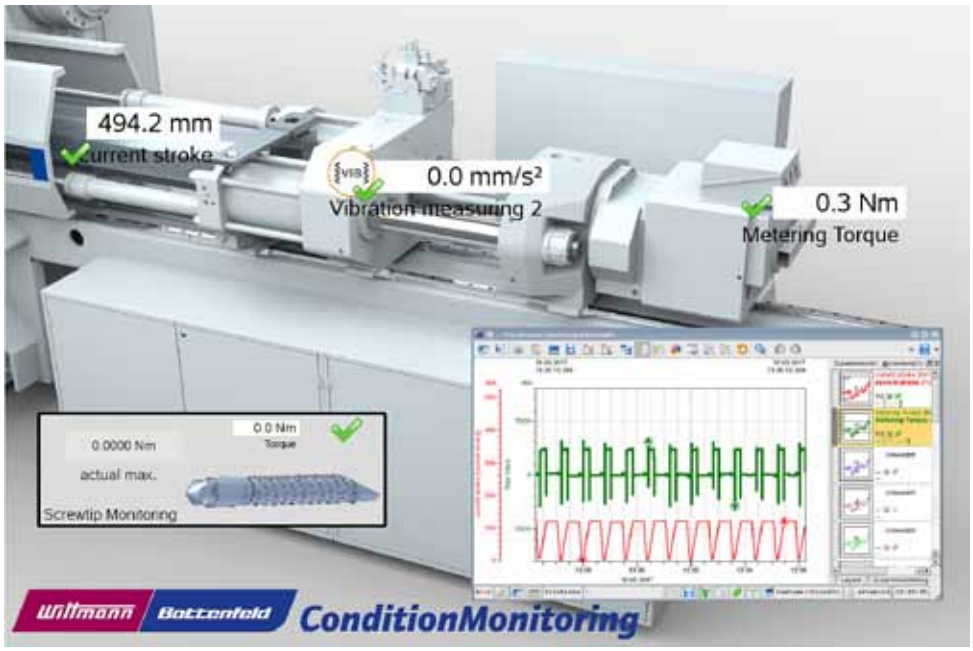


Fig. 3: Display example of condition monitoring of the screw drive and check valve function.

Condition data processing on three levels

1. Measurement data collection and display on the machine

The data (temperatures, moisture, signals from the smoke detector inside the electric cabinet) are collected on the machine partly cycle-synchronously and partly dependent on time, and subsequently transmitted to the CMS computer for evaluation.

On the machine, the current condition data are displayed compactly on an overview page of the machine's B8 control system (Fig.4, p. 10). Deviations from pre-set reference values (temperature ranges, air pressure, and smoke detector signals) are visualized by green/red traffic light indicators.

2. Data analysis/processing on the CMS host computer

The heart of the CMS system is the CMS computer. It is part of a production control system. It communicates with the injection molding machines and draws the measurement data, collects and saves them for possible later backtracking. The CMS software processes the measurement data into trend-tracking models.

A CMS control station is able to monitor up to 50 machines simultaneously and pass on advance warnings to maintenance staff by email (Fig. 5, p. 10).

3. Data evaluation and condition analysis

Evaluation of the data is based on generally recognized quality standards, such as the NAS 1638 (National Aerospace Standard) oil quality assessment or the oil purity rating according to ISO 4406. >>

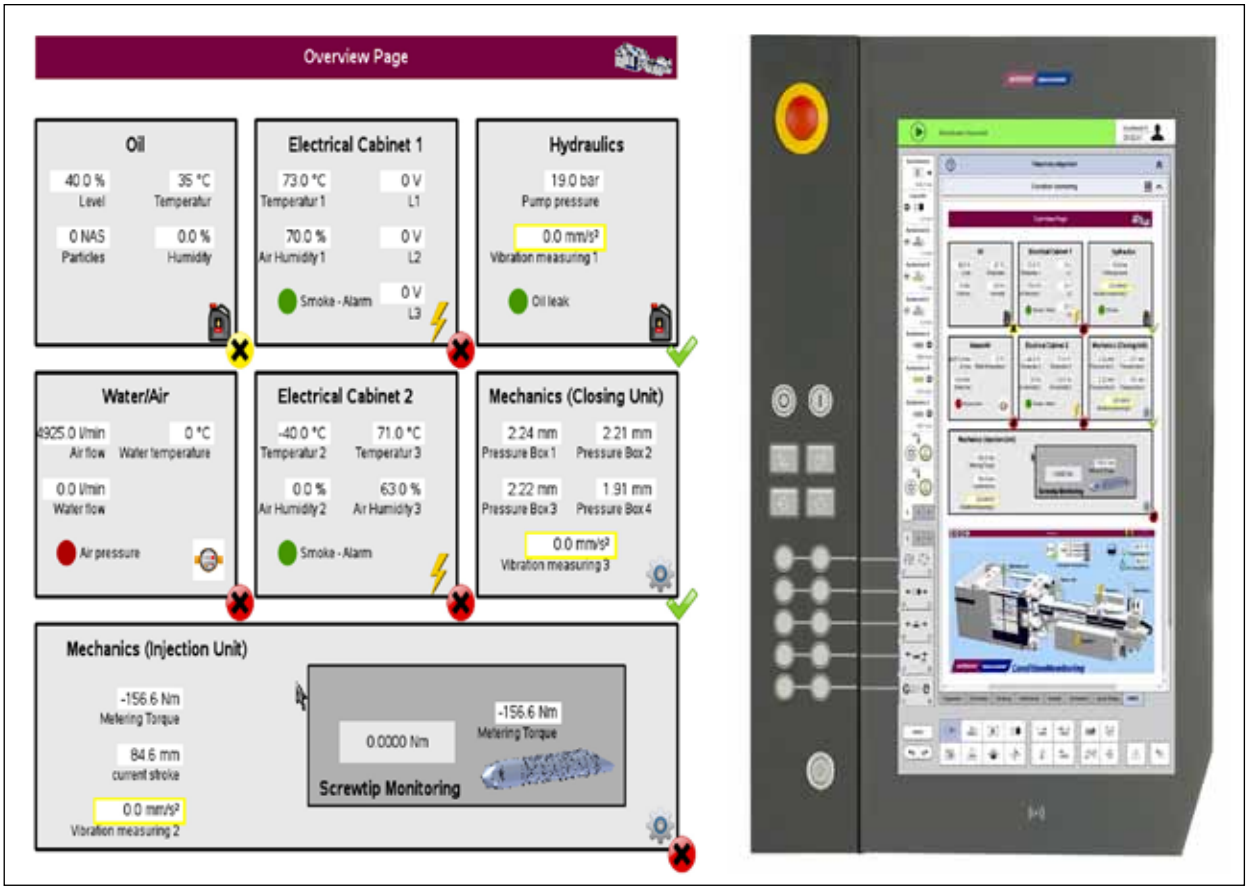


Fig. 4: Overview of condition values on the B8 machine control system.

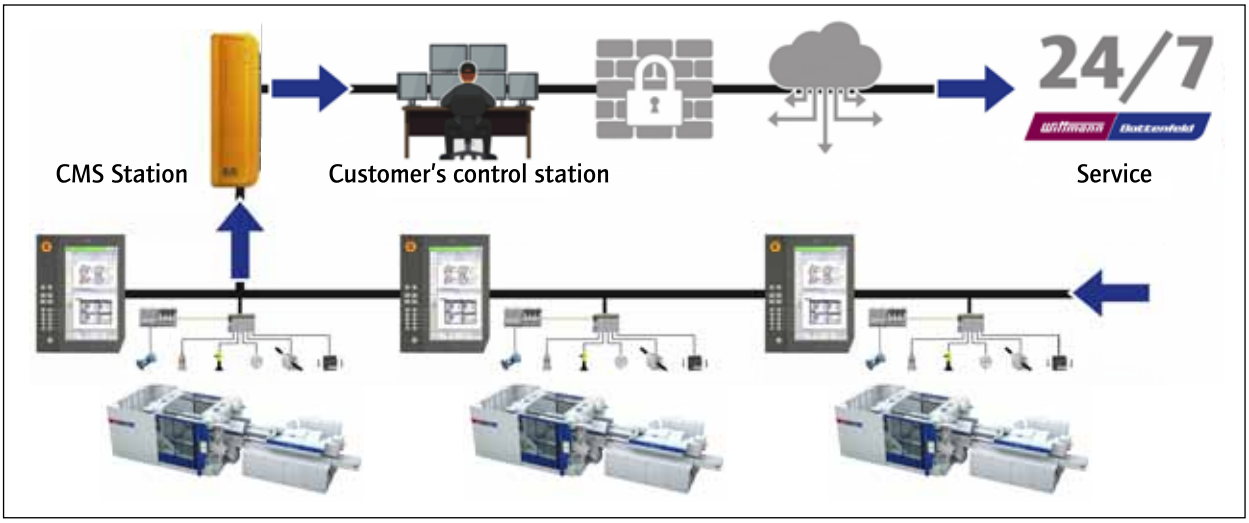


Fig. 5: Monitoring data from up to 50 machines are collected on a host computer. Where the values exceed or fall below tolerance margins, the calculated data trends trigger signals which must be correctly interpreted and followed up by appropriate action on the part of maintenance staff.

Empirical limit values are used for judging air and oil pressure values, temperatures or the closing behavior of the check valve. In addition, the vibrations of components exposed to wear are measured by vibration sensors and evaluated by analysis algorithms (Fig. 2, p. 8).

Besides current status information, the CMS software also delivers trends indicating changes in functional values. These provide the basis for decision-making by maintenance staff. Should no sufficiently qualified or experienced personnel be available on site for correct interpretation of this decision-making tool, it is also possible to outsource the interpretation of the data to a service center via online networking and have the necessary maintenance work initiated from there. This service can be supplied by the WITTMANN BATTENFELD service organization (Fig. 5).

Summary

Condition-oriented machine maintenance of injection molding machines offers better failure protection than servicing in fixed regular intervals or a preventive maintenance concept since, due to lack of information, malfunctions developing between maintenance sessions (loose screws, gradual failure of bearings) with a risk of sudden total breakdown are very hard to detect.

This is why a CMS system is a useful contribution to improving failure protection of production processes, primarily and in particular for just-in-time production chains. The cost of implementing a condition monitoring system is already compensated for by preventing only a few days of production standstill. ◆

***Reinhard Bauer** is a freelance journalist and communications consultant specialized in plastics technology.*

Blow molding: Internal Air Cooling

Aaron Farrag

WITTMANN's innovative Internal Air Cooling Systems (IACS) in blow molding operations, shorten cooling times, reduce stresses in the finished product, and decrease crystallization rates. In all blow molding methods throughout the plastics industry, one of the most critical steps is the cooling of the plastic parts. Selecting the right technology for this work step can yield the greatest time and material savings.

In blow molding, parts are typically formed by injecting compressed air, which presses the hot material out against the mold surface from within, whereupon the parts are then cooled along the walls of the mold merely by means of cold water. This not only creates material stresses due to the temperature difference between the inner and outer wall of the parts, but it also results in a significantly slower rate of heat removal because that removal takes place exclusively through the outer wall of the formed parts. And that's where the Internal Air Cooling Systems (IACS) from WITTMANN make all the difference. The added cooling of the inner wall of the parts by cold compressed air generally increases production by at least 15%, whereby considerably better values can be achieved in most cases. Moreover, the lower material stresses make significant material savings possible, reducing the weight of the finished product by up to 10% while ultimately still passing the same leak, drop and strength tests as before. Experience has shown that the amortization period for such internal air cooling systems is much less than one year.

Any Internal Air Cooling System starts with a compressed air cooler. In this case, that means either the WITTMANN Blow Molding Booster (BMB), which produces a compressed air temperature of about 5 °C, or else the Blow Air Chiller (BAC), which cools the compressed air down to about -35 °C. Specially developed Blow Valve Blocks (BVBs) control the various processes via a control box: the flow of the compressed air through a core pin into the interior of the product and the subsequent discharge of compressed air out of the product via controlled ventilation. Each individual product to be cooled in this way in the blow molding process requires the development of its own special core pin. This is because the precise distribution of the air to be established inside differs from one product to another. That distribution, together with the right balance of supply and exhaust air, plays a hugely important role here.

Production increase of up to 50% or more

The Blow Molding Booster (BMB) was specially developed with certain properties in mind – properties which now characterize it. It is compact, inexpensive, maintenance-free, and – in terms of the quality of the compressed air used – features perfectly simple operation. The air discharge temperature always remains above freezing, thereby eliminating the need for a complicated system to dry the compressed air and obviating the question of which oil to use in such a system. The only requirements are compressed air pressure between 6 and 15 bar and an adequate supply of cold filtered water that does not exceed 15 °C. Blow Molding Booster units are available in three different sizes with compressed air capacities ranging from 160 to 600 Nm^3/h and generally achieve production increases ranging from 10 to 35%. In most cases, the compact design of these devices enables direct installation on the production machine, which keeps supply lines short and production floors clear.

WITTMANN Internal Air Cooling Systems (IACS) for blow molding: Blow Molding Booster (BMB, left) and Blow Air Chiller (BAC).

The design of the Blow Air Chiller (BAC) is considerably more complex. It also demands suitably high-quality compressed air ranging in pressure from 7 to 15 bar with a residual oil content of 0.01 mg/m^3 and a pressure dew point of 5 °C at 7 bar (or lower). The molecular sieve in use here also requires maintenance from time to time. This expense yields production increases ranging from 15 to above 50%. In some cases, blowing and ventilation time could even be cut to one third of the original value. With the Blow Air Chiller, the compressed air is fed through the internal Pressure Air Dryer (PAD) equipped with a molecular sieve, which regenerates itself simply by means of dry compressed air. The dew point of the process air is lowered to -40 °C to prevent ice from forming in the system. The Blow Valve Blocks that control the processes are designed to operate at such low temperatures. Like the Blow Molding Booster, the Blow Air Chiller also requires a cold water supply with a maximum temperature of 15 °C – at a pressure of 3 to 8 bar. WITTMANN Blow Air Chillers are equipped with an integrated FIT controller, a control display for visualizing the process and accessing all relevant device data. The user can also store data and use special control functions to pass it along to other process machinery.

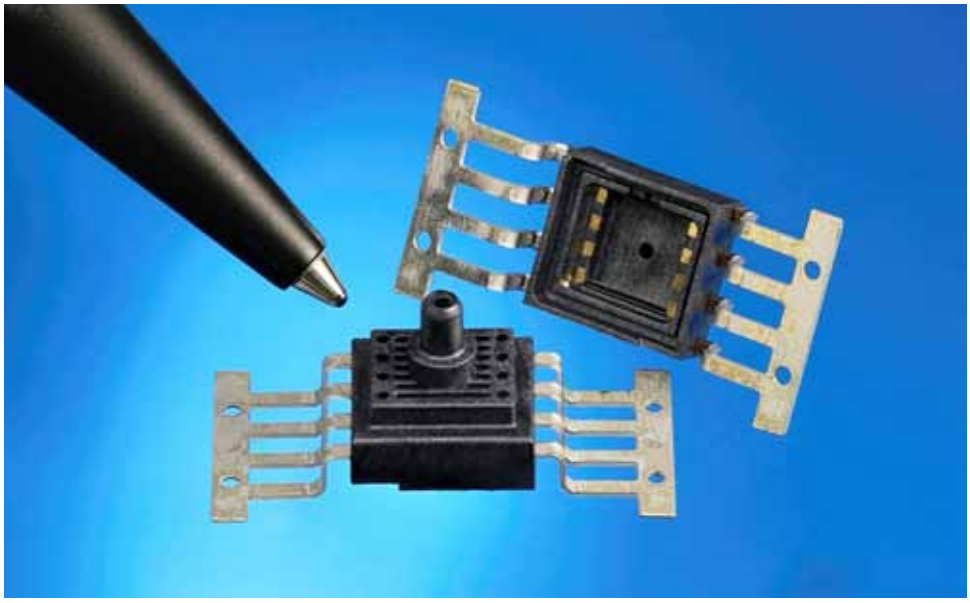
WITTMANN Group's specialists offer a full range of consulting services for all internal air cooling systems. Following a comprehensive review of their system requirements, each customer receives a customized, free-of-charge quotation, including an estimate of the expected production increase. ◆

***Aaron Farrag** is the Head of the Product Division Compressed Air Drying and Mold Cooling of the WITTMANN Group.*

How to automate high-precision "micro" insert molding

What does it take to automate a horizontal injection molding cell to handle micro-sized inserts and molded parts? General-purpose top-entry robots and tooling may not be up to the job.

Joe Varone *[First published in "Plastics Technology", December 2020.]*



Two examples of micro-inserts that are increasingly common, but can challenge the capabilities of older automation systems designed for "normal" sized parts.

Insert overmolding is an exacting technique in injection molding, but in its early days, it was not often handled by a robot – it usually required the assistance of human hands, especially for inserts with more difficult geometry. The robot technology and know-how of those days was not yet very capable for insert handling.

Loading inserts into the injection molding tool was done – and sometimes still is – manually by workcell operators, especially for inserts that presented challenges in size, shape or the need for absolutely precise location and orientation.

For years, horizontal machine operators would wait for the mold to fully open, let the parts fall, slide open the safety gate, carefully orient and hand-load the inserts into the mold, close the gate, and continue the overmolding cycle. It was an inefficient and labor-intensive method; the opening and closing of gates lengthened cycle times; and it was often prone to inaccurate insert orientation. Vertical molding machines had similar challenges, but this article focuses on horizontal-clamp machines, which are much more common among injection molding shops and are favored for higher production insert molding. And because top-entry robot design favors horizontal machines, vertical presses did not experience the benefit of technological advances in this type of automation.

Micro-insert part examples

Time is technology's friend, and robot technology has much improved, particularly for horizontal injection molding and top-entry linear robots. Nowadays, most molders with higher production runs for overmolded insert parts have automated the process with top-entry linear robots to streamline the process, save direct-labor cost, and improve

quality control. But what works for common overmolding applications with "normal" sized inserts and parts, is not necessarily sufficient for the micro-sized inserts and parts that are increasingly common in this era of miniaturization in electronics, medical devices and micro-mechanical systems. A dozen of these inserts might fit on a penny. This scale offers a much greater challenge to molders and robot suppliers alike.

Micro size, big challenges

At the micro scale – say, less than 3 mm – insert overmolding is still often done manually (or not at all) because of the challenges of automated handling such tiny inserts. This means the part design often defaults to a two-piece assembly rather than an integrated one-piece overmolding. Why? Because molders and part designers aren't always aware of the capability of the latest generation of injection molding robots or the capability of the suppliers' custom automation engineering groups to manage and successfully implement such workcells.

Micro applications may not be suited to your existing older-generation robot that still "goes through the motions". But today's top-entry linear robots feature such advances as higher precision (< 1 mm) drive trains, multi-axis precision servo motors, and software control. When seen from a distance on a shop floor, today's higher-tech top-entry linear robots don't appear much different from earlier models of 20 years ago. But they are, in fact, more accurate, more programmable, more capable, and easily integrated with custom automation. Just as important, some robot suppliers' custom automation engineering capabilities have grown to match the more advanced-generation robots they supply. In addition, "in-workcell" devices, sensors and quality-control technology have also improved for precise insert applications.

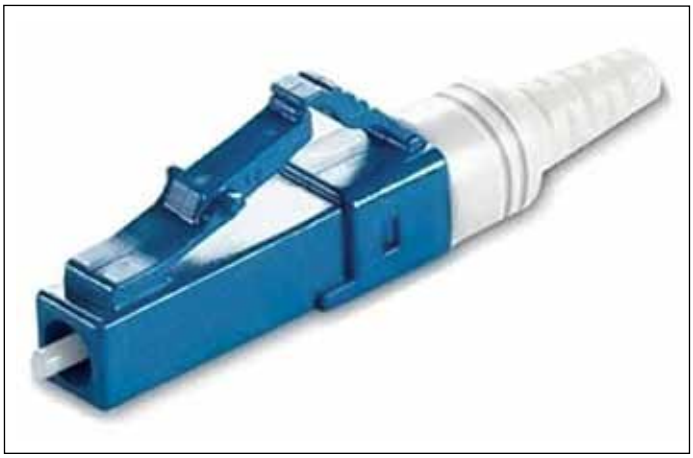
An example is the use of more advanced, yet cost-effective modern vision sensors, proximity sensors and other technologies to ensure that inserts are present, in the correct location and orientation, with very high precision. Combine this with advances in the use of insert feeders, escapements, end-of-arm tooling (EOAT) technology, and workcells have evolved to become very efficient and cost-effective for overmolding even the most challenging of micro-inserts.

And critically, in terms of project management, the molder can have confidence in a qualified primary robot supplier to take responsibility for the complete robot and automation workcell, so the molder does not have to go to a separate third-party integrator for special insert-molding applications. Managing a project with one supplier has to be better than managing two, right?

Real-world examples

High-precision micro-insert injection molding is now being successfully implemented on precision horizontal injection molding machines in the 15-ton to 165-ton range with molds "smartly" designed to facilitate automation from the outset for such applications before mold steel is cut. Here are two illustrative examples of micro-insert applications and the accompanying challenges.

Example Project A is a polyetherimide (Ultem®) electrical part less than 1 in. long, with a cylindrical, ceramic polymer insert measuring 1.25 mm (0.0492 in.) diameter. The mold has eight cavities, and the locational tolerance of insert placement in each cavity is 0.01 mm (0.0005 in.) The inserts must be oriented front to back. The cell includes a 110-ton press, a top-entry linear robot, and vision inspection to confirm that the insert is present and orientation of the substrate in the overmolded part.



Electrical part in Example A, less than 1 in. long, insert overmolded in eight cavities with Ultem® PEI.

The robot places the parts on an exit conveyor that indexes by shot. The challenges for this automation project included:

- Ensuring the quality of the inserts – i.e., that they are consistently within tolerance and are very free of contamination such as dust, dirt, specs, static or moisture.
- Ensuring that the insert is kept at the correct orientation as it moves from the automated bulk feeding station prior to the overmold process, prior to mold insertion and are correctly seated in the mold cavity before the mold closes. Robot-integrated cameras and vision sensors handled this requirement.
- Careful calculations of mold-steel thermal expansion, which could affect the tolerance of the cavities and seating of the micro-inserts and thus quality of the overmolded part. This is especially critical when processing at such tiny scales and high tolerances.
- Common insert application issues, such as the mold location on the platen had to be perfectly level, square and plumb. This is also required for the mating robot EOAT, even if the latter has mold-engagement alignment pins.
- Machining the EOAT to high tolerances (± 0.0005 in.) from high-quality stainless steel – instead of standard acetal, mild steel or rubber – for the "fingers" gripping the overmolded part. Other parts of the EOAT and feeding station are special anodized or hardened materials for wear-and-tear surfaces.

Example Project B is another electrical part, this one of PBT with a cylindrical metal insert. The insert size is less than 2 mm and it must be inserted into 4 cavities with front-to-back orientation and location tolerance of 0.03 mm (0.0012 in.). Vision sensors check insert orientation >>

and presence in the mold. Cycle time is 15 sec in a 110-ton press. The challenges for this metal micro-insert overmolding project were very similar to those of Project A. One difference is that metal rather than ceramic inserts must be free of oxidation and coatings to avoid introducing contaminants. On the other hand, ceramic inserts may be more abrasive, and thus special consideration must be made for use of hardened contact surfaces. Also, metal inserts tend to be less fragile and heavier than ceramic inserts, so gripping and handling metal inserts might be a tad easier, though there is nothing easy about handling objects the size of a grain of rice.

Lots of factors to control

Other common technical considerations for automated handling of micro-inserts and parts include:

- Static charge. – Even the tiniest static charges can affect the insert and part, and so tests must be made to determine if the parts or inserts have to be de-static washed or bathed in clean deionized air.
- Environmental control. – Parts and inserts of this tiny scale are more consistently handled if managed in environments with controlled temperature, humidity and air flow. Ambient temperature changes might change the size of the insert, which is critical at precise tolerances. Humidity might negatively affect any hygroscopic polymers; and air flow (such as draft from a nearby vent or doorway) might push the tiny insert or part out of position. Well-designed enclosures and HEPA filters are often used to alleviate these risks, as well as controlling particulate contaminants.
- Micro-insert consistency and quality control. – Inserts must be very consistent and highly QC'd for dimensions, flash, debris, and other specs by the supplier for consistent inserting and handling.
- Micro-parts detection. – The need for workcell vision cameras vs. simple vision sensors will be determined through testing. Advanced technology will be needed for tasks such as orientation, inspection, mold-seating confirmation, and post-mold QC. The naked eye is usually not up to such small-scale inspections.
- Micro-EOAT gripper precision. – The robot and automation grippers and fingers will be machined to very high tolerances and often made of special materials based on the application need.
- Insert feeding. – This will not be your plain-vanilla, garden-variety bowl feeder; careful consideration will be made to the feeder design and materials of construction, tight tolerances, and creative orientation management with precision sensors confirming each step of the process.
- Mold seating and engagement. – To assist in making the initial setup easy, the EOAT often will include a docking feature to dock with the mold while locating the micro-inserts. This also ensures consistent inserting and demolding. The EOAT might not include common mechanical grippers, because the inserts are so small; rather, pneumatic tubes on the EOAT might be used to seat the micro-inserts into the cavities.

A plethora of other fine details to consider for optimized inserting, demolding and handling of micro-inserts and micro-parts will be familiar to an experienced robot supplier during the specifications and design-review phase of the project.

Qualifying an automation supplier

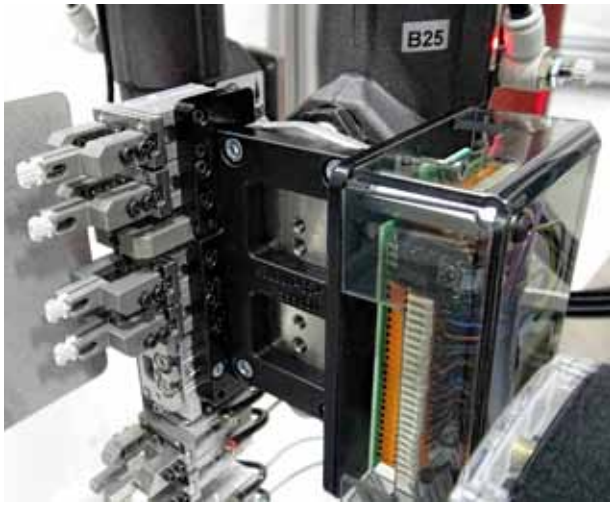
New robot and automation technology for micro-insert molding now offers the possibility of plastic product designs that were unheard of just a few years ago, and on a size scale that even the best 20-20 vision would struggle to make out. Now, a tiny part assembly can become more robust single-piece design with insert molding/overmolding, thereby reducing post-molding assembly needs and reducing the overall part numbers in a finished product.

So, molders, be encouraged to reach out to your robot suppliers, interview them, inquire about the possibilities. If possible, get the customer's product-design/development specialist sitting in the same room with the qualified robot supplier and the mold-design manager; then discuss what is possible and plausible in your injection molding machines, do the economic math and move forward. This may very well be your competitive "edge" in your market segment.

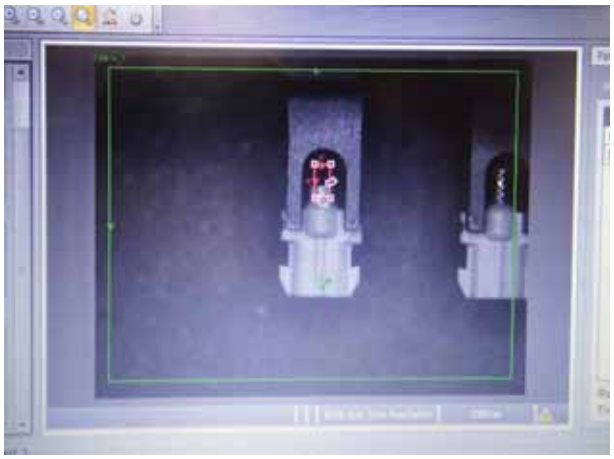
How do you select such a high-level robot supplier to collaborate on high-precision small or micro-insert molding? Consider such factors as these:

- The size and expertise of the custom automation engineering group. – It might be best to avoid overseas sources. You'll rest easier with a local robot and automation engineering group for years of technical support needs going forward for the life of the project. Tour the robot supplier's facility for proof of its ability, size, scale and scope.
- The location and experience of field-service support. – Like the advantages of domestic custom automation engineering, it is just as important to have experienced local/regional field "direct" service tech support for lower cost startups, workcell commissioning and fast response to future tech-support needs as part of "uptime-management" assurance.
- Local project management. – The third layer of a successful automation project is the ever-critical project-management factor. It really should be domestic and regionally based to bring all the key project elements together without the time lags, communication issues and time-zone challenges of foreign contacts for such intricate, high-communication projects.
- Robot user-programmability, capability, and circuit limitations. – Micro applications involve more than basic pick-and-place or off-the-shelf automation. Thus, the top-entry linear robot must have all the latest technology to easily integrate with custom automation. The robot should be completely end-user programmable, and capable of 0.1-mm or greater position accuracy. It should not require the molder to purchase custom programs, should not be limited to a limited choice of preset sub-routines, circuits and I/O. And robots with modular mechanical design offer the flexibility desirable for special custom applications. ◆

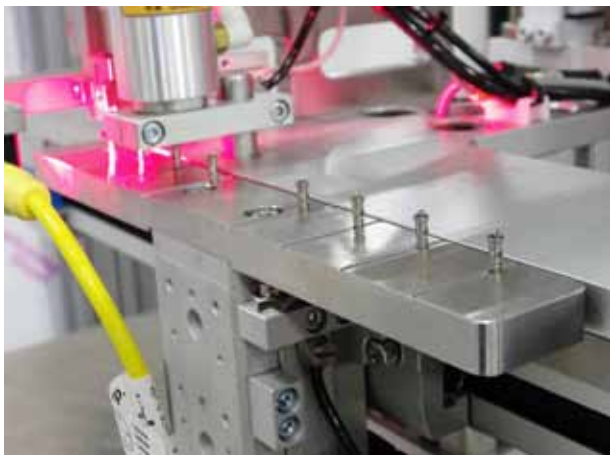
Joe Varone *is Regional Manager for the Robot Division of WITTMANN BATTENFELD, Inc. in Torrington, CT, USA.*



Left:
WITTMANN W822 robot with micro-insert EOAT. Most insert molders with higher production runs are using horizontal injection presses with top-entry robots.
Right:
EOAT presenting parts to a single Cognex camera at lower right.



Left:
Insert orientation check by camera.
Right:
Camera inspection shows insert missing (red box).



Left:
Micro-inserts loaded on pins on a shuttle prior to pickup by a robot. Red light is flash illumination for camera inspection.
Right:
EOAT picking micro-inserts from nest.

Left:
Micro-grippers (shown holding inserts) are machined to very high tolerances and are often made of special materials based on application needs.
Right:
Micro-insert feeding will require more than a "garden-variety" bowl feeder.

Success for the PG Group, India, with WITTMANN's automation and ancillary expertise

The flagship company of the PG Group, PG Electroplast Ltd in Surajpur, Uttar Pradesh, India, is one of India's leading players in electronics manufacturing, plastic injection molding and the manufacturing of printed circuit boards. For some years now, PG Electroplast has been steadily building its success by sourcing equipment from the WITTMANN Group.

Kishore Kumar

A view of the PG Electroplast production hall, showing WITTMANN robots.

Since foundation in 1977, the PG Group has continuously upgraded and transformed its operational capabilities. The company is focussing on delivering the highest quality products, the company specializes in turnkey solutions for various industries. The PG Group has a varied clientele spanning diverse industries such as consumer electronics, automotive, lighting systems, domestic appliances, mobile phones, and bathroom fittings. The business is renowned for offering innovative and cutting-edge solutions to these sectors.

From the outset, the PG Group vision was to become India's premier supplier of electronic components. Today – with a turnover in excess of 70 million US dollars – all that has come true. The PG Group is now one of the most proven and effective supplier partners to OEMs (Original Equipment Manufacturers) in India. Turnkey solutions are a speciality, as is supply work in PCB assemblies (Printed Circuit Board), full product assembly, plastic injection molding and engineering services for all its diverse clientele.

The company runs four established plants – three in injection molding and one in toolmaking. Approximately 150 injection molding machines deliver the volume of the company's output. These are fully integrated into the variety of manufacturing work at the company and range in size from 90 to 2,100 tons of clamping force. The PG Group is a listed company in the Indian stock market and PG has ambitious growth plans for the coming years.

PG Electroplast Ltd Premises in Surajpur, Uttar Pradesh, part of the PG Group, and one of the most proven and effective supplier partners to OEMs in India.

PG Electroplast and the WITTMANN Group

The first piece of business with the WITTMANN Group began in April 2016. The focus was mold temperature controllers, and the PG Group bought these from WITTMANN

in bulk; 26 units of the TEMPRO C90 model and also 25 units of the C140 model – a total of 51 temperature controllers in all.

Having experienced the quality of this WITTMANN engineering at first hand and seeing the success of these new installations, the company next proposed an automated insert molding project.

Company Director Vishal Gupta recalls that "succesful automation was becoming key to our company in our quest to beomce a preferred choice of supplier to OEM customers. We looked to our partner, WITTMANN, to help us in our aim for low manufacturing costs together with world-beating quality in terms of parts per million (ppm). The project was a tough one – and WITTMANN worked hard with us in trail blazing the future."

The PG Group's first robot automation contract was signed off with WITTMANN in November 2016 and it comprehensively tackled a difficult insert molding task at the factory.

Soon after the success of this maiden voyage automation project the company then signed a deal for a further five automation cells. These six cells are based around WITTMANN's W818 robot and the configuation includes grippers, conveyors, guarding and fencing for health and safety purposes.

Vishal Gupta notes that "we derived multiple advantages from the deployment of these robots. All in all our investment amounts to the best ROI (Return On Investment) on capital equipment ever made at our company."

The automation project has also driven down cycle times at the company, saving cost and increasing margin. The company's goals on quality standard – with 0 ppm – have also been met and the automated workplace has also facilitated the adoption of poka-yoke systems at the company. The automation project has been so successful that the next envisaged goal is for the PG Group to automate its production plant in Pune, India.

Vishal Gupta says that "our group is a very quality conscious organization and we abide by all recent ISO and TS norms added to specific quality protocols by our OEM customers. Every OEM has their own quality standards of course and we derive much benefit by adopting the best of these in order to enhance our team's performance."

Meanwhile the PG Group continues to thrive by using WITTMANN mold temperature controllers. The "CE" mark on these is most welcome within the OEM context and the various special features such as Air Purge and other preventative maintenance measures are all highly useful functions for the production team.

The company is now in current discussion with WITTMANN on matters of materials, drying and conveying. The PG Group is also now playing a full part in the Indian Government's campaign to "Make It In India". Its cost effective activities – enabled by WITTMANN – have put it in the driving seat for expansion and new business with its OEM client base. ◆

***Kishore Kumar** is the Vice-President of WITTMANN BATTENFELD India pvt Ltd. in Chennai, India.*

Bulgaria: WITTMANN BATTENFELD BULGARIA EOOD

The team of WITTMANN BATTENFELD BULGARIA EOOD, the local WITTMANN Group subsidiary, in front of the main entrance of the company's office premises in Plovdiv. Forth from the right: Stanislav Dundekov, General Manager.

The year 2020 was a challenging period for WITTMANN BATTENFELD Bulgaria, and not only because of the pandemic. In the first instance, it was a year of management changes in the technical as well as administrative fields.

In the course of the fourth quarter, Yassen Sterev, the long-term General Manager of WITTMANN BATTENFELD BULGARIA EOOD, left the company. His successor, Stanislav Dundekov, was then installed.

Dundekov holds a diploma in Technical Engineering, and has been the Head of the After Sales Services Department of the company for the past seventeen years.

At the end of the year, along with these management changes, WITTMANN BATTENFELD Bulgaria also moved to new office premises in Plovdiv – the second largest town in the country.

Having acquired an appropriate piece of land of 6,000 m² on the outskirts of Plovdiv near the village of Voyvodinovo – an attractive location for many manufacturers – the company has now initiated an investment plan for the construction of an own office building, including showroom and a new warehouse. The construction of the new premises holds is now in its first stages, obtaining planning approvals and elaborating on the building layouts in detail.

For day-to-day business, Stanislav Dundekov relies on a team of eight professionals in sales, warehousing, customer services, and finance. One of the team members especially focusses on the sales and purchase of spare parts, because for two years now, this business segment has shown great potential and substantial growth.

The Bulgarian market

According to market research reports, the Bulgarian demand for plastic parts and rubber products has increased at a significant rate, including plastic packaging products, automotive parts, electrical engineering products, rubber mats, conveyor belts, and rubber gaskets. This comes as a result of the growing construction and automotive sectors.

A closer view of the current market situation shows two other main tendencies:

- Local processors have put on hold their medium-turn investment plans. Orders are placed in consideration of the actual demand.
- There is strong competition with regard to the supply of auxiliary equipment.

In these challenging times, one of the most competitive advantages of WITTMANN BATTENFELD Bulgaria is the excellent after sales service the company offers. In addition to Stanislav Dundekov's comprehensive expertise, the company's service team consists of two excellent technicians – able to promptly locate any customer's technical problem and smoothing out any issues that prevent defect-free production.

Since the beginning of the New Year, WITTMANN BATTENFELD Bulgaria has received a substantial number of inquiries referring to injection molding machines and other equipment. Stanislav Dundekov believes that the situation will become even better, and that the slight uncertainties that occurred in the market through 2020 will soon be forgotten. ◆

Articles that appeared in *WITTMANN innovations* so far

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- MIHB and JUNIOR 3 Compact *4/2016*
- ARaymond and the G-Max 33 *3/2017*
- Liebherr Bulgaria central system *1/2018*
- The new S-Max granulator series *3/2018*
- Feeding shaft for granulators *1/2019*
- Granulator service tips + Hoffer, USA *1/2021*

Flow Control/Temperature Control

- Advantages of pulsed cooling *1/2007*
- Comparing water to oil *2/2007*
- The new TEMPRO plus C series *3/2007*
- COOLMAX cooling units *2/2008*
- TEMPRO "guarding" IMMs *3/2008*
- TEMPRO with DUO cooling *4/2008*
- Variothermal tempering *1/2009*
- TEMPRO plus C180 *2/2009*
- TEMPRO direct C120 [C250] *3/2009*
- WFC: Water Flow Control *4/2009*
- TEMPRO plus C180 *1/2010*
- TEMPRO: Universal benchmark *2/2010*
- BFMOLD® mold cooling *3/2010*
- TEMPRO plus D *4/2010*
- Online-thermography *1/2011*
- Tempering at Fuchs & Sohn *2/2011*
- TEMPRO plus D in automotive *1/2012*
- Oscilloscope function *2/2012*
- Compact temperature controller *4/2012*
- Optimal tempering = quality *1/2013*
- The Starlinger special solution *2/2013*
- New WITTMANN equipment *4/2013*
- TEMPRO uses heat waste *1/2014*
- Clean solution at DELPHI *4/2014*
- Blum using a special solution *1/2015*
- The new FLOWCON plus *4/2015*
- TEMPRO plus D at Fischer (D) *1/2016#*
- WFC retrofit kit is available *2/2016*
- FLOWCON plus at COLOP (A) *3/2016*
- TEMPRO plus D180 at Wethje *4/2016*
- The new TEMPRO basic C120 *1/2017*
- Rejlek Group uses TEMPRO *3/2017*
- TEMPRO plus D with *SpeedDrive 4/2017*
- Water: high-temperature medium *4/2017*
- Flow control at SANIT, Germany *3/2019*
- New series 110 and 310 *2/2020*

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