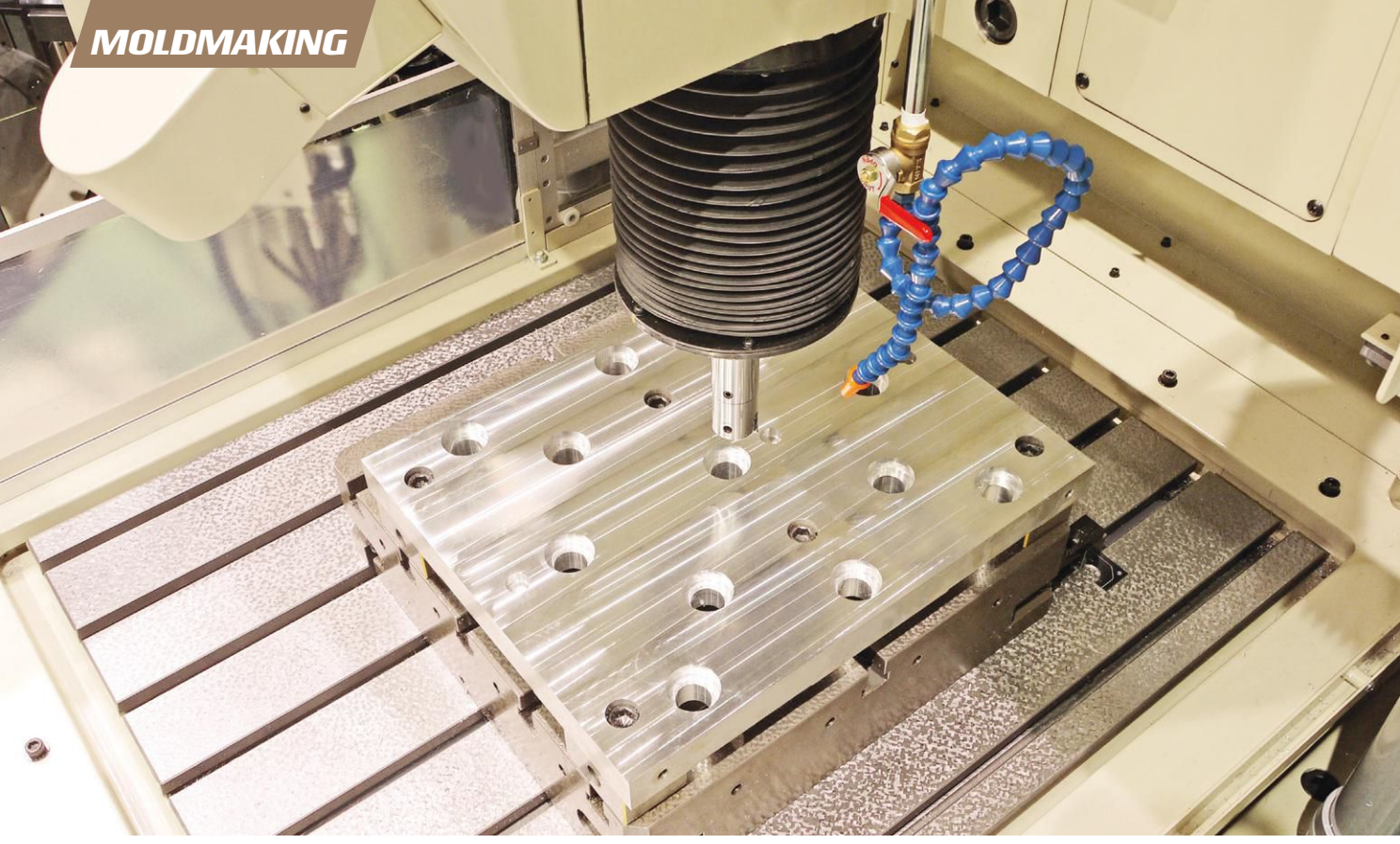

Moldmakers Power Up With Advanced Tech

In moldmaking, time is money—here's how to save it

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Complex molds containing cores and cavities with fine details and demanding surface finish requirements for injection molding, blow molding, glass molding or blow molding parts require high accuracy for use in automotive, medical, aerospace, or consumer products. To efficiently make accurate molds, moldmakers are aided by new developments in machines, cutting tools, CAM programming and scanning to shave precious hours and even days from the process.

The following article focuses on new technologies that are streamlining moldmaking today.

All Molds Are Not Created Equal

The pressure to meet customer demand for faster turnaround times is especially challenging for a shop like Moulexpert Inc., Saint-Romuald, Quebec, Canada. It specializes in

Manufacturers of mold bases use jig boring and jig milling machines to finish precision bores that can feature tolerances of less than 5 µm in roundness, perpendicularity, and straightness. (Provided by Mitsui Seiki)

thin-wall, multicavity injection molds for the food packaging industry. To expand, the shop searched for precise, repeatable and versatile machine tools.

According to company CEO Steve Nadeau, it's more difficult to inject plastic into thin mold cavities because the flow channels are just 0.015" (0.38 mm) wide. During plastic injection, the thin flow channels create tremendous pressure inside the tool. Even with a good mold design, any uneven wall thickness will affect the mold. A machine tool must produce mold components with tolerances in the range of 5 µm, said Nadeau.

As the shop positioned itself for further growth, Moulexpert selected the high-speed, five-axis Mikron MILL P 800 U ST from GF Machining Solutions LLC, Lincolnshire, Illinois. Designed to achieve high removal rates and precision on round and other challenging mold cavity components, the Mikron MILL P 800 U ST, with an 800-kg part table capacity, provided the capabilities Moulexpert needed, in a minimum of floorspace.

The Mikron MILL P 800 U ST mills and turns with a 20,000-rpm spindle and a hydraulic system that locks it in place for turning. The new machine enabled the shop to reduce lead times and improve productivity, especially for thin-wall molds for round-shaped containers.

"The machine's compact design and its turning functionality to run round containers were important," Nadeau said. "Also, we liked the machine's versatile spindles that allow us to drill and tap holes in mold cavities, then rough and finish turn them to within 5 µm tolerances. If we had purchased a turning machine, we wouldn't have five-axis capabilities, and we would have had to buy two machines."

Additionally, the patented Machine and Spindle Protection (MSP) System protects the machine's spindle in the event of a crash. The machine also has automated pallet handling without restricting access to the work area.

For optimal part production, the machine's Intelligent Spindle Monitoring (ISM) feature helps save tooling costs by extending the machine's working life, increasing part quality and reducing machining cycle times. ISM displays the milling vibrations in X, Y and Z directions for process optimization.

Jig Mills Round Out Moldmaking Tech

When it comes to machine tools for moldmaking, "one size fits all" won't do. "Moldmakers shouldn't be forced into buying machining solutions in a box," said Tom Dolan, vice president, Mitsui Seiki USA Inc., Franklin Lakes, N.J. "Our approach is to provide customers with choices of spindle technology, machine configuration and axis drives," he said.

Moldmaker Moulexpert chose the Mikron MILL P 800 U ST to achieve tolerances in the range of 5 µm that are needed to machine thin-wall molds for the packaging industry. (Provided by Moulexpert and GF Machining Solutions)

"[Moldmakers] have one shot to make something perfectly good. The number of cavities [in production molds] are starting to multiply, some upwards of 36, 72, and 144. The larger the number of cavities, the more repeatable the manufacturing processes have to be because all the cavities have to be identical," said Dolan.

"The end users of those molds, our customer's customer, are looking for a faster turnaround time on repair or replacement of those cavities as they wear in production. As a result, moldmakers need machines that are able to deliver accurate mold components as spare parts down the road."

Mitsui Seiki has expanded its jig milling machine lines. "We look at the mold as a system and cater especially to the large and medium-sized mold bases, hot runner plates and larger components," said Dolan. "The differences between a jig borer machine and a jig mill are significant. The jig mill allows moldmakers to get more out of a single machine tool and a single workholding system and setup and do precision boring work, with accurate positioning and geometry to produce round, straight bores in precise locations. In addition, with the jig mill, moldmakers can do general milling, tapping, drilling and other operations on the same component without changing machines or setups."

Mitsui Seiki jig mill models include the J1220 with 1,200 × 2,000 mm strokes in the Y and X axes. Longer components can be handled with the J1230 with 1,200 × 3,000 mm, and a larger machine, the J1625 with 1,600 × 2,500 mm stroke can accommodate much larger plates and workpieces weighing up to 15,000-16,000 lb (6,804-7,257 kg).

The new PJ812 jig mill with 800 × 1,200-mm stroke was recently introduced by Mitsui Seiki for the medium-sized mold segment. Smaller bases and hot runner plates can now be economically made on the same basic machine platform that would be capable of high-speed profile machining. Manufacturing of those types of components for plastic injection molding, die cast molding, glass molding, or silicon molding is increasingly being done in North America, according to Dolan. Mitsui Seiki jig mills feature spindle speeds that range from 10,000-25,000 rpm, or 30,000 rpm with HSK 100/50 taper or HSK 63/40 taper spindle tapers.

"The advanced spindle technology allows the use of larger end mills and face mills, working with the side of the tool as opposed to just axially working the tool, as is the norm on traditional jig borers. Jig mills also have a variety of high-capacity toolchangers and significantly more in-machine process automation to even further enhance moldmakers' productivity," said Dolan.

Tools for Fast-Feed Milling, Roughing

Iscar Metals Inc., Arlington, Texas, continues to add to its lines of cutting tools that are appropriate for moldmaking. LOGIQ4FEED, a family of small-diameter, fast-feed milling tools, for example, features narrow, bone-shaped, double-sided inserts with four cutting edges. The family is designed for roughing operations, especially when machining deep cavities like those typically found in moldmaking.

The bone-shaped insert has four indexable cutting edges. Each edge comprises two edge sections: a major cutting edge and a minor cutting edge, which improves cutting action in ramp-down milling. The cutters 17º cutting edge angle with a progressive cutting geometry reduces cutting forces and enables smooth cutting.

Cutter diameters range from 0.500" up to 2.00" (12.7-50.8 mm) diameters. Built-in side clearance on the insert allows all four edges to be used without fear of losing tool life when working near straight walls, heavy pocketing, or helically interpolating holes. With its 0.031" (0.79-mm) max Ap with optimum corner radius and straight-wall capabilities, the insert allows semi-finishing operations to sometimes be eliminated. Available with four cutting edge geometries and six grades, it has maximum application versatility.

The LOGIQ4FEED narrow insert design allows for a higher tooth density, while a larger core diameter on the cutter body adds extra strength and rigidity. The cutter bodies all have through-coolant with pinpointed holes aimed directly at the cutting edge and have a polished coating for wear resistance and superior chip flow. Iscar is also expanding the application range of its solid-carbide end mill and MULTI-MASTER lines by adding barrel and lens type tools for five-axis profile milling applications.

These new profiling tools constitute a new cutting tool class (a hybrid) that incorporates large, truncated radii in the tool's cutting zone. This reduces the number of cuts and passes needed for a given operation, thus reducing processing time and creating machined surfaces that are smoother than when applying traditional ball nose end mills under similar cutting conditions.

This new tool class is suitable for machining a range of materials, including exotic materials such as titanium, Inconel and stainless steel, according to the company. Aerospace and power generation components (such as blisks, impeller blades and turbine blades), medical industry components (such as implants, prosthetics and orthopedics) and die and moldmaking components (such as mold base, core and cavity milling) are some examples of products that can be created with these new five-axis profiling tools.

When coupled with modern CAM systems capable of recognizing hybrid cutting tool profiles (such as Mastercam and *hyper*MILL) and five-axis machine tools, these new end mills have the potential to reduce cycle time for semi-finish and finishing applications by up to 50 percent, said Iscar.

Data Hold Key to Quality, Time Savings

Producing an acceptable injection-molded or blow-molded part relies on the quality of the tooling, according to Frank Stone, national sales manager, Capture 3D Inc., Farmington Hills, Mich. "One of the big advantages of using a metrology-grade 3D scanner is the amount of information and feedback that the moldmaker gets during the design and manufacturing processes," he said. "First, you start by 3D scanning the mold and then analyzing the data to make mold corrections, which is called tuning. One important goal for companies is to reduce the number of tuning loops, or iterations, to speed up time to market while reducing wasteful costs. The next phase is using the mold tryout to prove out the part to make sure that the tool is making the part correctly," said Stone.

Iscar's LOGIQ4FEED family of small-diameter, fast-feed milling tools features narrow, bone-shaped, double-sided inserts with four cutting edges for roughing operations, especially when machining deep cavities such as molds. (Provided by Iscar USA)

There are different names for 3D scanning technology, such as an optical measuring machine, white or blue light 3D scanner, structured light 3D scanner, non-contact 3D scanner, etc. Capture 3D's ATOS series of industrial, structured blue-light 3D scanners uses non-contact optical technology with a blue LED light to capture millions of points in a single rapid scan. The ATOS series is used in various industries and measures different object sizes, surface finishes, and shape complexities.

"The advantage of non-contact optical collection of data points versus tactile collection is really a matter of the number and density of points, and the time it takes for the entire measuring process," said Stone. ATOS captures full-field scans of a volumetric area, collecting millions of points per scan, and a single scan can be as fast as 0.2 sec. With tactile measurement, there are more steps and programming time involved in mold tryout and correction. With structured light technology there is no concern if there is enough data to make a sound decision.

Companies are using this technology throughout various processes, from toolmaking, mold flow simulation, and mold tryout to measuring the final part. “Using an accurate, industrial 3D scanner that is metrology-grade significantly speeds up the process from mold design to producing a good part,” said Stone.

The time it takes to scan a workpiece depends on its size and complexity. “One of the nice things about our scanning technology is that it is portable and can be taken onto the shop floor in the die and mold area. Our structured light scanners capture millions of accurate data points from a part in minutes,” Stone said. “Also, automating this technology has been a trend to further improve throughput, repeatability, and productivity.”

Based on the principles of triangulation, the ATOS projects a fringe pattern across the part’s surface, and as the patterns rapidly shift during each scan, two cameras capture the displacement to calculate the 3D coordinate measurements. Setup for the ATOS is minimal as it doesn’t require specialized programming skills or highly accurate fixtures. ATOS discovers discrete, problematic areas by quickly scanning the entire object in its point cloud. These areas would not have been detected by traditional measurement methods.

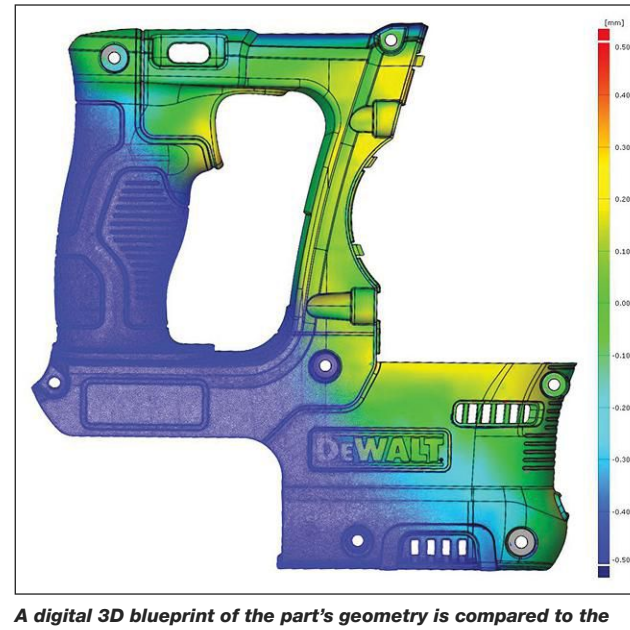
This digital 3D blueprint of the object’s geometry is then compared to the CAD drawing with a 3D inspection color map displaying a spectrum of colors that signify areas in and out of tolerance. Another advantage of high-quality data is the ability to “mold fingerprint.” With 3D scanning, a user can actually scan the final mold after the rework to digitally archive the data for reproduction or modify it for future projects. This is accomplished by running the scan data through a CAM program, according to Stone.

CAM Software Creates a Digital Twin

You might expect the COVID-19 pandemic to be devastating whole segments of manufacturing, and it has. However, some companies, especially those with strong digital presence, have been able to continue to provide high-level support to their customers. DP Technology Corp., Camarillo, Calif., developer of ESPRIT CAM software, has been able to adapt its digital network and continue to deliver direct support to its customers across the country, whether it be for machine programming, optimization or simulation.

According to Don Davies, vice president, ESPRIT CAM software creates a digital twin of all types of machine tools, including twin-spindle, twin turret, five-axis mill-turn machines, additive/subtractive hybrids, and Swiss-style lathes, among others, including machines used for mold-making. ESPRIT delivers edit-free G-code using a digital twin of the CNC machine including part setup, tooling assemblies, and automation.

Automated scanning of plastic parts with the ATOS scanner. (Provided by Capture 3D)



A digital 3D blueprint of the part’s geometry is compared to the CAD, with a 3D inspection color map displaying a spectrum of colors showing areas that are in and out of tolerance. (Provided by Capture 3D)

"The digital twin builds an exact representation of the machine tool in the computer. Our solution is to have the user push a button to create the code, just like pushing a button on a computer to print something. It's a big time-saver. There's no need to go back and forth editing and re-editing code to get the programming right," said Davies. "Machine tool builders are always coming up with new machine tools. Good ones typically last for 20 years, creating a window of time during which we will support them through changes in controls and post-processing requirements."

DP Technology has provided temporary licenses to enable its customers to work at home and away from their facilities. "Our digital support network has made it fairly easy for us to migrate to online training and consultation," said Davies. "It's not difficult to imagine training delivered to multiple people in one company or multiple companies participating in the same time zone. We don't see face-to-face meetings being replaced in the future, but for the time being travel and events like IMTS and Smart Manufacturing will certainly be missed as they are an important part of our overall business dynamic."

Davies believes that as we move into the future of CAM, it will be dominated by both digital and virtual—and CAM will become "one" with the machine tool.

FYI

Capture 3D Inc.
714-546-7278 / www.capture3d.com

DP Technology Inc.
800-627-8479 / www.espritcam.com

GF Machining Solutions LLC
847-913-5300 / www.gfms.com/us

Iscar Metals Inc.
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Mitsui Seiki USA Inc.
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