

Easy Five-Axis Machine Tool Programming Allows Bottles to Keep Flowing

At Sidel Inc. (Norcross, GA), productivity for producing complex molds on five-axis machining centers came from more than just the machines. It also came from how fast and easy the machine could be programmed.

The Sidel Group is one of the largest worldwide manufacturers of plastic rotary blow-molding machines, along with equipment for filling and capping the final product. Their production equipment is used for PET (polyethylene terephthalate) containers of liquid and semi-liquid consumables for such products as water, mayonnaise, ketchup, fruit juices, tea, milk, and cooking oils. In fact, more than one of every two PET bottles in the world is produced on a Sidel machine.

In 1988, the company started a division in Norcross, GA, to produce molds for their equipment. This would allow the company to offer molding only or a turnkey package including design, development, mold build, and prove-out of the complete process. To produce these molds, Sidel started production as primarily a repair and support operation with limited production capabilities. When production needed to be increased, they purchased two FJV vertical machining centers from Mazak Corp. (Florence, KY).

Although the FJVs served Sidel's needs, they found that five-axis technology was a better way to produce their molds for greater productivity. Even though it had a five-axis machine from another vendor, Sidel's production manager, Jay Lowry, said the company needed more productivity. Sidel then purchased two Mazak five-axis Variaxis 630 VMCs in

2002. Lowry stated, "What we like about the Mazak is the conversational control. We can do a lot of the programming at the machine, whereas most 5-axis machines have to be programmed offline."

Mazak's Mazatrol plays an important role in Sidel's operations. Lowry is a believer in empowering operators and all employees in the implementation of advanced technologies to keep the company's competitive edge. Programmers and machinists are cross-trained in-house. Mazatrol allows a significant portion of the programming to be accomplished on the shop floor, reserving CAD/CAM programming for complex mold cavities.

Lowry also mentioned that five-sided machining was the second factor for moving to the five-axis Variaxis. "Most of our molds are cylindrical, around six inches in diameter. We also have an older type of mold for large bottles, such as a 1-gallon mold that we're currently working on made out of stainless steel. They can also be manufactured out of aluminum. The mold is made from two halves that make a 180-mm square. We're able to machine the back of each mold half then mount it to a fixture, and finish machining the other 5 sides in one setup."

Sidel also found an unexpected benefit with the Variaxis machines. The accuracy of the primary operations, such as squaring the piece, improved dramatically in a single-setup environment. Lowry can keep the molds on one machine, reducing or eliminating transfers between machines and stack-up of machining variables. This benefits the rest of the processes. Tolerances are in the range of ± 0.0004 ".

Basically, three components make up the mold cavity: the two mold halves and the bottom part of the mold that actually retracts away from the bottle. "We have 600 psi that blows into the molds to form the bottle. Air has to be removed between the pre-form and the cavity wall. We need escape vents for the air, and the five-axis gives us the capability to do this in the production of the molds."

Another important feature of Mazak's Variaxis machine tools is the pallet-changing system that increases spindle usage. One pallet is in the machine having parts produced while the other is having components placed in the workholding fixture. But to increase the flexibility of these machines, Sidel is adding a Mazak Palletech material-handling system with 12 pallets that can be automatically shuttled between the two machines, allowing lights-out (unmanned) automated production.

Mazak's Palletech wasn't first factored into Lowry's decision to purchase the Variaxis machines. He said, "It was in the back of our minds, eventually we really want to step up our unmanned production time. We figure we can get another 15 to 20% out of the Variaxis just by adding the Palletech system. We have two shifts and we want the third shift to be unmanned from 10 pm to 6 am."

Products that Sidel produces are containers that hold anywhere from 4 to 6 ounces and up to one gallon. For a four to six ounce bottle, the mold is roughly 10 inches long and the cavity is about five to six inches long and about six inches in diameter. Sidel builds its molds from aircraft-grade aluminum and a stainless-steel grade comparable to 420. "I'd say 80% of the molds are aluminum, and the other 20% is stainless. We also use high-speed machining whenever possible," added Lowry. Aluminum is used for the molds because Sidel's rotary blow-molding machines use centrifugal force, and light molds produce less centrifugal force and offer quicker cycle times.

Molds are generally produced in complete sets, meaning from six to twenty-five molds produced in a lot. With the Mazak Variaxis machining centers, lead times were reduced from 8-10 weeks to 3-5 weeks to meet customer demands.

Lowry also remarked that Sidel has the Mazak Fusion 640 control on both of their Variaxis machines. It's very easy for them to go from one machine to the other. For downloading programs, they use an Ethernet network throughout the plant for sharing engineering information, CAD/CAM programs, and production schedules. To keep machine utilization high

and maintain production flexibility, the first mold building operations are programmed on the Mazak machine in Mazatrol. This includes milling, drilling, and tapping of mold features and roughing the cavity. Complex mold cavity programs are done off-line in EIA format and downloaded to the Mazatrol. Lowry added, "Most of our programs are just for mold cavities. We also have macros that we use for the drilling of the 5-axis parts. They are basically a macro setup sub-routine where we answer just variables; how many holes, what angles, how deep? And it works in conjunction with the Mazatrol program to do the hole-vent cutting of different size mold cavities."

As stated by Lowry, Sidel looked at another machine builder for their high-speed machining capability when they first began the purchasing process. "But we really decided that for our shop it was best to keep one control type for the machine, and Mazak was one of the few that we felt comfortable going with for almost all of our needs. Mazak also has a new training facility in Suwanee, GA, so it's really close to us, and we get good support from them."

To implement these reductions in lead-time and increases in production, Sidel uses Mazak multi-tasking and high-accuracy machines to combine operations, eliminate practically all EDM functions (including engraving) and dramatically lower hand polishing on mold surfaces. The Variaxis machines are not required to machine a mirror finish, because final hand-polishing, which only takes about an hour per mold, was less expensive to do manually than using the machines.

Mazak's Variaxis 630 offers 24.8" of travel in the X axis, 30" for the Y, and 20" for the Z axes. The A-axis is a tilting motion of +30 degrees to -120 degrees. C axis rotation is 360 degrees with contouring capability. Pallet tables are 19.7" by 25". A 30-hp spindle with 12,000 rpm is standard and an optional 25,000 rpm spindle is available. Rapid traverse rates are 1969 ipm.

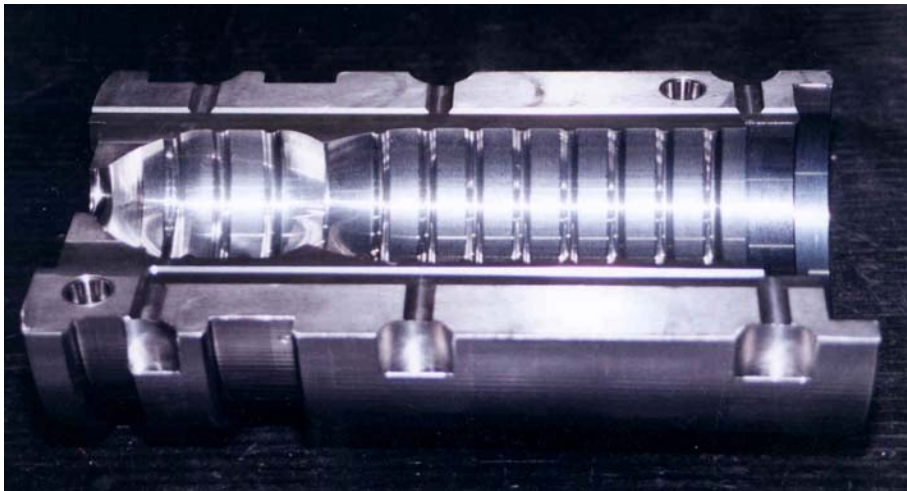
Sidel continuously trains their people to upgrade skills and realize increased throughput by investing in, and embracing, technology throughout the company. Employee turnover is

extremely low. Since 1998, production has ramped up from 35 molds per month to about 250, or more than 700%, with no increase in manpower (15 operators on the floor).

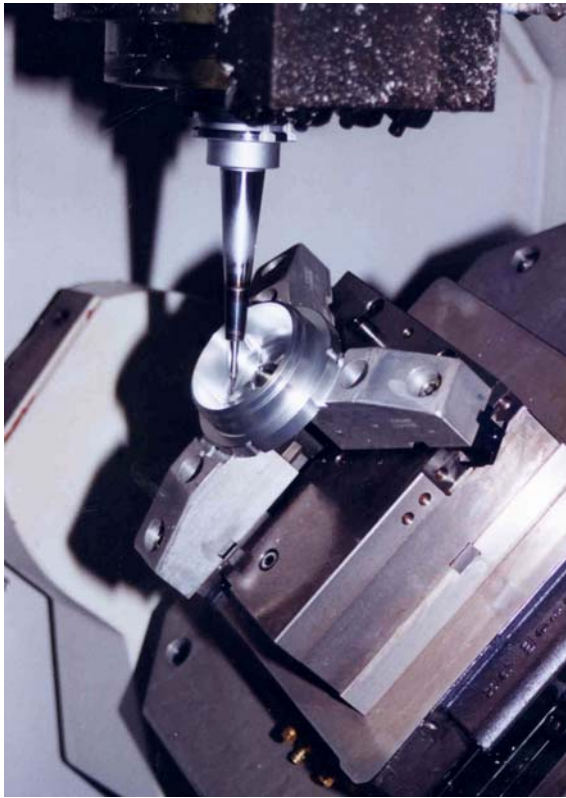
Captions:



Ease of conversational programming while taking advantage of five-axis machining in a single setup meant big production gains for Sidel Inc.



Bottle molds require multiple operations including milling, drilling, boring, and tapping, all accomplished in a single setup on the Mazak Variaxis.



The A-axis is a tilting motion of +30 degrees to -120 degrees on the Variaxis. Pallet tables are 19.7" by 25".



Molds are finished to such a degree that EDM and even hand-polishing operations could be eliminated. Since 1998, production at Sidel has ramped up from 35 molds per month to about 250 (more than 700%) with no increase in manpower.