As price pressures squeeze manufacturing margins, new abrasive waterjet technologies are enabling job shops to cut components faster and more accurately, getting parts to customers more quickly and lowering overall production costs. The abrasive waterjets boast an ability to cut a very wide array of materials, ranging from thick, hard metals to stone, granite and glass, while leaving no heat-affected zone (HAZ) on the workpiece with this inherently cool manufacturing process. The latest abrasive waterjet cutting systems also can pack a greater punch, with many sporting new higher-pressure pumps that reach up to 90,000 psi or higher and allow shops to increase cutting speeds to help reduce part costs.

Waterjet speeds and lowering the cost of consumables like abrasives are the biggest trends in waterjet machining, said Bob Pedrazas, marketing manager, KMT Waterjet (Baxter Springs, KS), a builder of waterjet pumps sold to waterjet OEMs. “They’re all looking for speed, productivity, and how to reduce abrasive...”

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Senior Editor

New Technologies Raise the Bar for Abrasive Waterjets
consumption,” Pedrazas said. “Abrasives are the biggest cost factor—it’s something between 50–75% of operating costs are in garnet.”

Need for Speed

By cutting faster at higher pressures, waterjet operators can substantially reduce cutting times, and abrasives consumed, he noted. “We have a 90,000-psi, 125-hp [93.2-kW] motor, and we can run two cutting heads at a time,” Pedrazas said. KMT’s broad line of pumps range from 15-hp (11.2-kW) models to the 125-hp motors powering the highest-pressure waterjets. “In the metalcutting industry, at 90,000-psi, two cutting heads with 0.011” [0.28 mm] orifices can easily cut metal at once,” Pedrazas said. “What people ask is ‘How do I reduce our abrasive costs and improve productivity?’”

Higher pressures equate with faster cutting and better productivity, said Chip Burnham, global vice president of marketing for Flow International Corp. (Kent, WA). Among the key trends in waterjets is raising the waterjet pressure to improve the cutting efficiency, he said. “In our experience of working with countless shops across the world, a few pursuits are common in manufacturing: lowering production time and costs; reducing demand on high-skill labor; and maximizing shop-floor equipment reliability and uptime,” Burnham said. “To meet these common goals, Flow has worked hard to improve productivity of waterjets through raising pressure, and thereby cutting efficiency, simplifying programming and operation by making the software smarter, and offering a variety of in-house service contracts to reduce or eliminate machine maintenance.”

The Flow HyperJet’s 94,000-psi (648.1-MPa) pump, which delivers significantly higher operating pressure, can reduce waterjet cycle times and operating cost, he said. “Raising the pump ratings from 60,000 psi [413.7 MPa] to 94,000 psi increased waterjet stream velocity up to nearly Mach 4,” Burnham added, “and with this advancement, the waterjet becomes more efficient. The HyperJet 94,000 psi pump delivers a 30–50% reduction in abrasive [which is half the operating cost of a 60,000-psi abrasive waterjet system], while increasing cutting speed. Since the invention of waterjet cutting in the early ’70s, water pressure has always gone up, as has efficiency.”

No Downtime Allowed

Along with faster cutting speeds, waterjet users expect more reliability than ever from their equipment, as any
downtime drastically cuts into the bottom line. “Customers are putting a bigger and bigger premium on uptime,” said Mike Ruppenthal, vice president, sales, for waterjet builder OMAX Corp. (Kent, WA). “Waterjets are becoming more of a mature technology, and machine downtimes are fewer and farther apart.”

More reliable waterjet pumps play a big part in reliability, and Ruppenthal said that OMAX’s EnduroMax pump is in its fifth generation. The pumps, which previously had a 500-hour maintenance interval, now don’t require maintenance service until the 1000-hour mark.

“Waterjet cutting was an immature technology for a long time, and as with the first HD TV or the first electric car, the guy that bought those is going to understand there may be some problems,” Ruppenthal said. “Today, customers aren’t willing to put up with problems. We put a lot of emphasis on that.”

Visitors to this month’s FABTECH show in Chicago will see an OMAX 6120 waterjet machine equipped with a rotary axis, which makes it a six-axis system, Ruppenthal added, plus the company’s 100-hp (74.6-kW) pump introduced last year at IMTS and other new waterjet innovations.

Besides demanding excellent cutting capabilities, abrasive waterjet users are increasingly looking at the overall operating cost of a system, said Sara Mancell, HyPrecision Waterjet team leader, Hypertherm Inc. (Hanover, NH). “Speed, efficiency, abrasive and water usage all come into play along with maintenance,” she said. “They want a system with the longest maintenance interval possible, and a system that is easy to maintain so when it does require work, they experience minimal downtime. Ease of use is another really important feature for users today since it’s getting so hard to find experienced operators. They want a system that is intuitive to learn and use.”

At FABTECH, Hypertherm plans to introduce two new waterjet systems that Mancell said are designed to significantly reduce waterjet operating costs by delivering marked labor and consumable savings for companies operating the waterjet machines.

Versatility Helps Waterjets Expand

The breadth of applications found for waterjets is expanding due to the many advantages of waterjet machining processes. “Waterjet cutting is found in all sorts of cutting applications from harder materials such as stainless steel, aluminum and granite, to softer materials like rubber, plastic and food,” Mancell said. “In the automotive industry, waterjet is used to cut headliners and panels for cars and trucks. Waterjet is used in building construction to cut out the sink and fixture holes in granite and stone for countertops. In the food industry, waterjet is used to chop leafy vegetables and cut the hulls off of strawberries in preparation for freezing.”

While predominantly used by job shops and fabrication facilities, the flexibility of waterjets has made it an attractive option for other industries. “We’re seeing other industries adopting it, for things like elevator interiors, where they use a variety of materials,” said OMAX’s Ruppenthal. “Another application is a company that makes cooling equipment for data centers for cloud computing, and lately glass has become of interest, with companies in the Northeast working in architectural and scientific markets using industrial glass for telescopes and electronics.”

Another interesting use of waterjets beyond discrete manufacturing is in the packaging industry for packing materials, said Jeff Schibley, Great Lakes regional manager for waterjet developer Jet Edge Inc. (St. Michael, MN). “We’ve
seen a lot of people in the packaging industry using waterjet for the foam packaging industry. Your new Dell computer or printer is shipped with an engineered structure that fits to the product," Schibley said. “Often they’ll fabricate devices that allow us to load that sensitive electronic equipment into this egg crate that goes in the box. It’s been in use for a number of years, but I find more fabricators are using it.”

Even toy companies are getting into the act, as Schibley cited the case of Jet Edge user YOXO Inc. (St. Paul, MN), a company that makes creative toy-building kits for children that are cut from cardboard with the waterjet. YOXO recently added a second Jet Edge machine to handle the volume of toys produced, which are sold in Target and Barnes and Noble stores nationwide. YOXO (pronounced “yock-so”) produces kits that include Y, O, and X-shaped links that connect with household items like paper tubes, towel rolls and cereal boxes. The YOXO links are waterjet cut from colorful sheets of recycled wood fiber.

“They’re all looking for speed, productivity, and how to reduce abrasive consumption.”

“They make the parts out of cardboard and they’ve been very successful,” Schibley said. “If they were to build dies of those, they’d have a huge inventory of those dies.”

More Automation

Today’s waterjet users are also looking for more automation in their manufacturing processes, to require less intervention in the process by the operator, noted Schibley. “Customers are still demanding ease of use and features that enhance their productivity and make their systems more convenient to use,” Schibley said. “For the most part, I’m finding that customers are looking to do anything they can to enhance the operation, and yet reduce labor content.”
New technologies that can help reduce operator involvement are key, Schibley said. An option from Jet Edge features contact height sensors that along with waterjet’s controller software can help users avoid any potential collisions. These sensors overcome significant variations in material flatness by maintaining a constant automatic standoff within 0.040” (1 mm) of the set standoff height.

“Speed, efficiency, abrasive and water usage all come into play along with maintenance.”

“Collision or height sensing is important when the customer wants it running without an operator,” Schibley said. “This reduces labor content by the operator not having to adjust it. It’s a feature that many customers didn’t purchase in the past, but now they are saying that’s something they want.”

Another productivity-enhancer for shops is using nesting software that helps maximize how much material is cut, with a reduction in the amount of scrap produced. “A lot of waterjets offer what’s called an array nesting, where you have maybe about 24 parts and it draws a rectangle around the parts,” Schibley added. “But with our system’s true shape nesting, we can look at that shape and recognize the true geometry.”

**Software Enhancements Speed Programming**

The new features in waterjet software play a key role in boosting machining productivity, with the move toward more 3D modeling leading the way.

“Good software is the brain driving the cutting system, so it’s incredibly critical to achieving optimal cut quality, and reducing operating costs,” said Mancell. “In addition to Hypertherm’s CNC software, we also offer CAD/CAM software for both 2D and 3D applications. What sets Hypertherm’s software apart is that our engineers and programmers are all in-house. This allows them to integrate development among our different software platforms leading to optimized cutting outcomes and ease of use for our customers.”

Hypertherm’s Rapid Part technology is a good example of collaboration among our various software platforms, she added. “By working together, our developers were able to reduce the cut-to-cut cycle time by half, helping companies

**A high-pressure waterjet from Flow International cuts nested metal parts.**
process twice as many parts in the same amount of time,” she said.

New features added to OMAX’s Intelli-Max programming software, developed by the company, focus on making accessories work seamlessly, Ruppenthal noted, with easy interoperability offered for SolidWorks, AutoCAD and many more formats. “It’s making 3D easier and easier, it’s ever-improving with the software models,” Ruppenthal said. “How we model the water stream is important. The software probably has the single biggest input on how well you can use the machines.”

Flow’s FlowXpert 3D model-based CAD/CAM programming software greatly simplifies the process of “art-to-part” in a waterjet, said Burnham. “Software is one of the keys to maximizing waterjet for our customers. We found that some of our customers were already using solid models every day in their CAD/CAM department. Others saw solid models occasionally, and still others did not currently use solid models, but they knew the time was coming soon.” Due to the trend to move to solid models, Burnham said that Flow collaborated with CAD/CAM software developer SpaceClaim to develop a fully integrated model-based CAD/CAM waterjet programming software.

Solving the Skills Shortage

A familiar refrain in the manufacturing industry is the lack of skilled workers with the training and aptitude needed to do the job. One way to help alleviate that scenario is through in-house training programs like OMAX’s online training program. “Customers are looking for trained operators,” said Ruppenthal. “Oftentimes, somebody will buy a machine, and then have to send someone to school for training. They’re often starting with somebody new that doesn’t know anything about the machine. We’ve made our training program better, with an E-learning, Internet-based portal.”

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