BY MICHAEL CHAZIN, EDITOR-IN-CHIEF

There's a waterjet in your future

Waterjet cutting might just be the fastest growing technology in metalworking today. Reasons for its success include simplicity, high productivity, reasonable entry-level pricing and applications across all metals.

Chicago Waterjet uses its waterjet systems to cut anything and everything but primarily metals for a variety of tool and die and automotive customers. (Photograph courtesy of OMAX Corp.)

Waterjet cutting technology isn't complicated or difficult to understand; it's just different from more established metalworking processes. The process has evolved considerably since it was first introduced for industrial applications and today offers viable cutting technology for a number of different markets. Its growing popularity in metalworking is due, at least in part, to its relative ease of operation.

All waterjet systems contain the same basic components: A pump pressurizes the water, and a high-pressure line transports the water to the cutting head. Typical pressures in use today range from 50,000 psi to 60,000 psi. At the delivery point in the cutting head a gemstone orifice—typically diamond, sapphire or ruby—focuses the cutting stream.

"It has to be a really hard material," explains John Dedic, marketing manager for KMT Waterjet Systems, "so that the water stream doesn't cut the opening wider. When the water goes through the orifice at 60,000 psi it is moving about 2,200 mph and is able to cut some very hard materials."

Even at that speed and the associated force of the waterjet, water alone can't cut metal so an abrasive, such as 80-grit garnet, is added to the water stream. An abrasive feed line is attached to a hole in the cutting head, and as the water passes this hole it sucks in the abrasive which mixes with the water just before it enters the focusing tube, which refocuses the water and abrasive mixture.

Easy to use

Although industrial waterjet cutters have been around since the early 1970s, it is only recently that technological advances and changes in pump design have enabled them to cut more efficiently, explains Dedic. "We can manufacture the pump with better precision and tighter tolerances, and that has enabled us to raise the water pressure. Our pumps now operate for long periods at 60,000 psi with minimal but regular maintenance.

"The real draw is the ability to produce different parts without any setup change," says Dedic. There is no tooling to change and no adjustments to make. No secondary process is needed to clean up the metal after the cutting takes place, and the integrity of the material is maintained; it doesn't get warped or damaged, adds Dedic.

"The surprise about waterjet is that it is very fast to set up," says Dr. John Olson, vice president of operations for OMAX Corp. "You can switch from aluminum to steel with virtually nothing to do." It also is a good choice if other metals need to be cut. It works well cutting copper that wouldn't go on a laser.

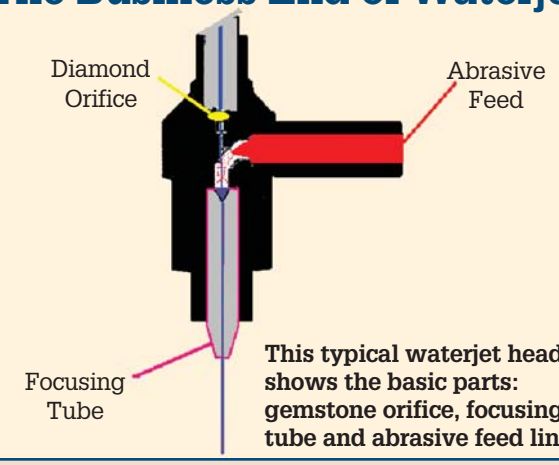
The precision of the waterjet process offers additional advantages. "If you're building a machine base, for example," says Olson, "you can make holes so precisely that all you have to do is tap them." He summarizes the advantages as follows: "Fast setup, good at thick materials and good at thin sections where you might worry about melting through with a laser."

"It's fairly simple technology," explains Misty Puls, marketing director for Calypso Waterjet. Software, both off-the-shelf and proprietary offerings, controls most of the finer points of waterjet operations. "If you want to switch from cutting metal to cutting granite there's no retooling. Most of that is handled by the software." The software accepts CAD file input and automates the whole front-end process, which makes it easy to train workers. "It's plug-and-play as far as they're concerned," she adds.

Besides ease of use, waterjet users also cite versatility as an advantage. "When they get a waterjet, job shops get the versatility to cut not only metal," says Dedic, "they can cut composites, marble, glass or plastic. They can cut just about anything with this one machine."

Most buyers today have a budget for capital expenditures, says Puls. "They are looking to diversify, and they are looking to add additional capacity. They want to get the most for their money, and they're looking at waterjet." These potential buyers recognize that waterjet gives them the option to branch out into other applications. They can bring in more business

The Business End of Waterjet



This typical waterjet head shows the basic parts: gemstone orifice, focusing tube and abrasive feed line.

KMT Waterjet Systems' E-series pumps were designed for efficiency and value. The pumps include just the most essential applications without compromising performance.

and utilize the machine more fully, which makes it easier to justify the investment.

A fabricating company might already be cutting metal parts for an automotive customer. That same customer might have composites that need to be cut. The waterjet system can handle both. Puls refers to one metal fabrication shop that bought a waterjet and used that capability to land a contract with a foam company that was producing automotive parts. "People are getting inventive and are seeing the possibilities that waterjet offers," she says.

Generally waterjet buyers arrive at two realizations. First they find that the rapid setup enables them to run a lot of parts on their waterjet, says Olson. "Then they find that their operations change and almost every job starts on the waterjet, because it saves so much time in downstream machining."

Plasma cuts fast but produces rough edges that require further processing. "For people who want a quick, rough cut, plasma is a good option," says Dedic. "Laser cutting will give you a heat-affected zone around the cut," he adds. "It is a good process for material up to about ¾ in. thick, but it can't cut very reflective materials. Above ¾ in. is where laser is out of reach at a reasonable price and where waterjet really shines."

Why not a laser?

The typical metals industry prospect who is thinking about buying a waterjet is comparing it to a laser system, according to David Andrew, vice president sales and marketing for PTC. Waterjet is viewed as a choice either in addition to a laser or as a one-to-one replacement.

"If you are going to cut fairly thick steel or any kind of metal that is fairly thick," says Andrew, "it is going to take a pretty high dollar laser with a lot of wattage. You can easily spend $250,000 to get laser equipment to do that job. Your entry level for a waterjet system, including the motion control system and pump, can be packaged for less than $100,000."

One of the first considerations when specifying waterjet equipment is to determine the largest size sheet that needs to be cut. This will help determine what size cutting table to specify. For example, PTC offers four standard sizes. "We start with a 2-ft.-by-4-ft. platform that is great for small parts or a lot of prototype work," says Andrew. PTC also offers 5-ft.-by-5-ft., 5-ft.-by-10-ft. and 6-ft.-by-12-ft. tables. Other waterjet suppliers offer similar size options. "Job shops never know what they're going to handle so some of those companies will go for a bigger table," he says.

Ongoing maintenance is one factor that differentiates waterjet from other cutting options. Any part of the system that comes in contact with the water, especially internal workings, is susceptible to wear.

"The majority of maintenance is on the pump, but the cutting head has a few parts that wear out approximately every 120 hours," explains Dedic. The focusing tube, the last section of the cutting head that focuses the water and abrasive mix, will wear out and need to be replaced after about 120 hours of operation. The gemstone orifice that focuses the stream also will wear out and need to be replaced. A diamond orifice will last more than 800 hours, a sapphire orifice will last far less.

Watch the differences

Differences in the amount of time the waterjet system is in operation, the pressure that the system is using, ambient temperatures in the plant and other variables can influence the wear so that time periods between maintenance will not always be the same.

Typically the cutting stream is going to be between 0.030 in. and 0.040 in. "As you cut, the stream is going to grow bigger and bigger until it is so large that it is more of a spray," explains Dedic. At that point the system is no longer cutting efficiently. That's when it's time to change the focusing tube.

With maximum performance in mind, it's sound advice to keep an eye on the machine periodically as it is not going to degrade consistently over time. "Sometimes it's going to get worse before or later than you expect," says Dedic. "You have to look at pieces coming off, but you also have to watch the machine as it cuts; not constantly, but you have to check on it."

The pump requires the most maintenance. Again, depending on ambient temperatures and the quality of water in the system, the seals will last for a variable amount of time. KMT offers free water testing for customers to determine if and how much filtration might be appropriate. The average period between seal changes will be about 1,000 hours, says Dedic.

Replacement seals will run around $100. It is not the cost of the seals but the time that it takes to replace them. "It is really how long am I going to be down because the seals are worn out," says Dedic. He suggests that buyers investigate how easy it is to change the seals on any system before they make a purchase.

"Talk to some people and find out what kind of life they get," he says. "Find out where those seals are and how you change them." And be sure to ask how long the process takes. Dedic adds that KMT's pump was designed with easy seal replacement in mind,

8 POINTS TO KEEP IN MIND

Waterjet systems are versatile. In addition to cutting metals, waterjet systems can cut composities, marble, tile, glass and plastic.

Consider the work volume. Frequently companies that implement waterjet technology find that new opportunities come to them because of the ability to handle different substrates.

Know your needs. When selecting a waterjet system, think in terms of the largest size sheets you process. This will determine the size of the table you need to specify. Larger worktables are more expensive but provide greater flexibility.

Fast setup. Waterjet equipment is easy to set up. Switching from steel to aluminum and back again requires virtually no input.

Don't overlook maintenance. Unlike other processes, waterjet equipment requires regular maintenance. Review the ease of maintenance on the pump because more time is spent on pump maintenance than any other part of the system.

Don't worry about maintenance. The high productivity of the waterjet can completely cancel out concerns over necessary maintenance and abrasive costs.

Invest in training. Take the time and make the effort to obtain the necessary training as this will expose features and functions that might not be readily apparent.

Don't be constrained. Don't consider waterjet as a replacement for a current process. Think of it in terms of the next step and where it can take your business in the future.

and that its seals can be replaced in about 15 minutes. The same procedure on other pumps, he adds, can take two hours or more.

Productivity trumps costs

The importance of maintenance on a waterjet system can't be emphasized enough. The best performance and top efficiency of a waterjet system can only be obtained with a system that is properly maintained. Waterjet users shouldn't let these maintenance demands obscure the utility and versatility that the system has to offer.

"The very high productivity completely cancels out issues about having to buy abrasive and having to do more maintenance than you would on a milling machine," explains Olson. "In general a waterjet machine is so productive that the benefits far outweigh the costs."

The capital required for an investment in new machinery is always a serious concern, yet Puls reminds prospective buyers not to feel constrained by the purchase. "You just have the capital to spend on one machine," she says. "Make sure that it is something that is flexible and gives you the opportunity to expand your business.

"Think about it in terms of what might be the next step. Where can it take your business, and what can it do for you moving into the future." **FFJ**

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