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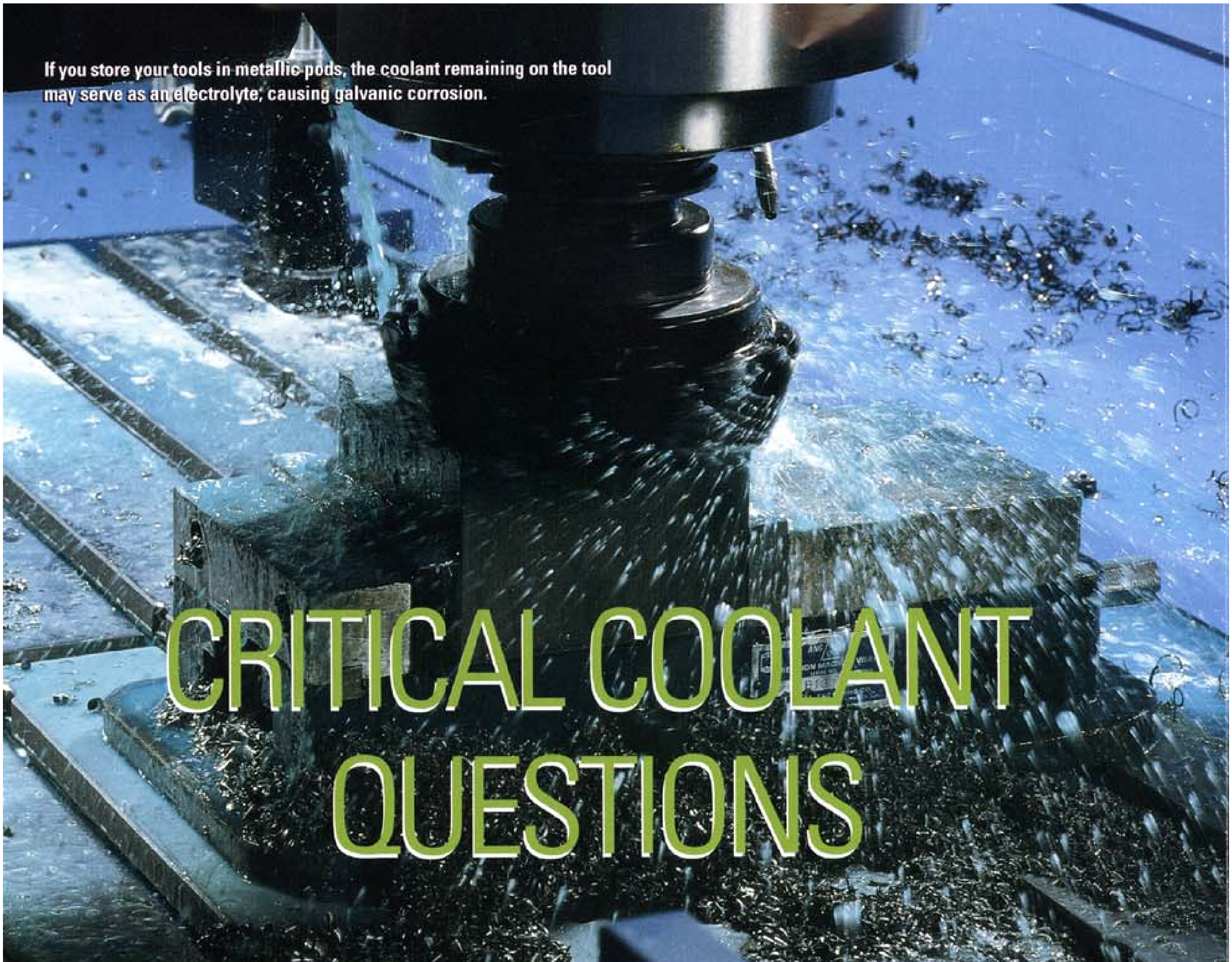

If you store your tools in metallic pods, the coolant remaining on the tool may serve as an electrolyte, causing galvanic corrosion.

CRITICAL COOLANT QUESTIONS

Make sure your machine tools and systems are coolant-compatible

Milton Hoff
Vice President, Strategic Technology Development
Master Chemical Corp.
Perrysburg, OH

Machine tool design, installation, and operation influence coolant usage and performance in important ways. When selecting and installing new equipment, or when coolant problems persist on existing equipment, take a hard look at every element of the machine tool that coolant can affect. Here are the most likely suspects. Some of them may surprise you.

When coolant problems are reported, find out if there are "dead" areas on the machine tool that permit chips to accumulate. Chip buildup prevents the free-flow of coolant and can lead to clinkering. Sump areas where coolant flow is restricted become stagnant and promote the growth of bacteria. In addition, metal chips provide a large surface area that makes it easier for metal to dissolve, increasing coolant conductivity and contamination that promotes rust and corrosion.

Find out if the chip-handling system will prevent chip accumulation. Some machines come equipped with chip-handling systems that catch chips and carry them away. If the system is not properly designed, however, the sump cannot be cleaned easily and chips accumulate, leading to clinkers, corrosion, possible rancidity, and part finish and tool-life problems.

Can the sump be removed easily for cleaning? Does it have quick disconnects? Are wash-down hoses attached and convenient? If a sump can be cleaned quickly and easily, employees will probably perform regular maintenance when it's scheduled, and that maintenance work will consume less time.

If maintenance is messy

and difficult, it probably won't be done until the coolant becomes rancid. When installing a machine, make sure to allow enough room around the machine to make it relatively easy for employees to clean the sump, and to pull out the conveyor. Quick disconnects will pay for themselves over and over.

The sump cover should have an area/opening for sampling coolant and/or installing a tramp-oil removal device. Because users want the footprint of every machine tool to be as small as possible, some manufacturers put the sump under the base of the machine, making it impossible to sample the sump coolant unless the machine is running. Obviously, the sump is not very accessible for cleaning either. There's no easy fix; the equipment will need to be reconfigured.

Make sure the sump is made of a noncorrosive material. Different metals from the workpieces fall into the sump, and create a corrosive environment unless the sump is made from a high-quality, corrosion-resistant material.

Air becomes entrained in your coolant, along with chips. Coolant is aerated as it's pumped through the tool, flows over the part, and drops into the sump. If the sump is too small to allow air to escape, when the coolant is pumped back through the tool, it will foam like shaving cream. Because newer machine tools operate at higher pressure and run at higher speed, they beat even more air into the coolant, making sump size a big issue.

Are the coolant pumps in the system located at the right height, and do they allow adequate coolant depth? Proper installation of the coolant pump is critical, and is related to the size of the sump. If the pump is set too shallow (near the surface), evaporation and carry-off lower the fluid level, and cause pump cavitation, because the pump sucks air. If the pump is too near the bottom of the sump, where there's significant coolant depth, it will pick up fines and pump them back to the point of cut.

Do you know the flow requirements for optimal operation of your machine tools? If not, find out. As a rule of thumb, a machine's sump size should be three to 10 times gpm flow. If coolant flow is 10 gpm (38 L/min), minimum sump capacity would be 30 gal (114 L), and maximum sump capacity would be 100 gal (378 L). A good planning number for determining flow is 1 to 2 gpm (8 L/min), per horsepower used in the cut, depending on chip-handling requirements and duty cycle. So a 100-hp (75-kW) machine that uses 80 hp (69 kW) in a drilling cycle will need a coolant system that can deliver 80-160 gpm (69-605 L/min) to the point of cut.

The flow requirement also dictates the size of the pump. But don't automatically oversize the pump. If the pump delivers 35 gpm (132 L/min) to a milling operation that requires only 1 gpm (4 L/min), you move a lot of unused fluid that will create heat, foam, and other problems.

Technician cleans the sump of a Mori-Seiki machining center. Easy access to the sump makes it more likely that regular maintenance will be performed.

Does the tool have filters for high and low-pressure pumps, and are they sized to accommodate the appropriate fluid flow? Filters are essential to ensure that fines don't damage the pumps, restrict coolant flow, or get between the tool and the workpiece. Users often learn that the tool has no filters after the pump or tool is damaged or parts are rejected.

Was coolant-resistant paint used to coat your machines? To be effective, coolants have to wet well, and this wetting property enables coolant to get between the paint and machine tool and lift off the paint. If the paint degrades, it will contaminate the coolant, leading to maintenance costs, downtime, and possible plugging of coolant lines. Large pieces of loose paint can plug a pump or tool. The right paint, properly applied to a properly prepared machine, is especially important when repainting. The preferred paints are either a catalyzed polyurethane or a two-part epoxy for both the base coat and the finish coat.

Your machine tools' enclosures may be vulnerable. Are the windows coolant-resistant? If not, they will degrade rapidly, losing impact resistance and becoming a safety hazard—nor are they useful as windows.

Lexan®, a polycarbonate material, is commonly used for machine tool window guards. Long-term exposure of polycarbonate windows to a coolant-affected environment, even on the operator side, can lead to deterioration. The useful life expectancy of a window guard protected on both sides and sealed on the edges is five years. A window guard unprotected on one side should be replaced after just two years. A polycarbonate window retains only 20% of its original impact resistance after 10 years. Windows are a safety as well as a functional maintenance item, and should be replaced on a regular schedule.

Are the bellows, hydraulic hoses, and electrical cables on your equipment chemical-resistant? Coolants are chemicals, and they are dispersed all over your shop. Coolant mist and splashes can damage or destroy nonresistant bellows, hydraulic hoses, and electrical cables. Damaged cables can short out and become a safety hazard. Machine tool designers have to consider that coolant will contact a wide area, whether intentionally or not.

Water-soluble products have different compatibilities than straight oils. The materials used for bellows, hoses, and cables must be compatible with the concentrated form of the coolant, because evaporation makes the fluid less dilute.

Have the seals/elastomers used on your machines been tested for swelling or cracking in coolant? O-rings and seals are meant to keep coolant out of certain areas. Today, more and more materials are being tested and approved for use with coolants. Viton® is among the materials known to be chemically resistant, but there are many different grades of this material. Ask your coolant manufacturer to test the O-rings and seals used on your machines.

Are your tool pods and toolholders compatible when wet with coolant? If the pod and toolholder are of different metals, coolant remaining on the tool will wet the contacting surfaces of the pod and toolholder, creating galvanic corrosion.

That's not the only problem. The corrosion will stick to the toolholder, get transferred to the spindle, and may damage it. Aluminum has been used as a holding tool because of its light weight, but steel tools can corrode in aluminum. However, plastic pods appear to work extremely well.

Lubricants and coolants are different animals. Do the lubrication systems on your machines prevent contamination of the coolant with way and hydraulic oils? Both oils are coolant contaminants, and difficult to remove. Also, note that the amount of oil pumped onto a way is adjustable. It should be set to deliver the proper amount rather than left on "high."

Today there are firms building machine tools that prevent excess way lubricant and hydraulic oil from dripping into the coolant by capturing the excess oil and diverting it outside the coolant sump. Systems that effectively eliminate the problem of way lubricant and hydraulic oil contamination are worth investigating.

Corrosion happens. Machine tools aren't made entirely of one piece or one metal. A base will have other components attached to it, for example. If the metals used in your machine tool are dissimilar, is there a protective barrier between them to prevent galvanic corrosion? Even a $300,000 machine tool can corrode in a matter of months. When fixtures rust, tolerances drift off, so use water-resistant grease when mounting them.

Silicone sealers should be used where nonferrous metals and coolant come into contact to keep coolant away from electronics, gages, and sensors. They should resist water and chemicals and be compatible with the metals they contact. The wrong sealant can release acidic vapors during curing that will attack copper contacts. If the sealant isn't water-resistant, it will fail, allowing coolant into areas where it can cause damage.

Are there functional sight gages on your machines to prevent overfilling, and indicate when more coolant should be added? When sumps aren't topped off and coolant levels maintained, contamination escalates quickly. With gages, overfilling and out-of-balance coolant ratios are easy to correct and manage to avoid contamination.

For example, a full 50-gal (189-L) sump with 2-qt (1.9 L) leakage of tramp oil in it has 1% contaminant. The next day, however, if the volume drops by 10% due to evaporation, the percentage of contaminant increases to 2%. Good sight gages help prevent overflow and make proper sump top-off a straightforward task.

Machine tool grounding is an installation question, but extremely important for operator safety and corrosion prevention. Before the machine tool is installed, find out if it can be properly grounded and ventilated.

A good ground requires about 8´ (2.4 m) of copper rod sunk directly into the earth. When reconfiguring or setting new equipment, work with your contractor and/or equipment installer to ensure proper grounding, as well as ventilation.

Coolant suppliers, along with machine tool builders, should be able to help you with machine tool installation, and assist in determining the machine's operational compatibility with coolant. Some companies offer machine tool evaluation as a free service through their district managers.■