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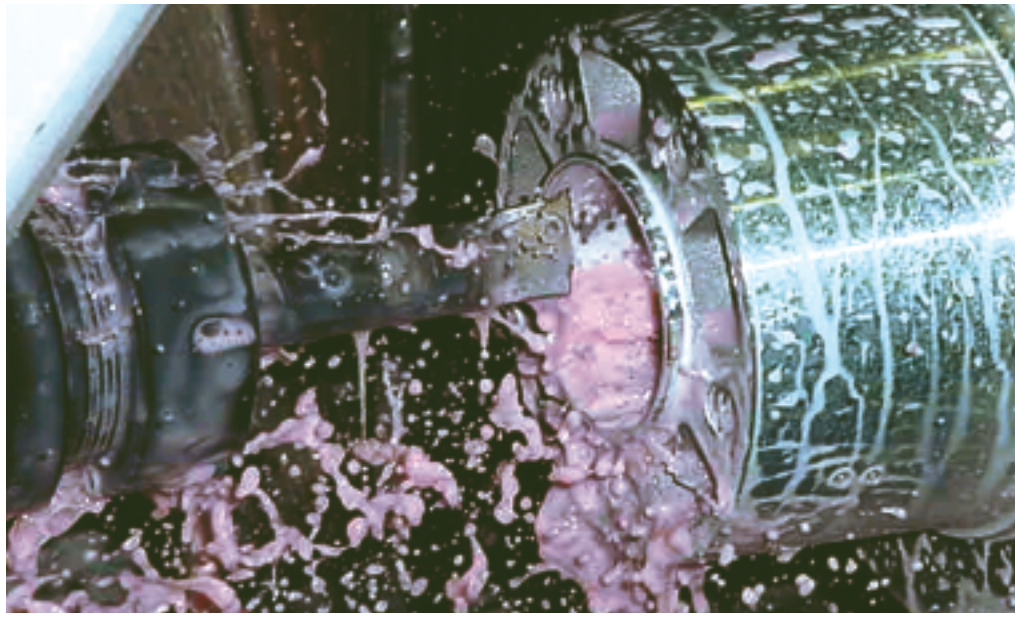
Managing the Flow

The basics of managing metalworking fluids.



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By thinking of metalworking fluids as "manufacturing resources" as opposed to commodity products (fluids that get dumped and changed, or recharged, frequently), it is easier to select and manage the best fluids for a shop or plant. Managing metalworking fluids, such as performing fluid testing and using filtration or recycling equipment, prolongs the life of metalworking fluids in both central systems and individual machines. Without actively monitoring fluids, their performance and impact on the metalworking process is simply an unknown. Poor fluid management can add costs to a plant's entire operation.

Selection criteria, testing methods and corrective action plans need to be established and followed. This helps ensure the most effective metalworking fluids are obtained and that they are managed properly. Several basic steps can be taken to implement an appropriate fluid management program.

First Steps

A survey to understand the key requirements for all the metalworking fluids used is typically a first step. Requirements include matching the fluid to the application, such as knowing the types of metals machined, typical machining and grinding operations and difficulty of the operations. The survey is conducted by reviewing all of the manufacturing operations in the plant. This involves reviewing the machines, sump capacities, filters, process flows and operations with engineers and operators.

Review the applications and select the most suitable fluid for each operation. Keep the number of fluids to a minimum to avoid the difficulty of managing numerous fluids. For most plants, one or two general-purpose fluids can meet the requirements for all operations. Of course, there can always be a special application that may require a unique fluid. Review the fluid management program and its goals with a fluid supplier and obtain recommendations.

Review the product's material safety data sheet and product literature for the fluids to understand the health and safety information as well as the fluid management requirements. Understand how to store, mix, transport, measure, manage and, eventually, properly dispose of the fluid.

Assign responsibility for selecting and managing metalworking fluids. Ideally, one person should have the authority to control and manage all fluids. He should have the job of testing fluids and making additions such as

concentrate, water or additives. Keeping track of all three leads to better understanding of fluid changes.

Track metalworking fluid performance through tests that measure pH, concentration, particulates, bacteria, mold and tramp oil. Other specialized tests may be needed. For individual machines, concentration and pH tests are recommended. For central systems, typically more tests are performed to track fluid performance. Concentration and pH tests for individual machines are simple and quick, and can be done by operators. More specialized tests for central systems need laboratory assistance.

Take corrective action to keep fluids within the recommended operating parameters. For example, if the pH is declining and bacteria counts are increasing, this is a sign that the fluid needs some corrective action. This may include concentration adjustment, adding a pH adjuster and, finally, adding additional biocide.

Managing metalworking fluids properly prolongs the life of the fluids.

Maintain Concentration

Test metalworking fluid concentration frequently—once each shift or, at least, once per day. Concentration can be tested with a refractometer for individual machines or chemical titration for central systems. A refractometer is a hand-held optical measurement instrument that provides a visual scale reading of the refractive index of the fluid mix. For a specific fluid, the higher the number on the scale reading, the richer the concentration. Chemical titration is an analytical procedure in which a reagent, called a titrant, is slowly added to another substance. It results in the measurement of key chemical components in the fluid mix by using a colorimetric or pH-based endpoint.

If the concentration is kept within a specified range, or within control limits, the fluid performs well. On the other hand, if the concentration becomes too rich, problems such as foaming and residue formation can occur. If the concentration becomes too lean, corrosion or growth of microorganisms can occur. With lean mixes, the fluid may not be able to provide sufficient lubricity—a concern for obtaining proper finish and tool life.

The starting concentration for most metalworking fluids is 5 percent, or approximately 1:20, with an acceptable amount being up to 10 percent, or approximately 1:10. Therefore, the remaining 90 to 95 percent is water, which means high-quality water is essential. Water quality greater than 200 ppm (meaning hardness measured in parts per million of calcium carbonate equivalent) is considered "hard." Water quality less than 50 ppm is considered "soft." Both extremes can create problems for metalworking fluids.

Hard water can lead to emulsion instability, increased concentrate use, filtration problems and residues. Water with high levels of chloride and sulfate ions can lead to corrosion. High levels of sulfates alone can create biological growth and odor issues. Soft water can create foam, causing coolant tanks to overflow and loss of lubrication because the fluid cannot reach the tool/workpiece interface. An ideal water makeup has a quality of approximately 125 ppm with low ion content.

Proportioners or premix systems—small tanks that hold premixed new coolant ready to use to makeup for coolant losses in the machine sump caused by evaporation and carry-off—can help provide the correct metalworking fluid concentration. There are various types of proportioners, such as venturi types and positive displacement metering pumps. Automatic level control and automatic fluid makeup—especially important for systems that have high fluid losses—reduce fluid concentration variation and ensure optimal fluid performance.

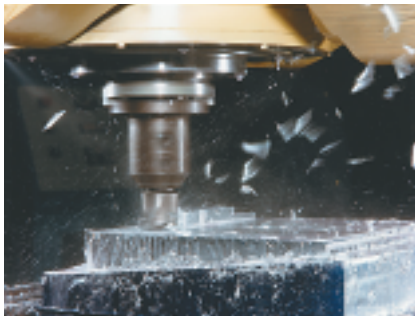
Fluid evaporation and carry-off losses can be up to 5 percent by volume per day. Of course, this varies depending on the type of fluid, fluid system, machining or grinding operation, and workpiece material and the environmental conditions in the plant. The fluid concentration tends to become somewhat richer with evaporation and the sump volume decreases with carry-off losses. Both of these affect fluid performance.

Filtration Importance

Good filtration is also important to the metalworking fluid condition. Fines or chips that accumulate in the machine sump can encourage growth of microorganisms—they need a surface film to attach to and nutrients in order to multiply.

Good flushing is needed for both central systems and individual machines. Proper fluid flow, fluid pressure and placement of flush nozzles are keys to returning the fluid to the filter. The effectiveness of filtration can be monitored by testing for particulates in the filtered fluid or monitoring conditions such as part finish, tool life or filter media usage.

Use tramp oil removal equipment, such as oil skimmers, belt skimmers, coalescers or centrifuges to keep metalworking fluids clean. Tramp oil from various machine lubrication oil sources contaminates the fluid. It can lead to biological growth problems and higher mist levels in the plant. Tramp oil contamination can also lead to loss of lubricity through removal of fluid components and possible emulsion instability. Tramp oil can be monitored by measuring total oil with the acid-split method, which is a test to measure all oil in fluid by splitting the emulsion with an acid; free oil, measured as the floating oil in the fluid; and "extraneous oil," the



If the concentration is kept within control limits, a metalworking fluid performs well.

difference in total oil and product oil (formulated in the product).

For individual machines, metalworking fluid life can be extended and overall costs can be reduced through recycling programs that use various types of filtration equipment. For example, sump cleaners are effective for removal of chips, swarf and fines for individual machines that do not have dragout conveyors or filtration equipment. Portable recycling units can be effective in removing tramp oil and smaller fines. Media filtration, such as bags, cartridges, fabric and screens, is important to remove fines that interfere with tool life, part cleanliness, machine cleanliness and fluid life.

Central systems also can benefit by improving fluid filtration. For example, if the type of metals or operations has changed over the years on the central system, it may be time to determine if improvements are needed to filtration. During a fluid changeover on a central system, it is critical to have a thorough cleanout to remove fines, oils and microorganisms to ensure the new fluid gets off to a good start.

Finally, clean machines thoroughly before charging with new metalworking fluids. Individual machines can have a fluid life of several months, while central system fluids can last over 1 year. Of course, some fluids will last much longer. Alkaline machine cleaners are effective for removing oil, dirt and microorganisms to prepare for a new charge. This ensures the new fluid charge is not compromised by "old fluid problems" such as unwanted fines or chips, tramp oil or biological contamination.

Good housekeeping practices are essential. It is important to keep foreign materials, such as cleaning fluids, floor sweepings and mist collector residues out of the metalworking fluid. This contamination is a leading source of biological growth problems.

Implementing the basics of a fluid management program pays dividends. Metalworking fluid suppliers can also assist with fluid testing and fluid management recommendations. △

About the Author

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