Selecting the right products and keeping them healthy while they work for your operations is crucial to your bottom line.

Tougher metals, severe metalworking processes and the need to increase productivity while reducing costs have helped make issues related to cutting fluids hot topics for countless machine shops. Let's put things into perspective.

Cutting fluids perform three key functions:

- Lubrication of the chip/tool and tool/workpiece con-tacts to reduce friction, helping to extend tool life and improve the surface finish of the workpiece
- Cooling of the workpiece and tool to dissipate heat in the cutting zone, helping to prevent chip/tool welding and improve dimensional accuracy
- Flushing and removing of metal chips (swarf) from the cutting zone

With the multitude of factors that impact such fluids, however—*including the operating environment, machining application and machined-metal type*—no one cutting fluid can provide the required lubrication, cooling and protection in each and every operation. That's why leading lubricant and metalworking fluid providers have developed a range of fluids to meet the many (and varied) operations of today's machine shops. These fluids fall into two categories.

1. Neat (straight) fluids

Neat fluids, which are not mixed with water, are used in machining operations such as tapping and threading of high alloy steels—*operations that are beyond the typical performance profile of aqueous coolants* . Properly formulated, these products can improve machining in high-speed automated machining centers through outstanding cutting

performance, reduced tool wear and enhanced surface finish. Production professionals should typically seek products that are light in color to allow clear visibility of the workpiece.

Operators should also look for products with low-misting characteristics to help improve workplace safety, while minimizing product usage. Selection should focus on products that are chlorine-free to support environmental concerns, while balancing lubricity and cutting-tool performance.

2. Aqueous (soluble/water miscible) fluids

While neat cutting oils are provided in packs for immediate use, aqueous cutting fluids are provided in a concentrated form that must be diluted with water onsite before use. Optimum performance for these aqueous coolants requires an ongoing partnership-type of approach by the lubricant supplier and machine shop operator to help maximize productivity and reduce unscheduled downtime.

A machine shop needs to work with its lubricant supplier to identify the most appropriate type of aqueous cutting fluid for the operating conditions. There are three different types of these fluids, all with different performance characteristics:

- ***Milky or conventional…*** A cutting fluid with a high oil content (60-75%) that forms a milky-looking emulsion upon dilution with water
- ***Semi-synthetic…*** A cutting fluid with a low to medium oil content (10-50%) that, when mixed with water, forms a translucent emulsion that can be seen through

- ***Synthetic…*** A cutting fluid that doesn't contain any oil (chemical solutions) and is generally used for grinding

Different concentrations are required for specific machining operations and metal types. Using the correct concentration is vital to the performance of the fluid and typically varies between 3 and 10%.

For example, if a recommended concentration is 5%, the fluid has been designed to offer 100% protection and machining performance at that level. If the concentrate is just 1% outside this value, there will be 20% more or 20% fewer additives within the working fluid. With too high of a concentration, there's the potential for issues such as skin irritation, foaming and filtration

problems to occur. A concentration that's too low can lead to severe problems such as bacteria growth, corrosion and poor surface finish.

In machine-tool applications, the mixing of different lubricating oils (i.e., slideway and hydraulic) and aqueous fluids is virtually unavoidable. Using lubricants that are fully compatible with the aqueous cutting fluid is important to help remove the buildup of "tramp oil."

Tramp oil can compromise the effectiveness of a coolant by shortening its effective life and adversely altering cutting performance. High-quality, compatible metalworking fluids should be used in conjunction with a regular program aimed at removing (skimming) as much tramp oil as possible to extend the life of the coolant and avoid other potential performance, health and safety issues.

Ongoing monitoring is key

Once the correct type of coolant and operating concentration has been selected, it is crucial to continuously monitor the fluid's condition. The four parameters to monitor are:

- Fluid concentration
- pH value
- Bacterial and fungi count
- Dissolved-salts concentration and hardness of water

Of these parameters, fluid concentration is the most important—*and should be formally checked and recorded* .

During the lifetime of a coolant in service, its concentration can change greatly due to water evaporation from heat generation during the cutting process, fluid dragged by chips and losses resulting from highly pressured circulation. Consequently, close monitoring is required on a daily basis—*accompanied, as needed, by carefully measured corrective actions to help control the fluid concentration.* Simply approximating the amount of water and concentrate to balance the fluid can lead to problems such as lowered pH values and increased bacterial activity. These changes can lead to shorter coolant life, lower-quality machined parts and, ultimately, increased operating costs.

The following actions should be carried out on a scheduled basis:

- Check the concentration of coolant with a refractometer at the beginning of every day/shift.
- Check pH value with pH meter or pH paper at the beginning of every day/shift.
- Check diluting-water and coolant hardness with water-hardness strips every week.
- Every week, remove as much tramp oil as possible after the coolant has been static for one hour. Installing an automated skimmer can help to continuously remove tramp oil from the cutting-fluid sump.
- Always top-up with diluted coolant, never just water.
- Use monitoring charts to keep good records of coolant progress and take timely corrective actions as required.

Get the most from your cutting fluids
Selecting and monitoring cutting fluids—*especially water-soluble coolants*—doesn't have to be as problematic as you might have thought. By following the suggestions in this article, your business can minimize potential issues associated with these fluids, as well as maximize overall machine efficiency and operator productivity.
LMT

Handling & Monitoring Water-Soluble Coolants

Do:

- Add the concentrate to the water. Use freshly mixed product only.
- Ensure sufficient and correctly positioned coolant flow on the workpiece and tool without excessive pressure
- Monitor and record coolant condition regularly and take the necessary corrective measures in a timely manner. This includes using a refractometer to monitor concentration and a pH test to monitor the acidity/alkalinity of the product. pH levels should be kept between 8.3 – 9.5.
- Keep systems clean by avoiding addition of contaminants, such as food, drinks, cigarettes, etc.
- Remove tramp oil frequently
- Ensure that all leaks of hydraulic oil, gear oils and other machine tool lubricants are attended to immediately
- Keep coolant concentration at recommended level to help avoid slideway/ hydraulic oil contamination
- Actively seek advice and training on coolant maintenance and control from your local lubricants supplier
- Practice first in/first out inventory control to use the freshest concentrates possible

Don't:

- Use water from potentially infected sources, such as fire hoses, boreholes, header tanks, etc.
- Put clean coolant into dirty machines. Use a system cleaner and follow the specified cleaning procedure carefully.
- Leave machines full of coolant standing idle for long periods, particularly when contaminated with tramp oil
- Use an aqueous metalworking fluid beyond its working life
- Prepare diluted products in dirty or galvanized containers
- Top up with water. Always use diluted emulsion.
- Eat, drink or smoke near machine tools
- Use concentrates that are beyond their rated shelf life

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