



## Understanding the Basics of Metalworking Fluids and Proper Maintenance

*Taking care of your metalworking fluid can significantly reduce tool cost, reduce fluid cost, and make the work environment more safe for workers.*

Metalworking fluid management can produce a competitive advantage in today's marketplace. Industry estimates that metalworking fluids make as much as 10 percent of the cost of a finished part. It includes the initial cost, housekeeping, cleaning and disposal. At the same time, tooling only makes up about 6 percent of the cost of a finished part. The goal of properly maintaining your metalworking fluid is to reduce costs by increasing the life of the metalworking fluids and to decrease the amount of disposal. Other benefits include providing a safer and cleaner work environment for the operators.

### Coolant Selection

**Proper metalworking fluid selection is essential in coolant management.** For example, some lubricants and corrosion inhibitors are targeted specifically to work with certain metals. In this case, choosing a metalworking fluid designed for aluminum would most likely give poor performance for machining a ferrous metal. Ferrous metals such as steel are composed of 90% or more iron. Metals that corrode easily will require an oil-based product. Another consideration is hard-water situations. Metalworking fluids diluted by hard water (water that contains high concentrations of minerals) call for certain additives. Choosing the wrong metalworking fluid can be a costly mistake on many fronts, so start off right by choosing the appropriate metalworking fluid for the job.

Active Cutting Fluids has specialists who can help your company with its product selection process.

There are four major classes of metalworking fluids, and they each carry their own inherent advantages and disadvantages. **All metalworking fluids will lubricate, cool the metal, carry off chips and provide rust protection for the work piece and the machine.** The huge number of available ingredients in modern times makes it possible to tweak the chemistry of a fluid so that it is specific to what a given manufacturing process requires. There are an infinite number of possibilities. Let's look more closely at these four major classes of metalworking fluids.

### Water-Soluble Oils

Water-soluble oils are the workhorses of the metalworking industry. They are most commonly used for CNC machining of ferrous metals, but can be used in a wide variety of applications. They leave behind an oily layer on the parts and machines that acts as a rust preventative. When the coolant is used properly, it is very uncommon to have rust problems. The disadvantage of the water-soluble oils is that they will emulsify tramp oil. In this case, the foreign tramp oil (hydraulic oil, spindle oil, etc.) becomes part of the coolant. In effect, this weakens the emulsion stability of the metalworking fluid and can eventually split the emulsion components.

### Synthetic Metalworking Fluids

Synthetic metalworking fluids lend themselves well to grinding and light-duty machining. Synthetics work great for grinding because they allow for swift settling of the small fine swarf (metal sawdust) created during grinding. Grinding fluids should be cleaner than machining fluids because they cover a larger work area and can splash more than a machining operation. Whereas water-soluble oils will absorb tramp oils, synthetics typically will reject tramp oils — allowing them to be skimmed from the surface of the metalworking fluid.

In some applications, this feature allows synthetics greater longevity in the sump. Many synthetics work well for machining all metals and some of the newer and more expensive synthetics can approach the tool life of water-soluble oils. The disadvantage of synthetics is that some components such as lubricants and rust preventives can be used up before the rest of the metalworking fluid.

## **Semi-Synthetic Metalworking Fluids**

Semi-synthetic fluids are a good compromise between the water-soluble oils and synthetics — they are hybrid products of both water-soluble oils and synthetics. Therefore, they carry both the advantages and disadvantages of both groups. Semi-synthetics are less likely to cause rust than synthetics, will still provide rust protection because of their oil content and will emulsify tramp oils. Semi-synthetics are suited ideally for machining and grinding of cast iron.

## **Straight Oils**

Straight oils are not emulsified with water; they are used in undiluted form. They are often used in high pressure through-tool applications. Their strengths include great lubrication, rust inhibition, and no foam. Lubrication decreases friction which reduces heat that would otherwise be created; however, it does not cool as well as the other main fluid types. The lubrication from straight oils also prevents chips from being welded to the work material. Extreme-pressure additives are often added to straight oils to minimize viscosity and reduce tool wear.

## **Low- to High-Grade Products**

Manufacturers will formulate different grades of products, so that there are products available for all types of machining operations. Each category of coolant can have low- to high-grade products. Typically, the higher the price of the product, then the care and management of your metalworking fluid can significantly reduce cost, provide better performance, as well as provide a safe, clean working environment. Just because a metalworking fluid is lower in price does not mean that the customer will save money in the long run, because tool life can be affected greatly by metalworking fluids.

**In conclusion, select the right metalworking fluid to begin with, then adhere to a good sump maintenance program and you will get the most out of your metalworking fluid.,**

## **Drain, Clean and Recharge**

Proper metalworking fluid management involves the draining, cleaning and recharging of the machine at appropriate intervals. This is the most important step in breaking the cycle of rancidity and metalworking fluid failure.

Many modern metalworking fluids contain a biocide in their chemistry. Modern cleaners are very efficient and effective at cleaning the fluid system.

The legacy protocol for draining, cleaning and recharging the fluid system includes the following tasks. An effective biocide/fungicide intended for the use in metalworking fluids should be added 24 hours before the machine is drained, cleaned and recharged. The coolant should be circulated and the machine can continue to make parts during this process. This will eliminate the bacteria and fungi in the sump, pumps, filters and coolant lines. Do not use bleach as a biocide. Bleach will only shorten the life of the metalworking fluid. Drain and properly dispose of the old metalworking fluids. Clean the chip and swarf from the machine. Fill the system with just enough fresh water and alkaline cleaner that the pumps can circulate the solution. Circulate the cleaning solution for 15 to 20 minutes — this will clean the grease and sludge from the sump and coolant circulation system. Pump out the cleaning solution and circulate clean water through the system.

The machine tool is vulnerable to rusting after the cleaning process. Use a spray bottle with a mixture of 50 percent new concentrate and 50 percent water to spray all of the surfaces on the machine to prevent rusting. Make sure that you spray under all of the machine fixtures, and clean or change all of the filters on the machine tool.

Refill the system with fresh metalworking fluid and circulate. Remember always to use the OIL (oil in Last) method when mixing soluble oil or semi synthetic. This will produce stronger emulsions increasing the life of the fluid. In the worst cases a biocide/fungicide treatment should be considered two or three days after the drain, clean and recharge.

## Maintenance Ongoing

Maintenance of a metalworking fluid sump is divided between concentration and contamination management. Today's metalworking fluids are designed to function properly in concentration ratios of 3 percent to 10 percent. Just as diluted paint will not be very effective, the same holds true with coolants. The easiest (and most important aspect) of metalworking fluid management is to keep the concentration within the recommended range for the application. This will help prevent a host of future problems. Concentration can most effectively be checked with a refractometer. The use of pH to check concentration will not work, because metalworking fluids can have the same pH over a wide range of concentrations.

Over time, even the best coolants can lose components. The most common reason for the selective depletion of metalworking fluids components is adding water to the sump to reduce the concentration due to evaporation. Always add some concentrate to the sump even in low concentration to make up for the components that are being consumed in the process.

Foreign material in the sump can reduce the effectiveness of the metalworking fluids. The two main contaminants are: 1) tramp oils (way lube, hydraulic oil, spindle oil, etc.) and 2) fines created during the machining process. As previously discussed, tramp oils can emulsify with semi-synthetics or water-soluble oils, causing the emulsion to split. These tramp oils also can create a favorable environment in which bacteria can grow. Any fines that are not removed from the sump can rob the metalworking fluids of rust protection prematurely.

The simplest and most cost-effective method of removing tramp oil is a wheel skimmer. The skimmer is engineered with an injection molded frame that will accept both twelve- and eighteen-inch wheels. A new skimmer has a smaller footprint than conventional wheel skimmers, making it easier to fit on most sumps. Exclusive bidirectional tramp oil drains make it possible to remove oil from either side of the unit. Tramp oil skimmers are most effective when the sump is not in use. Coupling the skimmer with an automatic timer from a hardware store will allow it to operate during the off hours. Typically, a wheel skimmer only needs to operate one or two hours to completely remove tramp oils from the surface of a sump.

Proper maintenance of metalworking fluids is not complicated or time-consuming when compared to the advantage of longer coolant life.