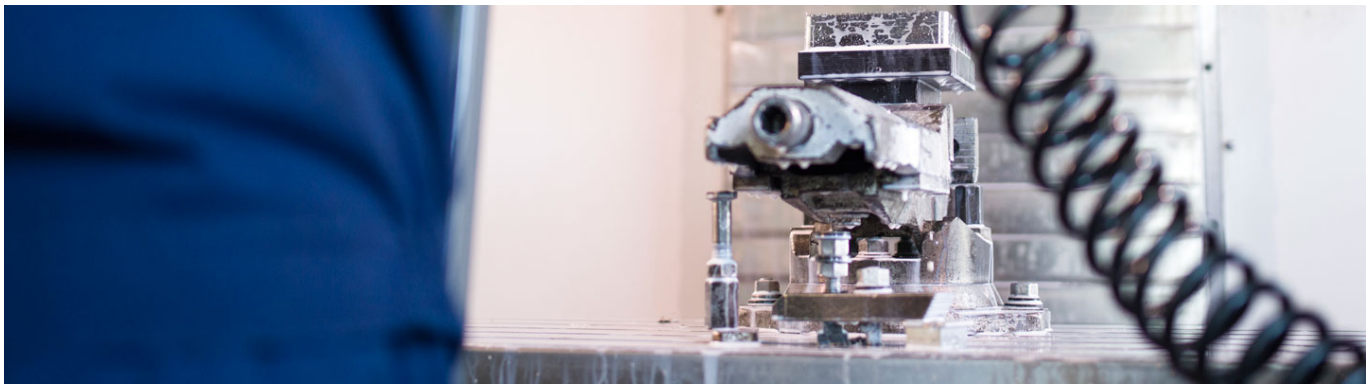

Technology

A Guide to Machine Lubrication: Find the Right Water-Coolant Type

Kip Hanson | Jan 16, 2018

What You Need to Know:

Virtually all CNC machining centers and lathes today are designed to use water-based fluids, but most Swiss-style screw machines use straight oil.
There are three categories of coolants that sometimes overlap: soluble oils, synthetic fluids and semisynthetic fluids.
All coolants contain additives that enhance lubricity, inhibit rust and bacteria growth, or reduce foaming; additives react favorably during machining to provide additional lubricity in the cut.
Invest in the cutting fluid that is best for machine throughput.

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Not sure if water-based lathe coolants are right for your shop? Dive into our primer on fluid coolants.

Anyone who's gone home at night reeking of sulfur-based oil after a long day of manufacturing parts on machines is thankful for the development of water-based cutting fluids or coolant. But are they as effective as so-called "neat" oils? And considering the variety of coolant options available today, how do you know that you have the right one, or that it's mixed properly for your particular application? This article offers some guidance on each of these questions, starting with a primer on what to look for in water-based cutting fluids.

Most Swiss-style screw machines continue to use straight oil, as do gear hobs, broaches and hones, gun drills, and other challenging machining operations. But virtually all CNC machining centers and lathes today are designed to use water-based fluids, and for good reason: Properly maintained coolant is far more pleasant to work with. It also does a better job of removing heat than oil, especially when machining aluminum and other nonferrous alloys, and in most cases, is just as effective a lubricant.

Machine Lubrication and Coolant Types

Depending on how much oil they contain before dilution, coolants are placed into one of three, ***sometimes overlapping categories***: soluble oils, synthetic and semisynthetic fluids.

Soluble Oils

The most common of all water-soluble cutting fluids, soluble oils (also known as emulsifiable cutting fluids) are typically 50 percent oil before dilution. When mixed with water, they form a milky emulsion that is an excellent choice for general purpose machining. They are, however, prone to "***Monday morning stink***"—a foul-smelling odor from microbiological growth of fungus and bacteria that can grow in your coolant sump if not properly maintained.

Synthetic Fluids

As you can probably guess from the name, synthetics contain no oil, using various polymers and chemical compounds to replicate oil's natural lubricity. They reject tramp oil, so they tend to be the cleanest of all cutting fluids but are often the least lubricious. They are commonly used in grinding applications, but proponents suggest that synthetics can be tailored to virtually any metalworking operation.

Semisynthetic Fluids

The best of both worlds, semisynthetics contain less oil than emulsion-based fluids and are therefore "less stinky," but they retain many of the same lubricating attributes, making them suitable for a broader range of work compared with straight synthetics.

When Little to No Fluids Are Needed: Steel, Alloys, Ceramics, Titanium and MQLs

Sometimes the best way to keep tools cool is to use no coolant at all. High-feed machining of hardened steels, alloy steels and many cast irons are often bone-dry and use a continuous blast of compressed air to keep the work area free of chips. This approach is most effective with cutting tools designed for such work, which, depending on the application, have sharp edges and lubricious coatings to reduce friction. And high-performance solid ceramic end mills can be used to machine superalloys such as titanium, again with no cutting fluid, using machining parameters that will have those unfamiliar with the process ducking for cover.

In a similar vein, a number of manufacturers are turning to minimum quantity lubrication (MQL) as a replacement for traditional flood and high-pressure coolant systems. These apply a metered amount of lubricant directly to the cutting zone, reducing friction and therefore heat. This may offer considerable cost savings, especially in facilities with large numbers of machines where cutting fluid maintenance and disposal costs add up. Be aware, though, that special equipment and basic plumbing will be required for MQL use.

Machine Lubrication with Water-Based Fluids

Many oil-based fluids have been replaced by vegetable oils and water-soluble cutting fluids. All coolants, however, contain additives that enhance lubricity, inhibit rust and (most) bacteria growth, or

reduce foaming. Additives react favorably during machining to provide additional lubricity in the cut. Among the most important are "extreme pressure" additives, commonly known as EP, and include chlorine, sulfur and phosphorus.

Whatever fluid path you take, be sure to follow the manufacturer's mixing recommendations, because more coolant is definitely not better. The water itself—which makes up roughly 90 percent of any cutting fluid—is also important. If you're not willing to drink your tap water, neither is your machine. Invest in a ***reverse osmosis system***, as well as a water softener if hardness is a problem. Also, install a tramp skimmer on each machine tool, and use a refractometer to keep a regular eye on fluid concentration.

How to Apply Water-Based Fluids and HPC to Cutting

The way in which you apply a cutting fluid is nearly as important as which one you're using, and in some cases, even more so. Nearly all CNC lathes and most machining centers have a through-the-tool coolant capability—so use it, even if that means investing in new toolholders and cutter bodies.

And if your machine is capable of high-pressure coolant, invest in a system and get pumping. HPC improves tool life, allows increased feeds and speeds, and largely eliminates problems with chip control—unless you cut easy material like brass or 12L14 steel all day, you're doing your shop a disfavor without it. Pump pressures of 1,000 psi are common, although even a few hundred pounds is better than the lackadaisical pressure that comes standard with most machine tools.

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Many machine operators notice an uptick in tool life after changing their cutting fluids. There's a reason for this: Clean fluid is free of the microscopic bits of metal and dirt that add to tool wear. And while you certainly can't change cutting fluids every week, you can filter them, which is nearly as effective.

Synthetics may require a deeper investment than soluble fluids, but cost should not be the deciding factor. The most important thing to consider when it comes to cutting fluids is this: If productivity suffers as a result of the wrong cutting fluid, then that may require a new strategy. Invest in what's best for machine throughput. As always, fluids should be kept clean and well-maintained, so you'll also need to have a quality ***sump pump***.

Comparing Water-Based Lathe Coolants

Soluble Oils

- **Oil composition:** 50 percent oil before dilution
- **Lubricity:** High
- **Bacterial growth:** High
- **Applications:** General purpose machining

Synthetic Fluids

- **Oil composition:** None

- **Lubricity:** Low
- **Bacterial growth:** Low
- **Applications:** Grinding

Semisynthetic Fluids

- **Oil composition:** Usually 5 to 35 percent before dilution
- **Lubricity:** Moderate
- **Bacterial growth:** Moderate
- **Applications:** Broad range

Frequently Asked Questions

Is CNC machine coolant toxic?

Cutting fluids contain chemical additives that can cause skin irritation, rashes and dermatitis. As the fluid gets dirty with bacteria, fungi and metal chips, the chances of skin and lung irritation increase.

Why does CNC coolant stink?

When soluble oils are mixed with water, microbiological growth of fungi and bacteria can grow in the coolant sump if not properly maintained, causing a foul-smelling odor.

What kills bacteria in CNC coolant?

Cutting fluids should have a pH of around 8.6 or higher to inhibit bacterial growth and prevent corrosion of metal surfaces. Monitor pH with a meter or test strips weekly. If pH gets low, use a pH adjuster to raise the pH of the fluid, or replace the cutting fluid.

What do you do with old CNC coolant?

When CNC coolant becomes too dirty or loses its effectiveness, it should be collected from the sump and disposed of according to local regulations for dangerous waste. Metalworking fluids can also be recycled, either by hiring a company to do it or purchasing specialized equipment to have at the facility.

How do I stop my CNC coolant from foaming?

Foaming can be caused by a variety of factors, including a leak in piping or hoses and high coolant pressure, and is more pronounced in fresh coolant. Many coolants contain additives that reduce foaming, and the additives may need to be replenished later.