



Machining

How Synthetic-Based Cutting Fluids Can Boost CNC Cutting Speeds and Feeds

Kip Hanson | Sep 24, 2019

Looking for an easy and inexpensive way to increase CNC machining productivity? A cutting fluid makeover might be all that's needed.

It seems as though new or improved cutting tools, software packages, workholding and machine tools are coming along every day. They are all designed to make CNC machining operations more efficient and cost-effective.

But have you stopped to think about the one thing that might be holding you back from higher productivity? The answer is one of the most basic and often underestimated pieces of the machining puzzle: your cutting fluid.

"A lot of shops upgrade their machine tools and other machining technology, but they don't think to upgrade their cutting fluids at the same time," says John Treese, director of global training for *Master Fluid Solutions*. "It's like putting leaded fuel in your new high-performance Corvette—it'll run for a while, but eventually, you're going to start having problems."

The Importance of Lubricity Via Esters and Other Chemical Compounds

Chief among these concerns is poor tool life coupled with the inability to realize a machine tool's full potential.

Today's premium-grade semi-synthetic cutting fluids counter both of these problems with high-lubricity esters and other chemical compounds that reduce or even eliminate the chlorinated paraffin and sulfur-based extreme pressure (EP) compounds found in traditional cutting fluids.

According to Treese, esters create a tight boundary layer around the microscopic oil droplets found in any emulsion-type cutting fluid, making the droplets less likely to break down under pressure. Since these additives are polarized, they tend to stick to the workpiece at a molecular level.

They do not stick enough to leave a residue, but they are sufficiently "grabby," making it more difficult for the tool to push the lubricant out of the way.

The result is better lubricity for more efficient machining across a broad range of metals, especially at the higher cutting speeds and feed rates available with modern machine tools and toolpaths.

The use of esters-based cutting fluids offers other advantages, too. Since they are better lubricants, less of the concentrate used to make the cutting fluid is needed. Esters reduce the amount of sulfur “food” for the bacteria lurking in any machine tool sump, leading to less stink and longer product life.

Esters also increase the relative percentage of water within the emulsion, which enhances the cutting fluid’s ability to cool the work zone—which is important with high-speed machining of aluminum. A high-performance semi-synthetic is generally more costly per gallon than commodity grade or “old-fashioned” cutting fluid. The long-term cost is often much lower, when you factor in the productivity boost and its effect on the bottom line.

There’s more innovation coming. Read about its evolution in “The Future of Metalworking Fluids, Machine Lubricants and Coolants.”

Cleaner Cutting Fluid Chemistry

Lastly, replacing sulfur and chlorinated paraffin with esters is better for the environment—and better for the machine operator, too.

“Over the past 20 years or so, chlorinated paraffin in particular has received some heavy scrutiny from the EPA, so we decided to be proactive and find safer, more effective alternatives, esters among them,” says Tim Stiers, engineering manager for **Castrol**, a division of BP America. “Doing so has eliminated some significant health and safety concerns.”

Castrol and others still use sulfur-based EPs, he noted, but these are now sulfurized esters, which are lighter in color, easier on human skin and produce far fewer offensive odors than the sulfur-based oils. They’re likely to stay in good condition longer, since premium-grade cutting fluids are much more resilient to neglect than are legacy fluids.

Even with newer fluid chemistry a modicum of maintenance is necessary to achieve maximum sump life.

“They’ll definitely last longer, but that doesn’t mean you can ignore them, no matter what brand the cutting fluid or how much you paid for it,” Stiers says. “The truth is that we visit far too many shops that don’t skim tramp oils, don’t check cutting fluid concentration regularly with a refractometer, don’t mix the fluids properly, nor recycle them as they should. That’s why we are big proponents of operator education and giving them the tools needed for proper coolant maintenance so they get the full value from the fluid.”

Another way to cut costs and increase efficiency is by recycling coolants and fluids. See how in “Recycling MWFs Can Help Reduce Machine Coolant Disposal.”

Cutting Fluids Explained

Until semi-synthetics came along, cutting fluids had been lumped into three buckets—straight or “neat” oils, synthetic cutting fluids and water-miscible soluble oils, commonly referred to as emulsions.

Of these, neat oils are still used on most screw machines and many Swiss-style CNC lathes, although the smoky, smelly sulfur-based oils of yore have mostly given way to newer, more advanced cutting fluid technologies, including environmentally friendly vegetable-based oils.

Synthetics remain popular for grinding applications or where maximum workpiece cooling is needed, but these are the least effective at preventing rust on workpieces and machine tools alike. Soluble oils have long made up the lion’s share of cutting fluids found in CNC lathes and machining centers, due mainly to their relatively low cost, ergonomic qualities and a nice balance of lubrication and corrosion-inhibiting properties.

Semi-synthetics, the relative new kid on the cutting fluid block, take soluble oils one step further, offering a productive marriage of synthetic fluids and soluble oils that’s particularly well-suited to today’s extreme spindle speeds and feed rates

Efficiency Now: The Need to Mesh High-Performance Fluids

Stiers points out another important reason to adopt high-performance semi-synthetic cutting fluid: high-pressure coolant, or “HPC.”

“Anyone who’s tried using their legacy fluids with HPC has probably discovered their tendency to foam at 1,000 PSI and higher,” he says. “This might not be a problem if the sump is large enough that the air bubbles have time to settle out, but in most cases, we’re going to recommend a semi-synthetic, which have anti-foaming properties and perform quite well at these elevated pressures.”

Master Fluid Solutions’ Treese offered another, somewhat surprising recommendation, this one related to machine cutting speeds.

“One of our customers replaced his older technology cutting fluid with a semi-synthetic only to see his tool life drop by 70 percent,” he says. “He was understandably upset, so we went on-site to see how the tools were failing. As it turned out, the new fluid was so lubricious that it prevented enough heat from being generated in the cutting zone for the tool to work properly.”

It wasn’t until Master Fluids advised that the customer double the cutting speed that the customer was able to achieve his previous tool life.

“We were able to actually triple it before tool life started falling off again,” he says. “Needless to say, the customer was thrilled with the results. It’s a great example of how much more productive shops can be if they use the right cutting fluid.”

Do you deal with foaming in your sump too frequently? It might be the lack of HPC. Speak your mind and ask questions in the metalworking forum.

