➤BY JOSEPH L. HAZELTON, SENIOR EDITOR

Fluid Expansion

Makers of metalworking fluids offer new fluids with improved properties to benefit parts manufacturers.

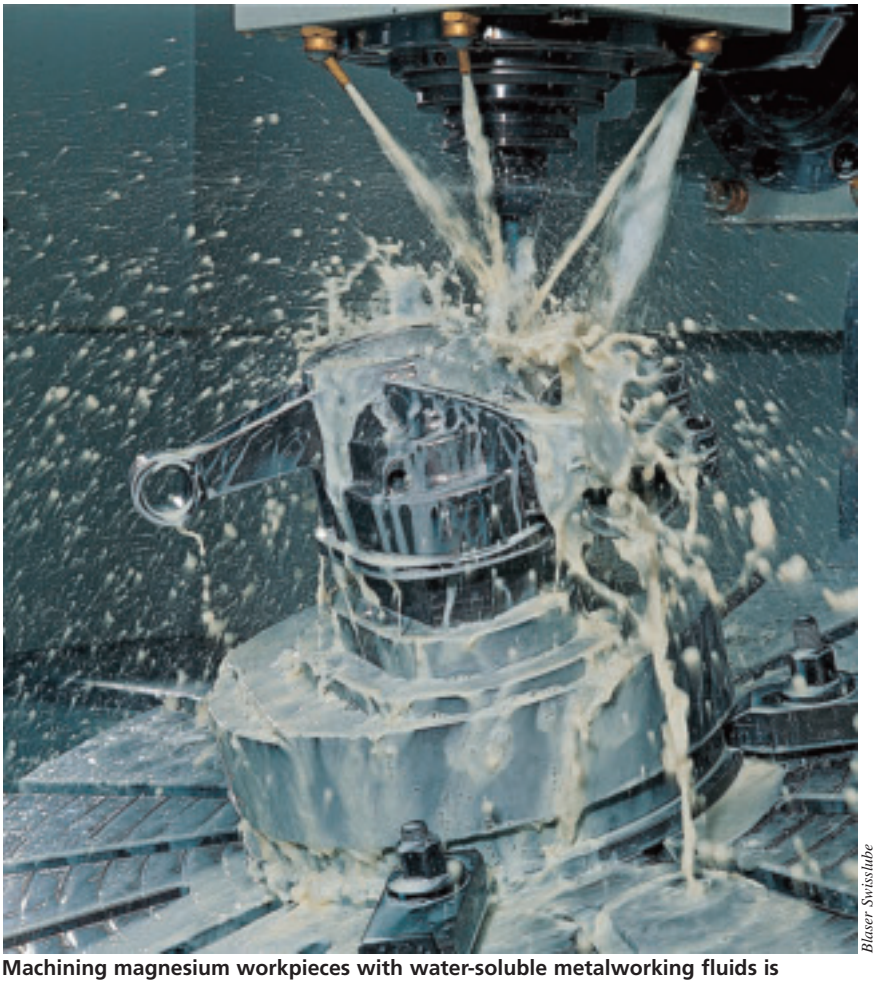
Increase tool life up to 40 percent, extend sump life up to 30 percent and improve productivity at least 20 percent.

According to Milacron Marketing Co., those are the potential benefits from its eight Z fluids, the recent additions to its Cimperial line of water-soluble metalworking fluids.

Like other fluid makers, the Cincinnati company experiments with mineral oils, additives and other components to enhance fluid performance and contribute to part quality. And in recent years, companies have introduced numerous products that improve on various aspects of their existing fluids. The expanded offering includes chlorine-free fluids and additional fluids for machining magnesium.

Chemtool Inc., Crystal Lake, Ill., introduced its NuSol line. The 14 formulations of this water-extendable metalworking fluid are emulsified from mineral oil with a viscosity of 2,600 Saybolt Universal Seconds at 100° F or from polyalphaolefin with a viscosity of 8,500 SUS at 100° F.

According to Dan Karagozian, vice president of sales and marketing, Chemtool mechanically emulsified the heavy oil, creating an emulsion that uses less than 1 percent of a nontraditional emulsifier. Also, the NuSol line is a more stable fluid. Karagozian cited a company's use of NuSol 21 Ultra Max to replace Chemtool's Lubricut 4085, a traditional water-soluble fluid with extreme-pressure additives, for machining Inconel.



Blaser Swisslube

Machining magnesium workpieces with water-soluble metalworking fluids is challenging. Dissolved magnesium from workpieces can split emulsions and increase fluid pH, which can cause workpiece staining and excessive foaming.

The 4085 lasted 2 or 3 weeks in the customer's sump before its pH dropped, and it became rancid. The NuSol fluid is proving to have a much longer life in the sump. "It's been in there now for 8 months," Karagozian said.

Hangsterfer's Laboratories Inc., Mantua, N.J., created seven new fluids, its NeoSol line. Several NeoSol fluids are low foaming at high pressure and improved upon Hangsterfer's current products. The company tested those fluids against some of its existing fluids and against some

competitors' products.

According to Skip Wolford, senior product specialist, foam can interfere with a fluid's lubricity and can affect the workpiece's surface finish. He added that the NeoSol fluids' foam broke 75 percent faster than the other fluids' foam. "You want it to break as quickly as possible," Wolford said. "A couple of seconds is what you need."

Also, Blaser Swisslube Inc., Goshen, N.Y., introduced Vasco 5000 to achieve greater lubricity and performance than its predecessor, Vasco 1000.

Machining Without Chlorine

Makers of metalworking fluids offer a number of chlorine-free fluids, such as semisynthetic Rustlick Ultracut 370R from ITW Rocol North America, Glenview, Ill. Starting in 2006, several makers added to that number. The chlorine-free fluids include Blaser's semisynthetic Blasocut BC 235; Far West Oil Co. Inc.'s KleenKut fluids, a line of seven semisynthetic fluids; two of Milacron's water-soluble Z fluids, Cimperial 1060CFZ and Cimperial 1080 CFZ; and Mullen Circle Brand Inc.'s Circle Cut 729.

Moreover, neither the KleenKut fluids, Rustlick Ultracut 370R nor Circle Cut 729 contain sulfur as an EP additive.

A main advantage of chlorine-free fluids is they're suitable when machining aerospace alloys, such as titanium. According to Karagozian, the aerospace industry is leery of chlorine because it can cause hydrogen embrittlement in titanium. "This can cause the part to form microscopic fissures, weakening the material and causing it to crack," he said.

As EP additives, though, chlorine and sulfur become active at higher temperatures to maintain a fluid's lubricity

Milacron Marketing

Keywords

coolant: Fluid that reduces temperature buildup at the tool/workpiece interface during machining. May also take the form of pressurized air or other gas. Because of water's ability to absorb great quantities of heat, it is widely used as a coolant and vehicle for various cutting compounds, with the water-to-compound ratio varying with the machining task.

cutting fluid: Liquid used to improve workpiece machinability, enhance tool life, flush out chips and machining debris, and cool the workpiece and tool. Four basic types are: straight oils; soluble oils, which emulsify in water; semisynthetic fluids, which are water-based and have reduced amounts of oil; and synthetic fluids, which are water-based and have no oil.

—CTE Metalworking Glossary

Fluid makers work to increase the stability of their fluids for longer sump life, but the fluids still require regular checking to maintain their effectiveness in parts making.

at the tool/workpiece interface.

Chlorine is active from about 200° C to more than 500° C and sulfur from about 650° C to more than 950° C. Consequently, the lack of chlorine and sulfur would mean a loss of a lubricity, and, therefore, an increase in friction and heat at the higher temperatures and pressures.

However, fluid makers can replace those additives with partial boundary lubricants, such as esters, fatty oils and fatty acids. Far West Oil, Sun Valley, Calif., compensated for the lack of chlorine and sulfur in its KleenKut fluids by using synthetic EP additives.

Mullen Circle Brand, Lincolnwood, Ill., likewise applied different additives to its Circle Cut 729 to compensate for the absence of chlorine and sulfur. These additives allow 729 to make greater use of its phosphorous. That EP additive is often used in conjunction with chlorine and sulfur.

According to Ken Reed, Mullen's president, 729's substitute additives permit 729's phosphorous to remain active beyond the high end of its temperature range. "If you can keep the phosphorous from breaking down," he said, "you can keep the parts from getting all that hot."

Machining Magnesium

Besides more chlorine-free products, fluid makers are offering more fluids specifically for machining magnesium. In 2006, Blaser and Chemtool introduced magnesium-capable fluids. Blaser's fluid is Blasocut BC37MG, while Chemtool offers Lubricut 1042 and 1043. Also, Milacron is in the final stages of field-testing its water-soluble fluid for machining magnesium, CX-188A.

The additional fluids arrive as the use of magnesium for making parts appears to be increasing. The use takes advantage of magnesium's strength-to-weight ratio, which is higher than aluminum's. "We're seeing more and more magnesium every day," Karagozian said.

He cited increased use of magnesium in the metal structure under car dashboards. In the past, the structure was an assembly consisting of as many as 115 stamped steel parts welded

together. Karagozian said the structure is often machined today from one piece of magnesium and weighs 33 percent of what it used to. He added that the reduced weight is sought by automakers working to achieve higher fuel efficiencies in vehicles.

However, machining magnesium involves several challenges, such as its reaction with water. During machining, some magnesium from the workpiece dissolves into the fluid mixture, increasing its hardness. "You've created a huge new source of hardness," said Greg Foltz, engineering and development manager for Milacron's Cimcool metalworking fluids. As the mixture hardens, it becomes more capable of splitting the emulsion, of separating the mineral oil and water and thereby making the fluid useless for metalworking.

Fluid for machining magnesium needs to be made more resistant than other fluids against dissolved magnesium in the used fluid.

Consequently, fluid for machining magnesium needs to be made more resistant than other fluids against dissolved magnesium in the used fluid. For example, Blaser's BC37MG stayed emulsified in field tests where dissolved magnesium increased to more than 3,000 ppm.

In another of those tests, the fluid was applied in general magnesium machining operations where the emulsion accumulated 3,500 ppm of dissolved magnesium without separation. The fluid's pH was 9.2. In another test, the fluid was mixed with water having 3,700 ppm of magnesium and 163 ppm of calcium, which also hardens water. The pH then reached 9.3.

"There was no separation, and good results," said Randy Templin, Blaser's vice president. "At those high levels of magnesium, all of our other products would have separated." He added that

if the fluid's pH had become too high, greater than 9.5, the fluid could have foamed excessively and stained the workpiece material.

Also, magnesium workpieces and magnesium-capable fluids create flammable gas. When dissolved magnesium enters the fluid mixture, a further reaction causes the mixture's water to release hydrogen gas. If exposed to a spark, the gas will ignite.

Magnesium burns fast and very hot, said Charles Vollaro, vice president of sales for Far West Oil. To avoid fires, he recommends applying a large-volume flow at the cutting tool/magnesium workpiece interface to reduce the possibility of generating a spark.

The flow's amount depends on the

The following companies contributed to this report:

Blaser Swisslube Inc.
(845) 294-3200
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Chemtool Inc.
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Milacron Marketing Co.
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Mullen Circle Brand Inc.
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Chemtool

Makers of metalworking fluids have introduced new fluids that improve on many characteristics of their existing products, offering more biostability, longer sump life and less foaming as examples.

fluid expansion

machine tool, part size, part configuration and amount of available fluid, among other factors. However, Vollaro said the flow should consist of as much volume as allowable given the previous parameters. He added that the potential for fire can be reduced by using a non-water-based fluid, like a petroleum- or vegetable oil-based one.

Besides avoiding fire, large-volume flow decreases the chance of oxidizing magnesium while grinding it. If oxidation occurs, the workpiece will provide an unfortunate show for the machinist. "It'll start to darken, to turn color, right in front of your eyes," Vollaro said. "Oxidation, if left unchecked, could cause irreparable damage to the substrate surface."

Lastly, magnesium chips can cause manufacturing problems. The light chips tend to float in metalworking fluid rather than settle in it, so they're difficult to evacuate from the sump area and filter out of the fluid.

A possible resulting problem is the chips washing onto a machine tool's pallet bed, preventing the pallet from sitting true on the bed and, thereby, affecting part accuracy.

However, Karagozian described two methods for removing the nonmagnetic chips. Manufacturers can design the sump so the fluid will carry all the chips to a wedge wire screen and conveyor system for removal. They can also use fluid with a wetting agent included in the concentrate or add a wetting agent to the tank. Either method permits the chips to sink.

Templin said that fluid with minimal entrained air and low foam behavior will help reduce the amount of floating chips, too. He added that manufacturers that machine magnesium with straight oil should choose low-viscosity products so chips can settle quickly rather than stay suspended. △

For more information, visit "Archived Articles" at www.ctemag.com and select the "Coolant" category.

Checking fluid avoids risk to workpiece

Machinists who fail to maintain a correct mix of water and water-soluble metalworking fluid risk part quality because of insufficient cooling and lubrication, as well as a potential lack of corrosion protection.

The higher friction and heat result from a reduced amount of fluid—including extreme-pressure additives—due to carry-off and the loss of water due to carry-off and evaporation. Increased corrosion comes from the loss of corrosion inhibitors.

Moreover, water evaporation could make the water-fluid mixture useless during metalworking. This risk is due to what Dan Karagozian of Chemtool Inc. calls "the tea-kettle effect."

As water evaporates, its minerals, such as chloride, settle out and accumulate in the sump. "Your water will get harder and harder and harder," Karagozian said.

If it becomes too hard, the water will start to split the emulsion, forcing the oil out of its water suspension. The separated oil and water aren't as effective during metalworking as they were when they were combined.

Those potential problems are always present because a sump loses fluid and water every day, possibly as much as 20 percent of the sump's total mixture.

A machinist, however, can maintain a mixture through two methods. He can check the mixture with a refractometer, a hand-held optical device that refracts light through a mixture sample. The refraction creates light and shaded areas that a machinist uses to obtain a reading, an index number, from the device. He then consults a chart from the fluid supplier or knows the index number by which to multiply the reading. Either way allows him to translate the number to a concentration level.

Greg Foltz of Milacron Marketing Inc. said taking a refractometer reading requires a few minutes.

However, a machinist may have trouble making a reading because the light and shaded areas on the refractometer can be indistinct at times. "It can be very complicated to get the number when you get into the fuzzy shades," Foltz said.

Also, tramp oil and other contaminants can interfere with the refraction.

The concentration of a water-soluble fluid may also be checked through titration. Foltz said a person would need about 10 minutes to titrate a fluid if he's familiar with the method.

Foltz added that a titration is more exact than a refractometer reading. "It's not subject to as many interferences," he said. "It's going to give a much more accurate result."

Titration consists of a person taking a sample of metalworking fluid from a sump, using a pH meter or an indicator solution and incrementally adding a chemical solution to the sample until an expected color or pH change occurs. The change marks the end of the test, so the person notes the total amount of titration solution that was needed to cause the change. He then references the fluid's product-factor chart to determine its exact concentration in the sump. After determining the concentration, he calculates how much water and concentrate to add to the sump to restore its supply to the recommended concentration range.

A sump loses fluid and water every day, possibly as much as 20 percent of the sump's total mixture. A machinist, however, can maintain a mixture through two methods.

Titration is more exact than a refractometer because titration measures specific components in the fluid.

Whichever method they apply, manufacturers can avoid the possibility of reducing part quality, or even damaging workpieces, by checking and correcting their fluids with a certain regularity.

"Every shift," Karagozian said.

—J. Hazelton