Innovation in Metalworking Fluids

The Changing Role of Today's Metalworking Fluids

E-LEARNING GUIDE

KOOLRite™

METALWORKING FLUIDS

TODAY'S ENHANCED TYPES AND APPLICATIONS

Metalworking lubricants and coolants are essential to maintaining the efficiency of the machining process.

New technologies are available that provide improved tool life, longer sump life, little to no odor and increased efficiencies.

Machine set-up and maintenance should always include changing fluid, but also choosing the most efficient fluid for the operation. Matching the latest formulations to the performance requirements of the machine and application is key to maintaining and improving a shop's ROI.

How Metalworking Fluids Affect the Application

Machining centers can be utilized for a variety of operations, from drilling, tapping, turning and honing. In many operations, such as drilling & tapping, there could be a series of multi-spindle heads holding 5, 10 or over 20 tools all performing one large operation. Any of these procedures will stress the tool, workpiece and the lubricant. Some metalworking applications can place high stresses on the machine and components. Facing/turning are typically less stressful applications. That is why the compatibility of the fluid is integral to the machining process.

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The chemistry of metalworking fluids typically includes different types of additives, base stocks and water. When combined, the fluid's lubrication and the cooling property of water provides for a smooth operation and reduces the transmission of heat. The specific chemistry that makes up a formulation can enhance the properties of the base stock. The ultimate formulation of the fluid must be matched to the material of the machining process, type of tool and the machine performing the operation.

Machine coolants are engineered to dissipate heat from the tool and part, plus flush out chips from the cutting area. The more sophisticated fluid manufacturers formulate coolants for specific applications, materials and cutting tools.

Today's Enhanced Metalworking Fluids

Metalworking fluids have come a long way over the past several decades. For centuries machinists have been using oils to lubricate their machining processes. As machining processes became more complex and as more and more chemistry types became available, metalworking fluids have morphed into complex formulations and are relied upon to do so many more things than just lubricate.

1) Straight Oils

Straight oils are made up of oil and chemicals and are meant to be applied to the process as received. They are mainly used for very difficult processes that require more lubrication. Straight oils provide good sump-life, corrosion protection, and lubrication. Their downfall is fluid consumption costs because they are used as-is and not diluted with water. They can also be messy to work with and cause misting. It's important to choose a straight oil with anti-misting properties.

A subsection within straight oils is Swiss Cutting Oils. These high precision products are designed to provide exceptional surface finishes on parts that are extremely small. This makes them ideal for the medical and aerospace industries.

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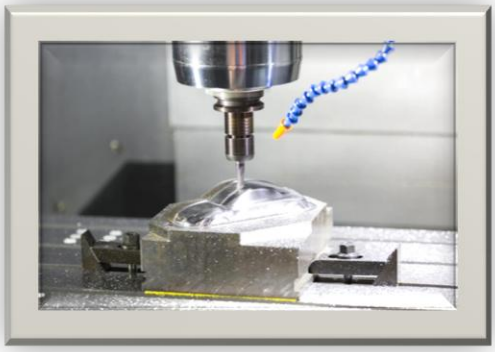
2) Emulsifiable Oils

With the invention of higher speed machining, so came the challenge of increased heat at the tool-workpiece interface. Straight oils provided lubrication but could not provide cooling. Water, on the other hand, provides excellent cooling yet does not have any lubricating properties. It was at this point, metalworking fluid formulators worked to make straight oils "soluble" in water.

Emulsifiable oils are essentially straight oils with the addition of chemicals called emulsifiers that help disperse the oil in water. They provide lubrication from the oil while also providing cooling from the water. The in-use fluid is typically made up of 85 – 97% water. This class of fluid has its place in the market as it tends to be more cost effective and have the highest lubrication of the water-based products. Emulsifiable oils also tend to have shorter sump-lives than some of the newer classes of fluids and leave an oily film that is sometimes undesirable to the end-user.



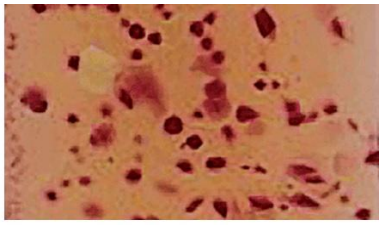
3) Synthetic Coolants

As machining processes continued to increase in speed, metalworking fluid formulators continued to increase the amount of water that was in their formulations to the point they no longer contained oil at all! These are known as synthetic metalworking fluids and are used in processes that generate extreme heat, like surface grinding. They rely heavily on water-soluble corrosion inhibitors, and lubrication from chemicals that have a cloud point. Chemicals with a cloud point are soluble in water at room temperature. As the temperature of the fluid increases during the machining process, these materials 'cloud' and are no longer soluble in water and move to the metal surfaces of the tool and work-piece providing lubrication. As the fluid cools, the chemicals become soluble again. At the time synthetic metalworking fluids were developed, these cloud point chemicals were a breakthrough technology, and although they still serve a purpose in traditional synthetics, there is a new class of synthetic fluids being developed that really deserves a category of its own.

4) Semi-Synthetic Coolants

As more and more chemicals were being developed for emulsifiable oils and synthetic fluids, metalworking fluid formulators continued to search for the best balance between lubrication and cooling. Emulsifiable oils provided the lubrication while synthetic fluids provided the most cooling. What if there was a formulation that combined the oil soluble, and water soluble chemicals and balanced the oil and water almost evenly? This is how the semi-synthetic fluid was developed. These higher performance coolants offer the best attributes of the previously discussed fluid types. They are also the most complicated formulations to develop, sometimes containing 15 – 20 different components. These components include oil soluble esters for additional lubrication, water soluble corrosion inhibitors, and water soluble buffering agents to increase sump-life. Buffering of semi-synthetic fluids has become one of the greatest positive impacts to the market in recent years. Suppliers are utilizing new and innovative amine technologies; formulating premium semi-synthetic fluids that have built-in resistance to bacterial growth without having to rely on bactericides. Most top of the line products available in the market today are semi-synthetic fluids and there continues to be much research and development in this area.

KOOLRite Coolant: Does not support bacterial growth



Competitive Coolant: Packed with bacteria

5) Hybrid Semi-Synthetic

Even newer to the market is a fluid that doesn't fit into any of the categories discussed above. This newer type of fluid relies on breakthrough technology that offers productivity unparalleled in the market today. Use of mineral oil alone or even with older lubrication technology won't provide the type of performance these new hybrid products can offer. These fluids are especially well suited for higher end markets such as aerospace, medical, and automotive because they require operations to run at much faster speeds and higher pressures; both of which a hybrid semi-synthetic can handle better than any fluid before now. This truly is ground breaking

technology that will provide significant savings to these high-end markets by lowering fluid usage, disposal, down-time and increasing tool-life.

6) Honing

Honing lubricants are essential to remove heat during the honing operation and to prevent the abrasive from picking up chips and welding to the part. A high-quality honing oil is formulated with an oxidatively stable base oil and a high-performance additive package. They normally come in two forms: oil and water-based. Because of pollution problems, there is a decided preference for water-based lubricants. Oil is often used on difficult-to-hone material such as aluminum and stainless steel. Filtration helps achieve fine surface finish and increases abrasive life. It is designed to work with abrasives, to keep the work piece extremely clean while providing excellent surface finish.

7) Other Specialty Fluids

Premium quality specialty products such as tapping, sawing and grinding fluids are integral to the operation of any shop.

- **Tapping fluids** are designed to be applied directly to the tool-workpiece interface and provide high performance properties to improve threading accuracy, extend tool life, and improve surface finishes. Manufacturers offer a variety of tapping fluids ranging from mineral oil-based gels to fully synthetic fluids. Both fluids can be used to replace molybdenum disulfide, which even though an excellent lubricity additive, can be dirty to work with.

- **Sawing fluid** is a general purpose semi-synthetic fluid formulated to provide both lubricating and cooling properties in metal sawing applications.

- **Grinding fluids** that are specifically designed for general purpose grinding applications are oil-free allowing for extended sump life with no sticky or oily residues left on machines or parts. Premium suppliers use state of the art technology to achieve maximum corrosion protection on a variety of metals making these grinding fluids ideal for multi-metal shops.

- **Synthetic minimum quantity lubricants** are designed to minimize the amount of fluid used in both cutting and forming applications. These vegetable oil based lubricants offer outstanding lubrication on a variety of different metals.

Conclusion

The metalworking fluids industry is changing. Faster and more high-tech machinery is forcing fluid manufacturers to rethink their formulations to produce fluids that provide increased efficiencies that can be tied to higher profits. Environmental awareness, the need for varying fluid type options and the high demand for custom formulations are some of the leading change agents in the industry.

To learn how these new and advanced metalworking fluids can benefit your operation, call KOOLRite today at 800-123-4567.

About the Author

JTM Products has been manufacturing quality industrial lubricants for more than one hundred years. Founded in 1890 as the Phoenix Oil Company, it produced the axle greases, belt dressings, and lubricants that helped the Industrial Revolution run smoothly. The company was on the leading edge in the early 1900s, when it introduced the first water-soluble cutting oil for machine tools. In the 1920s, Murphy Oil Soap was born. Now a household word, Murphy Oil Soap has remained a favorite cleaning product with homemakers, industrial, and commercial maintenance people ever since. As a pioneer in the field of industrial chemicals, JTM's mission has been to provide products which meet the changing needs of customers. All of the formulations have played key roles in emerging technologies.

In the mid-2000s, JTM Products introduced **KOOLRite™** Long Life Fluids and in 2018 SynMAX™ Ultimate Coolants; both product lines offering unique and innovative solutions to metal working industry challenges. We have a dedicated team focused on the metal working industry. Within the team we have a Certified Metalworking Specialist, a Certified Lubrication Specialist, and years of expertise with our chemists, sales and technical service staff. In addition to the KOOLRite and SynMAX Coolants, JTM offers a broad portfolio of metal working fluids including Swiss Cutting, Sawing and Grinding Fluids, Forming Lubricants, Rust Preventatives, Cleaners and many others.

Our goal remains the same as it was over 100 years ago….to provide quality, innovative products that meet the current and future demands of our customers and the industrial markets that we service.