

## METALWORKING FLUIDS

### COOLANT SELECTION

Now that we know what type cutting fluids are available, it is time to learn where to use the various types. First, however, let's list some of the qualities required in a good cutting fluid.

1. Good lubricating qualities to reduce friction and heat and therefore improve the machining/grinding action of the tool.
2. Good cooling action to dissipate the heat effectively that is generated during the metalworking process.
3. Effective anti-weld qualities to prevent metal build-up on the tool which reduces tool life.
4. Good wetting characteristics which allow the fluid to penetrate better into the cutting area and therefore lubricate and cool better. Good wetting also helps with rust control because it spreads out the inhibitors better on the metal surfaces.
5. Resistance to rust and corrosion via inhibitors built into the fluid.
6. Resistance to rancidity by using effective biocides and other rancidity control additives.
7. Relatively low viscosity fluids to allow metal chips and dirt to settle out and be flushed away from the work area.
8. Does not leave a sticky or gummy residue on parts or machines.
9. Stable solution or emulsion.
10. Non-misting to insure a safe working environment.
11. Non-toxic to insure operator safety.
12. Non-flammable and non-smoking.
13. Easy to filter and dispose.
14. Biodegradable so as not to harm the environment.
15. Economical.

If there was one product that met all the above mentioned requirements the selection of a cutting fluid would be easy. But there just is not such a product.

As is so often the case, each cutting fluid has its advantages. Each product has its place. Let's now compare the qualities of the four groups and find out where each works best.

### Straight Cutting Oils Advantages

1. Good lubricity
2. Effective anti-weld qualities
3. Good rust and corrosion protection
4. Do not go rancid
5. Form stable solutions

### Disadvantages

1. Poor cooling
2. Mist at higher speeds
3. Flammable
4. Smoke at higher speeds
5. Not biodegradable
6. Expensive to use

Straight oils perform best in heavy duty machining operations and very critical grinding operations where lubricity is very important. These are generally slow speed operations where the cut is extremely heavy. Some examples would include broaching, threading, gear hobbing, gear cutting, tapping, deep hole drilling and gear grinding. Straight oils do not work well in high speed cutting operations because they do not dissipate heat effectively. Because they are not diluted with water and the carryout rate on parts is high, these oils are costly to use and, therefore, only used when a water dilutable fluid will not do the job or the machine tool is not designed to handle water dilutable products.

### Water Emulsifiable Oils Advantages

1. Good lubricity
2. Good cooling
3. Effective anti-weld qualities
4. Adequate wetting abilities
5. Good rust and corrosion protection
6. Non-toxic
7. Non-flammable
8. Economical
9. Low viscosity

### Disadvantages

1. Rancidity
2. Emulsion stability
3. Misting
4. Disposal
5. Not biodegradable

Water emulsifiable oils are the most popular cutting fluids in use today. Because they combine the lubricating qualities of oil with the cooling properties of water they can be used in a wide range of both machining and grinding operations. Milanco products can be used for most milling, turning, drilling, reaming, boring and sawing operations. They provide good cooling for high speed production operations and are safe to use on both ferrous and non-ferrous metals. When machining soft metals like aluminum, an emulsifiable oil is almost always recommended.

Rancidity has always been the big problem with emulsifiable oils and the major reason for the development of the synthetic. Another more recent problem is disposal. Milanco feels, however, that products which form stable emulsions and are formulated with rancidity control additives, greatly reduce these problems. When you combine these quality products with good service, control, filtration and additives, have the best cutting fluid system available today.

### **Synthetic Fluids Advantages**

1. Adequate lubricity for grinding and light to medium machining
2. Excellent cooling
3. Good wetting
4. Good rust protection
5. Resistant to rancidity
6. Low viscosity
7. Stable solution
8. Very little misting problems
9. Non-toxic
10. Completely non-flammable and non-smoking
11. Easiest of all types to filter and dispose
12. Biodegradable
13. Economical dilutions

### **Disadvantages**

1. Insufficient lubricity for many heavy duty applications
2. Metal safety on non-ferrous parts
3. Residue can sometimes be a problem

Synthetic coolants provide many advantages as you can see from the above list. When considering water dilutable fluids, synthetics are by far the most resistant to rancidity. This one quality is probably the major reason so many shops have changed to synthetics in recent years. The excellent cooling qualities provided by synthetic fluids make them a popular fluid for noncritical grinding operations on steel and cast iron where cooling and rust control are of major concern.

These synthetic fluids are completely non-flammable because they are water based concentrates, most are biodegradable and they are generally very easy to filter.

As disposal problems become an ever increasing problem with the advent of the Resource Conservation and Recovery Act, synthetic fluids, because they present less of a disposal problem than emulsifiable oils, will become more popular. It is important, however, to understand that synthetics do not completely eliminate disposal problems. They too must be treated before they can be disposed. Generally speaking, synthetics are easier to treat than emulsifiable oils; and because they are more resistant to rancidity they last longer in the machine tool sumps. Therefore, the volume of coolant that needs treatment is greatly reduced.

Synthetics are most definitely the products of the future. A very large percentage of the development work on cutting fluids is devoted to improving the synthetic fluid technology. However, there are still some problems and still some machining and grinding operations that for one reason or another cannot be done using a synthetic fluid.

Lubrication has always been the big problem for synthetic coolants. There are still many so called "heavy duty" machining operations and "critical" grinding operations whose lubricity requirements are more than what the synthetic fluid, without oil, can provide. These heavy duty machining operations are typically the slow speed or intermittent cutting operations like threading, tapping, broaching, and gear hobbing. Also, the more difficult to machine metals like stainless steel and many high temperature alloys require more lubricity than the synthetic can provide.

Another problem caused by synthetics is the sticky and gummy residue that is sometimes left when water evaporates from the solution mix. This can cause parts to stick together and moving parts to "freeze" on the machine tool. With improvements in synthetic lubricant technology, however, this is becoming less of a problem.

Metal safety on non-ferrous metals is a problem with some synthetics because of their relatively high pH (8.5 to 10.0) and the lack of oil to act as an inhibitor. Softer, non-ferrous metals like aluminum also tend to build up on the tool more with synthetics than with emulsifiable oils. When this happens, tool life is reduced; and it is difficult to hold finish and tolerances.

As a general rule, use synthetic products like MD-SYN for surface grinding operations on cast iron and steel. For most cylindrical and centerless grinding operations on cast iron and steel use HD-SYN. The cylindrical and centerless grinding operations generally require a more critical surface finish and closer tolerances and, therefore, the lubricity requirements are more severe.

For light to medium duty machining operations like milling, turning, boring, drilling, reaming and sawing on steel and cast iron, use HD-SYN.

Synthetic fluids work very well in the grinding and machining operations just mentioned but, as a general rule, should not be recommended for grinding and machining jobs on non-ferrous metals or the harder to machine alloys like stainless steel.

### **Semi-Synthetic Fluids**

Since Milano makes a number of semi-synthetic cutting fluids, I will not spend time discussing the advantages and disadvantages of semi-synthetics. It will suffice to say that if you need to replace a semi-synthetic fluid, analyze the operation (metals being worked and types of machining and/or grinding) and recommend either a synthetic fluid or an emulsifiable oil, whichever fits best.

The following chart lists the various types of machining and grinding operations, the most commonly worked metals and the recommended Milano coolant. When using the recommendation chart note the following:

1. Not all applicable Milano products are listed on the chart. Where the chart recommends Nitrite, you could use HD-SYN if a non-nitrited product is necessary.
2. Where the chart lists S.O., this means a straight oil is recommended.

As with all charts of this type there will be exceptions, but this recommendation chart should greatly assist you in your selection of the proper cutting fluid.