Synthetic Lubricants, Inc.

1411 Callaghan Street, Greenville, MI 48838

(616) 754-1050 ♦ Fax: (616) 754-5230

GUIDE TO METALWORKING FLUIDS

This little work is intended to assist and enlighten people to the world of synthetic lubricoolants. It is not intended to be definitive; it is for information only.

As man began to shape and remove metal he began to need lubricants, starting with animal fats and greases, progressing upward through crude and refined oil. Many lubricants contained sulfur, chlorine and other additives. Disposal of these products has become expensive and socially undesirable. Ecology is here to stay. With the disappearance of sunset laws, a company can be held liable for heavy costs for indefinite periods of time.

During the 1930's, a new type of lubricant emerged; oil in water (O/W) or water in oil (W/O) emulsions. These products worked and were used exclusively until the 1950's when synthetics started coming along. One of the best of these was a sodium nitrite/surfactant type. It worked well but proved to be dangerous to operators. Amine/borate/fatty acids have been used for many years with moderate success. The borates will sometimes leave a hard shellac type residual on the tool and work piece.

There are two main problems in educating your customers to pure synthetic lubricoolants. They are improper mixture and oil in the lubricoolant.

Mixing is often confusing to your customer. They need a fast, simple, way to approximate the correct mixture. This is accomplished by use of a refractometer. A refractometer is a small simple instrument that resembles a telescope with prisms on one end and an eyepiece on the other.

To use, simply lift the top prism. Insert fluid and examine in suitable light through the eyepiece. You will see a dark field and a light field superimposed on a scale. Where these two fields meet on the scale is your "refractive index". This is not a percentage. Some chemicals show up under light waves better than others, some do not show up at all.

In working with pure synthetics, two sets of dilution factors must be kept in mind. The first is the working solution in the machine (example: 10 to 1). The second is the makeup solution used to refill the machine. A good rule of thumb here is at least 1.5 to 2 times the working dilution. (Example: 15 to 1 or 20 to 1). You do not boil away the "guts" of the lubricoolant. A word of caution, many salespeople either through deceit or lack of knowledge, use only the replacement dilution numbers. This can be very confusing to your customer. Take your time and explain this carefully.

Many companies hand out very detailed ratio-refractive readings with each operation having its own special ratio. This works well in the laboratory, but is too demanding and time consuming in the shop. Synthetics are all made with the same solvent (water) so don't be fooled by double talk.

What does work and is easy to use? Grinding and very light metalworking (.75 to 1.5 on the refractometer), sawing and general metalworking (1.5 to 2.5 on the refractometer), very heavy work (+2.5 on the refractometer). If your customer will stay close to these readings and keep the oil out of the lubricoolant, you both will be happy.

Oil in the sump tank presents special problems. It increases the cost of disposal, reduces the action of the lubricoolant, and mandates change of the lubricoolant more often. Incidentally, oil and water emulsions are very difficult to "degrade". Biodegradable is a term that is misused. Everything is "biodegradable". Trees are "biodegradable", so is a piece of steel. The real question is at what rate. The "rate" can be measured by how much oxygen is required to have the bacteria degrade the material in question. These measurements are called T.O.D. (Total Oxygen Demand) C.O.D (Chemical Oxygen Demand), and B.O.D. (Biochemical Oxygen Demand). I recommend you take a few moments and talk to your water treatment people. They can explain the system.

All of you by now know of an MSDS or material safety data sheet. Many people feel this represents a lot of extra work mandated by the government, but the operator of the machine should be able to look at the sheet and determine if the ingredients are potentially dangerous to him/her. The maintinance people need to know this also. The MSDS represents a host of knowledge about the safety, storage, disposal and handling of the material.

It is a "Kiss of Death" to furnish a sample "too" small for success. By the time your customer consents to a trial, you both have invested time and money. Give yourself a chance to be successful, and be present during the trial. Use a large sample; invoice the customer. If he likes it, he pays for it. If not, you send us a copy of your invoice and our invoice and we will issue credit with no questions asked. Remember, your customer is the judge.

Generally the first thing to look at is the working environment of the shop. If the shop has a clean working environment, then using a pure synthetic, or semi-synthetic is a great choice to recommend, because synthetics work well in these environments. A shop like a steel mill could utilize a synthetic, or semi-synthetic, and a foundry could utilize a semi-synthetic, or a soluble oil, but that all depends on how the shop is maintained.

If you run into a shop that is complaining about their coolants stinking, I would recommend a coolant change. Bacteria can become resistant to biocides in time, and it is good to change away from typical bacterial resistors from time to time. I suggest you find out what type of lubricoolant chemistry your customer is using and then it will be easier for you to recommend an alternative to them. Using the same type of chemistry will make it easier for the end user to switch over to our products.

Always recommend the use of a refractometer to your customer; it's the easiest method to monitor the lubricoolant ratio, which will in turn prolong the life of the cutting tool/bandsaw blade.

FUNCTIONS OF METALWORKING FLUIDS

Metalworking fluids or lubricoolants play a critical role in most machining processes. The main functions of metalworking fluids are:

COOLING: Reduce heat build –up in the cutting zone and in the workpiece.

LUBRICATION: Reduce friction between the tool and the chips being removed.

CHIP REMOVAL: Flush chips away from the cutting zone, carrying them back to the sump.

CORROSION CONTROL: Protects the machine workpiece and tool from damage due to corrosion.

COOLING VS. LUBRICATION

Every operation has its own specific requirements for cooling versus lubrication. By varying the mix ratio or concentration of a water extendable lubricoolant, you can alter the balance of cooling and lubrication.

In general, the more water (leaner mix), the better the cooling; the more the concentrate (richer mix), the better the lubrication provided.

When machining, the requirements for lubrication are generally greater than for cooling; hence a richer concentration is used. When grinding, the requirements for cooling are greater; a leaner concentration is then called for….. but not so lean as to cause rust.

There are exceptions to every rule and this rule is no different. Some high-speed machining can be performed well with rather lean lubricoolant mixes, and some grinding applications (such as form or creep feed grinding) require a rich mixture for high lubricity. Each operation should be evaluated on its own to determine proper concentration requirements.

TYPES OF WATER-EXTENDABLE METALWORKING FLUIDS

SOLUBLE OILS: Greater than 30% oil content in the concentrate. DILUTION LOOKS MILKY

SEMI-SYNTHETICS: Less than 30% oil content in concentrate. DILUTION LOOKS TRANSLUCENT

PURE SYNTHETICS: No oil content. DILUTION LOOKS TRANSPARENT

ATTRIBUTES OF SOLUBLE OIL

ADVANTAGES:

More economical than straight oils; dilution with water keeps net costs down.

Cools 2 to 3 times better than straight oils.

Can be used in most machining and grinding applications.

Better health and safety aspects vs. straight oils; no fire hazard, reduced oil misting and fogging.

More forgiving of concentration fluctuations compared to oil free synthetics.

Residue is generally oily, not sticky.

DISADVANTAGES:

Higher disposal costs due to high percentage of oil versus synthetics or semi-synthetics.

May be less tolerant of hard water.

Emulsion is milky; workpiece is not visible through fluid.

Poor cooling in high-speed applications.

May tend to load up with tramp oils due to partial emulsification.

ATTRIBUTES OF SEMI-SYNTHETIC COOLANT

ADVANTAGES:

Leaves oily film on machine and parts for protection.

Tends to reject tramp oils.

Very stable emulsion, long lasting.

Better cooling allows higher cutting speeds.

DISADVANTAGES:

There is always some oil content in the formula, in which mist, smoke or disposal may be a problem due to the oil.

High detergency may contribute to foam.

ATTRIBUTES OF PURE SYNTHETIC COOLANT

ADVANTAGES:

Rapid heat dissipation.

Excellent workpiece visibility.

Great rejection of tramp oils are achievable.

Easier to measure and control concentration.

Bacterial attack is easier to control.

Usually stable and potentially long lasting.

No oil mist problem; no oil disposal concerns.

Easily filtered.

Recycling or reclaiming is usually feasible.

Healthier for the operator, due to its lack of oil.

DISADVANTAGES:

High performance products can be expensive.

Residual film may be tacky.

Requires tighter control of concentration ratios.

COOLANT MAINTINANCE

This section contains suggestions for proper maintenance and control of lubricoolant that the customer can perform. Implementing these suggestions is not as straightforward as it seems. Particularly in small systems or individual sumps, control and maintenance of lubricoolant can be difficult.

Testing and lab analysis of lubricoolant is feasible on large central systems where the cost of these procedures is easily justified in the control of 10,000 gallons of lubricoolant. It is not as easy to justify detailed analysis of a 100 gallon sump. Unfortunately small systems are subject to much more rapid changes, and greater fluctuations and therefore actually should be checked MORE frequently than the large tanks to maintain control. Therefore a recommended maintenance schedule should be at a 3 to 4 month interval. These factors make the choice of lubricoolant particularly critical for small sumps.

CONCENTRATION CONTROL

Concentration control is THE most important parameter for a lubricoolant user to monitor. It is imperative for extending coolant life.

Low concentration is the most common cause of lubricoolant problems. Our lubricoolants have been designed to operate at a minimum concentration of (25:1). A lower concentration than this, even for a short period of time, could lead to problems such as machine and workpiece corrosion, poor tool life and rancidity of the working solution. Start the concentration in the (10:1 to 15:1) range, and then the customer can fine tune the dilution from there.

Control of the concentration should be done by the use of the refractometer.

EFFECTS OF VARYING CONCENTRATION

ADVANTAGES OF RICH MIXTURE:

Best corrosion protection for workpiece and machine tool.

Excellent lubricity for tough machining jobs.

Better resistance to rancidity and long sump life.

There is a cushion of protection in case an error occurs by adding too much water to the mixture.

DISADVANTAGES OF RICH MIXTURES:

Higher tendency to foam, due to rich mixture.

Stronger solutions can be more irritating to skin.

Heavier coatings on machine could lead to buildup.

Greater lubricoolant usage.

ADVANTAGES OF LEANER MIXTURES:

Excellent cooling for grinding or high-speed machining.

Least irritating to worker's skin, eyes, and lungs.

Minimal foam levels.

Lightest residual film.

Most lubricoolant mix for the money.

DISADVANTAGES OF LEANER MIXTURES:

Little margin for error. If water ratio is too high it may result in a lubricoolant mixture too lean for corrosion protection.

Less effective rancidity resistance.

Less lubricity may result in poor finishes and/ or shortened tool life.

MICROBES IN THE LUBRICOOLANT

Microscopic organisms (microbes) such as bacteria and fungus are naturally present in and on us and live in the air we breathe and water we drink. The vast majority is not pathogen (disease causing) and does not cause problems in metalworking lubricoolants. Some however, are ideally suited for life in the warm, damp and dark environment of a fluid sump and can eventually lead to problems such as odors, plugged lines causing poor coolant flow, corrosion and emulsion stability.

Since bacteria and fungi compete for the same food sources, the growth of fungus is kept under control by healthy bacteria colonies. If biocides are used indiscriminately and bacteria colonies are eliminated or drastically lowered, fungus colonies will grow rapidly, and form large rubbery masses. This is another great reason to keep the lubricoolant ratio under control.

TRAMP OILS

Another important factor in lubricoolant life is control of tramp oils. This refers to any oils which are not part of the original lubricoolant formulation, including way lubes, hydraulic oil, tapping fluid, gear lubes, etc. which find their way into the lubricoolant.

These tramp oils carry their own contaminants, such as sulfur, phosphorous or solvents, which can be detrimental to the lubricoolant, either directly by destabilizing the emulsion or indirectly by providing food for bacteria. If excessive tramp oil is allowed to cover and “seal off” the surface of the lubricoolant in the sump, oxygen will rapidly deplete and allow anaerobic bacteria (bacteria which live in the absence of oxygen) to grow and multiply, producing hydrogen sulfide, which is responsible for the “rotten egg” odor familiar to many machinists. Keeping the level of floating oils to a minimum will prevent the surface of the sump from “sealing off”. Use our “OIL GRABBERS” to help keep oil off the surface of the sump.

SOLIDS CONTAMINATION

Another area for concern is the level of chips, fines or swarf in the sump. Quantities of these small metal particles can provide an enormous surface area for bacteria to attach themselves to while at the same time creating "dead areas" where coolant cannot circulate. There are many methods available for removal of these particles such as magnetic wheels, conveyors or indexable filters, but a regular maintenance schedule is the ideal way to treat this contamination. The less solid material in the sump, or system, the better. The use of our CHIP TENDERS will help in the removal of this type of contamination.

WATER QUALITY

Due to ordinary evaporation, a metalworking sump acts like a still and minerals in the water will remain behind as the water evaporates. Over time the mineral build-up can result in poor emulsion (mix) stability, heavy residue on machine surfaces, corrosion problems and a host of undesirable conditions. A good rule of thumb is to use tap water for the initial charge and the purest water available for the makeup solutions, thus minimizing the level of mineral buildup. (a certain amount of water hardness can help keep foam levels down.)

LUBRICOOLANT MANAGEMENT

Use OIL GRABBERS to remove excess tramp oil from coolant.

Circulate coolant and check concentration with a refractometer. Maintain fluid level, and add water and/or mixture of coolant where needed.

Check pH using pH color sticks (available from LAB SAFETY SUPPLY, www.LSS.com 1-800-356-0783 part #9BB-53279). If pH starts to fall, add coolant to bring up concentration. If pH does not stabilize, it is time to replace coolant. If coolant needs to be replaced, dump old coolant, clean machine and charge with fresh coolant.

Check all filters, chip strainers, and canister filters.

Provide aeration of coolant during extended periods of idle time. An air lance with 5 psi pressure allowed to bubble gently in an idle sump is often sufficient to prevent excessive anaerobic bacteria formation.

TROUBLESHOOTING:

I am having a foaming problem, what do I need to do?

Generally, synthetics and semi-synthetics, made with surfactants, by their nature will tend to foam a little. The key is to pay attention to the dilution ratio.

Too much lubricoolant in the dilution ratio will produce a foaming issue. Reduce the ratio of lubricoolant, and increase the ratio of water.

If there is not enough lubricoolant in the sump, your pump can have a tendency to cavitate, producing a major foam issue. Make sure pump doesn't cavitate by increasing the amount of fluid in the sump

If your flood coolant lines are small, and you have a powerful pump, this can create foaming.

It is recommended you increase the size of the lines.

If these steps have been tried and you still have a foaming issue, you may be using the wrong type of lubricoolant for the specific job at hand.

I am having a rusting problem, what do I need to do?

Flash rust generally happens when there is not enough lubricoolant in the mixture. Recheck your dilution ratio.

If these steps have been tried and you still have a rust issue, you may be using the wrong lubricoolant for the specific job at hand.

What dilution ratio is best to use?

Generally, metalworking fluids have a working range of (5 : 1) through (25 : 1).

Most times we recommend starting at (10:1 to 15 : 1 range), and then you can adjust from there for the specific job you are machining.

Grinding is best with a lean ratio (20 – 25: 1)

Machining at (5-15 : 1) depending on the metal, and which lubricoolant.

Sawing (5-15 : 1) depending on the metal, and which lubricoolant.

This will also give you an idea of how much product is necessary to buy to fill the sump.

I don't know the size of my sump

If you don't know the size of the sump, you can use this equation:

L x W x H x .004329 = "Estimated" size of sump in gallons.

How long will the coolant last in the sump?

With a regular maintenance/cleanup schedule, you can expect this product to last to your next cleanup. We have however had customers use our product for more than seven months, just refilling the sump with a make-up solution when needed. It all depends on the job and shop cleanliness. A recommended maintenance schedule would be every 3 to 4 months.

How do I clean my machine and sump?

We manufacture a machine and sump cleaner **EXTREME KLEANE** to do this job. With the cleaner diluted to the specifications on the label, add to the sump and let the machine run for 15 to 20 minutes, then drain sump. Wipe sidewalls of sump, with cleaner and under table if you can. Put new lubricant in and run machine. The new lubricant will also do some cleaning, so be prepared to clean again in about a week. We also manufacture oil absorbent pillows and booms which will help keep your sump clean. You should clean your machine sump at a recommended maintenance schedule every 3 to 4 months.

Can I put your coolant in with the fluid I am using right now?

If we manufacture the product you are using right now, then the answer might be yes.

If it is made by our competition, we recommend that you do not. Due to the different chemistries in our competitors products, it is not advisable to mix chemistries. If your metalworking fluids were a soluble oil material, and you wanted to switch to a semi-synthetic material, as an example, mixing metalworking fluids does not give a good representation of what our products will do right from the start.

Can I paint my machined part right after machining it?

If your metalworking fluid is a pure synthetic, or semi-synthetic manufactured by Synthetic Lubricants, Inc, the part should be rinsed, and then sent to the paint booth. When using a soluble oil based lubricoolant, a solvent based rinse is needed.

A portion of this information was used from published work by ATW.