Industrial Technology Virtual Learning

Machine Tool

May 7th, 2020

Machine Technology 2

Coolant Basics
May 7th, 2020

Objective: Students will understand the different types of coolant when to use them.

Bell Ringer

Does the coolant in a car do the same thing as the coolant in a CNC machine?

Functions of Coolants

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

COOLING: To reduce and remove heat build-up in the cutting zone and in the workpiece.

LUBRICATE: and thereby reduce friction between the tool and the chips being removed.

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

PROTECT AGAINST CORROSION: of machine workpiece and tools.

COOLING VS. LUBRICATION

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

In general, the more water (leaner mix), the better the cooling; the more 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; hence a more lean concentration is used (but not so lean as to cause rust).

There are exceptions to every rule and this one is no different. Some high-speed machining can be performed well with rather lean 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.

Classifications of Metalworking Lubricants

Neat or Straight Oils
Neat oils are made up primarily of naphthenic or paraffinic base oils with extreme pressure additives such as chlorine, sulfur and fats. Neat oils will not emulsify with water nor do they contain any water.

Soluble Oils
Greater than 30% mineral oil and no water in concentrate. Dilution appears milky and not translucent.

Classifications of Metalworking Lubricants

Semi-Synthetics
Less than 30% mineral oil content in concentrate and the concentrate contains water. Dilution appears translucent.

Synthetics
Zero mineral oil content. Dilution looks transparent and is a true solu- tion with no droplet formation like semi-synthetics and soluble oils.

Advantages and Disadvantages

Soluble Oil Advantages

- More economical than straight or neat oils; dilution with water lowers cost without sacrificing a great deal of tooling effectiveness.
- Soluble oils cool 2 to 3 times better than straight oils.
- Emulsions of soluble oils are very versatile and can be used in most machining and grinding applications on a wide variety of materials.
- Soluble oils have better health and safety aspects with respect to the shop environment vs. straight oils; no fire hazard, reduced oil misting and fogging.
- Of all the water extendible metal removal fluids soluble oils are the most forgiving of concentration fluctuations and poor management .
- Residues created by soluble oils are generally oily and not sticky.

Advantages and Disadvantages

Soluble Oil Disadvantages

- Higher disposal costs due to high percentage of oil versus synthetics or semi-synthetics.
- Emulsions are milky; therefore the workpiece is not visible through fluid.
- Less cooling in high-speed applications vs. synthetics or semi-synthetics.
- May tend to pick up tramp oils due to partial mechanical emulsification from circulation through the coolant pump.

Advantages and Disadvantages

Semi-Synthetic Advantages

- Leaves oily film on machine and parts for protection.
- Tend to reject tramp oils.
- Very stable emulsion, long lasting.
- Better cooling allows higher cutting speeds.
- Semi-synthetics offer the best of both technologies; soluble oils and synthetics.
- Semi-synthetics emulsions offer micro size oil droplets that have advantages in single point turning applications where optimal cooling and less lubrication is required.
- Our semi-synthetics are ideal for powdered metals, cast iron and metals that when cut don't create chips but rather sand-like swarf that can clog filters and form sump clinkers. Monroe’s semi-synthetics are great for cast iron machining and grinding applications.
- Semi-synthetic coolants are great for cleanliness and workpiece visibility.

Advantages and Disadvantages

Semi-Synthetic Disadvantages

- Low oil content reduces the physical corrosion film that is needed in some applications.
- Mists, smoke or disposal may be a problem due to oil.
- Semi-synthetics are not very forgiving when it comes to concentration control and rust and corrosion could be the results of poor fluid management.

Advantages and Disadvantages

Synthetics Advantages

- Rapid heat dissipation.
- Excellent workpiece visibility.
- Total rejection of tramp oils possible.
- Usually easy to measure and control concentration.
- Bacterial attack may be easier to control.
- Usually stable and potentially long-lasting.
- No oil mist problem; no oil disposal concerns.
- Easily filtered.
- Recycling or reclaiming is usually highly effective.
- Low consumption due to the fact that synthetics are true solutions with no droplet formation adding to carry off issues.

Advantages and Disadvantages

Synthetics Disadvantages

- High performance products can be expensive.
- Residual films may be tacky or sticky, which may cause gumming in the moving parts of the machine.
- Compared to oils, they have significantly reduced corrosion protection.
- Less forgiving in poor fluid management scenarios and require tighter control of concentration ratios to protect against rust and corrosion.

Machine Charging Procedure

For best coolant life and successful coolant management program fol- low these methods to recharge a freshly cleaned machine with Monroe metalworking fluid:

1. When mixing coolant, it is best to use an automatic proportioner which accurately and thoroughly mixes coolant.
2. **Always replenish the coolant with a mixture of coolant and water, not just coolant or water. Never add coolant concentrate directly to the sump.**
3. Add the mix to the sump to the proper level.
4. Start the pump and allow the fluid to circulate for at least 1/2 hour.
5. Check concentration with refractometer and make necessary corrections before machining.

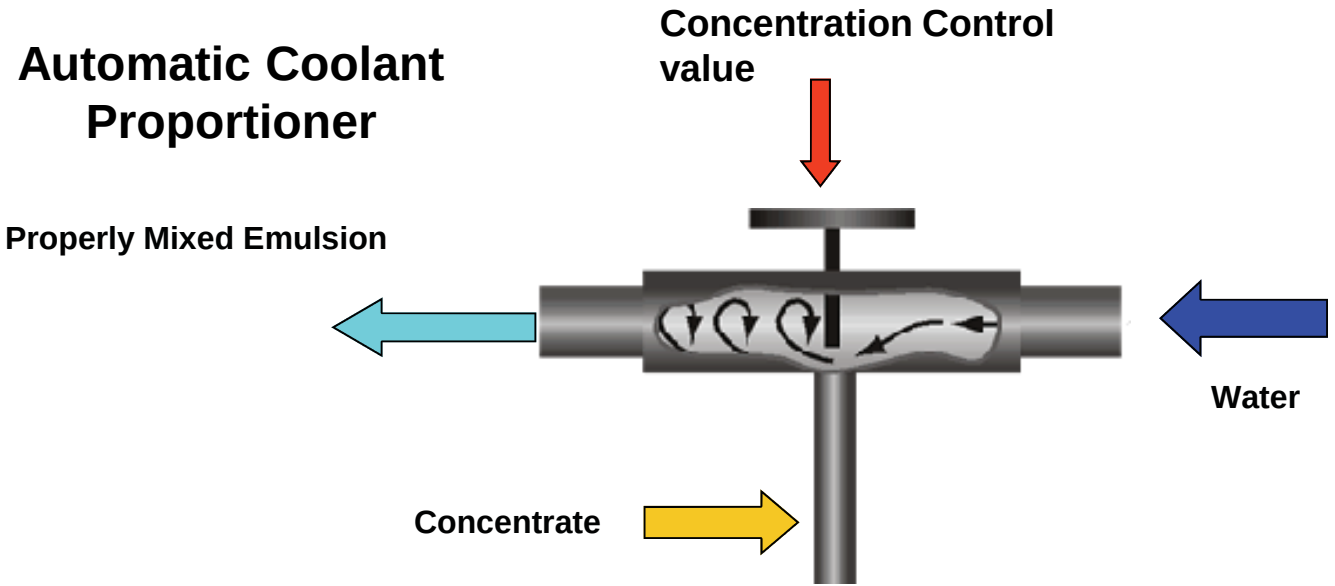
Concentration Control

Once a new coolant is in, concentration control is the most important parameter for a coolant user to monitor. It is imperative for long coolant and tool life.

As a rule of thumb: Concentration consistency can be achieved by never adding straight water or adding straight concentrate to the machine sump; always add a weak dilution half of the goal concentration. If the goal concentration is 7% always add 3.5% concentration. The reason for this is that the water evaporation rate versus additive and component depletions correspond to this formula.

Concentration Control

Low concentration is the most common cause of coolant problems that customers experience. Our coolants have been designed to operate at a minimum concentration of 4% (25:1). A lower concentration than this, even for a short period, could lead to problems such as machine and workpiece corrosion, poor tool life and rancidity of the in-service coolant.



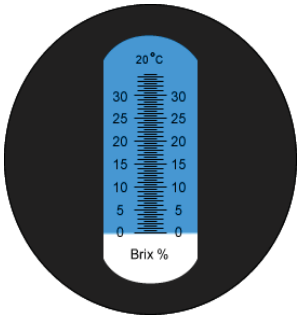
Concentration Control

Refractometers: designed for measuring the concentration of an aqueous solution, can be used for checking cutting and grinding fluid concentra- tions. Hand refractometers are useful for day-to-day control of concentra- tion and are much faster than the laboratory procedure.

To use a refractometer, you simply place one or two drops of the coolant solution onto the prism surface, close the cover plate, look through the eyepiece (facing the light) and read the scale. Compare this reading with the Brix chart for your coolant to get actual concentration. It is important to ensure that your refractometer reads zero on water alone. This is accomplished by placing a drop of water on the prism and reading the results normally. If the reading is not zero, an adjustment screw must be turned to calibrate the unit.

Hand Refractometer

View Through Sight Glass



Resource

Here are the resources that has been provided for you. These sites will help you answer some the questions.

https://www.youtube.com/watch?v=KqIFoJs1Pc8

This is a series of videos.
https://academy.titansofcnc.com/series/coolant-101

Assignment

You will be writing a paper for this lesson. Your are to write your thoughts to the following questions. 1 page typed is the format we will use. Proper spelling and punctuation are expected. All papers will be typed. No exceptions. You are to **freely give your opinion** even if your opinion disagrees with the teacher.

Make an effort and write a well thought out paper. In the real world of work you will be paid to give an excellent effort, each and every day. Marginal effort in the workforce results in you getting fired, your company suffering the consequences of your poor effort, and customers not getting what they deserve and paid for. So with that being said, start out with good work ethic on the papers you write.

Questions

1. What is the function of coolant?
2. Name 4 types of coolants.
3. Give 2 advantages and 2 disadvantages of each of the following types of coolants.

- Soluble Oils
- Semi-Synthetics
- Synthetics

4. When mixing coolant, what tool is used?
5. Should straight water be added to the machine sump?
6. What is a refractometer?