A Practical Guide to Metalworking Fluids

Supporting our Students and Schools-Investing in the future of Metalworking Trades

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IMPORTANCE OF METALWORKING FLUIDS TO THE OPERATOR

The proper metalworking fluids help the customer optimize the following areas:

- Maximize production rates and make machining operations more efficient
- Provide good surface quality and dimensional accuracy on finished metal parts
- Extend the life of cutting tools, minimize downtime for changing, dressing or sharpening tools

Metalworking Fluid: Functions

- **COOLING** - Reduce/Remove Heat in the Cutting Zone and in the Work Piece.
  - Water Carries Heat Away Better Than Oil
- **LUBRICATION** - Reduce Friction Between Tool, and Work Piece and Chips
  - Oil and Lubricity Additives Lower the Coefficient of Friction.
- **CHIP REMOVAL**- Flush Chips Away from Cutting Zone
- **CORROSION PROTECTION**– For Machine, Workpiece, and Tool.

Metalworking Fluid: Functions

- ***Cooling*** *versus* ***Lubrication***
- Every operation has its own specific requirements
  - **Machining** - Lubrication Requirements Generally Greater
  - **Grinding** - Cooling Requirements Greater
  - **Harder Metals** - Cooling Requirements Greater
  - **Softer Metals** - Lubrication Requirements Generally Greater

Metalworking Fluid: Functions

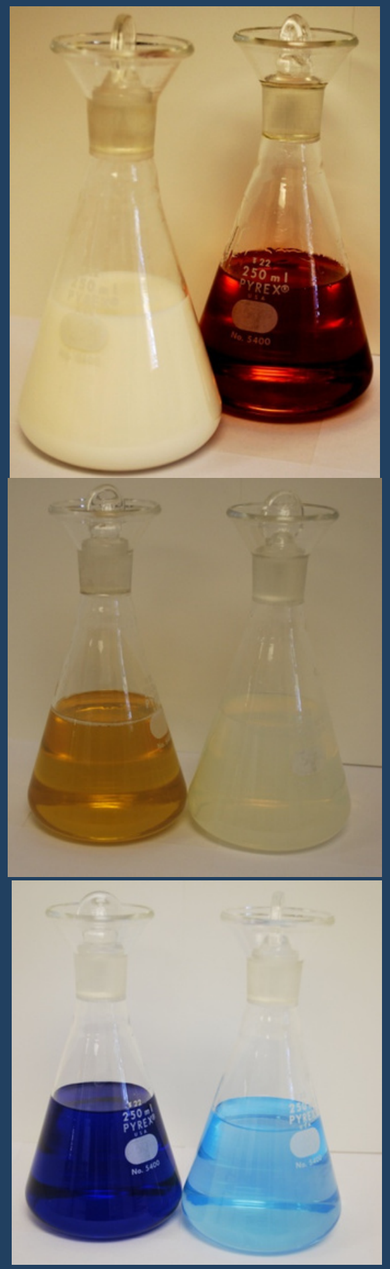
- Heat generated during machining is caused in part by friction as the cutting tool contacts the workpiece
- Metalworking fluid must provide lubrication to reduce the friction
- Friction results as the cutting tool enters the surface of the workpiece at an angle known as the shear angle. The result is the removal of metal in the form of chips
- Note: 3/4 of the work done in cutting is to form the metal chip and the remaining 1/4 of the work is done to overcome friction
- Flush metal chips and metal fines (swarf) from the cutting tool, workpiece interface to improve surface finish on the metal part
- Provide corrosion protection to the cutting tool, machine tool and the workpiece. In-use fluids can have over 95% water content

Typical Coolant Chemistry

- Naphthenic or Paraffinic Mineral Oils
- Emulsifiers
- Corrosion Inhibitors
- Lubricity Additives
- Wetting Agents
- Coupling Agents
- Alkalinity Boosters
- Biocides/Fungicides
- Extreme Pressure Additives
- Anti-Foaming Agents
- Water

Basic Types of Coolants

- **Soluble Oils**
  - >30% Mineral Oil
  - Dilutions are Milky
- **Micro-Emulsions**
  - Dilutions are Milky
  - A relatively new class of coolants characterized by very small oil droplets resulting in high lubricity and efficiency
- **Semi-Synthetics**
  - <30% Mineral Oil
  - Dilutions are Translucent
- **Synthetics**
  - No Oil Content
  - Dilutions are Transparent



Coolant Control

By refractive index, using a sight glass refractometer or digital refractometer for brix reading

Check with your coolant supplier to see if they offer a free routine analysis program

- **What Can We Measure?**
  - **Concentration**
    - **By Refractive Index (BRIX scale)**
    - **Refractometer**
    - **Use our Calculator for % (website)**
- **To get percentage, you must multiply brix reading by the product's refractive index # to get percentage of concentration.**
- **Every product has it's own refractive index #**

the brix reading is NOT the coolant concentration percentage. Use multiplier noted above

Metalworking Fluid Problems

- RANCIDITY
- POOR TOOL LIFE
- RUST/CORROSION
- DERMATITIS
- DISPOSAL ISSUES
- HIGH USAGE AND ASSOCIATED COST

Metalworking Fluid Problems

- **Solids Contamination (Chips, Swarf, Garbage)**
  - Surface Area For Bacteria To Attach To
  - Skin Irritation
- **Water Quality (Very important factor)**
  - Build Up Of Hardness/Conductivity Over Time
  - Use Tap Water for System Charge
  - Use Purer (Deionized//Reverse Osmosis) Water for Make Up

Coolant Control

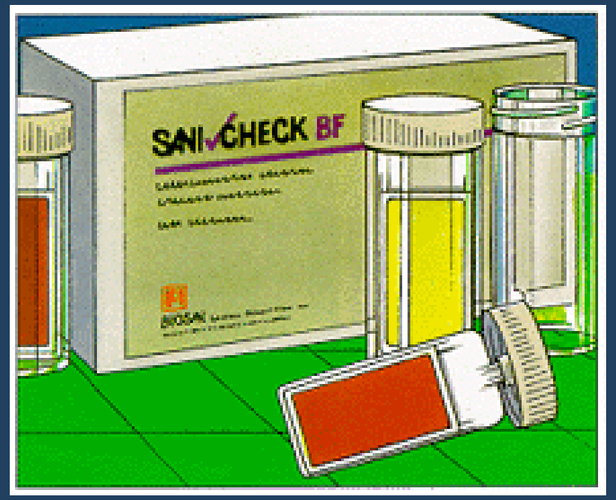
- **What Can We Measure?**
  - **pH**
    - Measures acidity/alkalinity
    - By paper or meter
  - **Conductivity/Total Dissolved Solids**
    - Measures dissolved contaminants
    - By electronic meter

Coolant Control

- **pH Control**
  - Measure of Alkalinity/Acidity
  - Lower pH is more favorable for “Bug” growth
  - Lower pH can contribute To corrosion
  - Fresh coolant: 9-9.5 pH
  - Point of no return: 8.0 pH

Coolant Control

- **What Can We Measure?**
  - **Biological Growth**
    - Bacteria and Fungus
    - Dip Slides



Microbes In The Coolant

- **Bacteria**
  - Lower pH- Decrease Emulsion Stability
  - Can Contribute to Dermatitis
  - Grow in Stagnant, Oil-Covered Sumps
  - Produce Sulfides - Acidic in Nature
  - Create “Rotten Egg” Monday Morning Odor
  - Low pH Can Lead to Serious Corrosion

Coolant Control: Bacteria & Fungus

Biocides

- Used to Treat Bacteria
- Use Only When Needed
- Must Be Used at Recommended Levels, No Higher, No Lower!

Fungicides

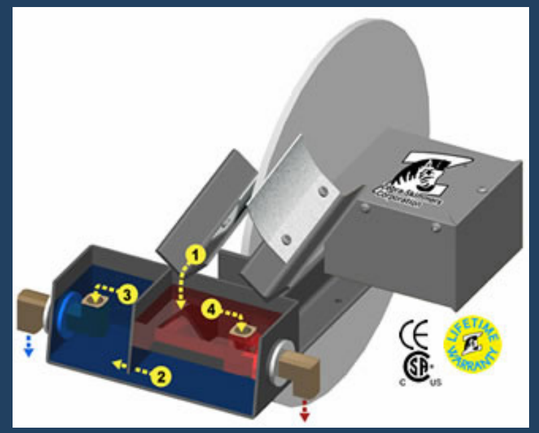
- Used to treat fungal growth
- Use only when needed
- Fungal growth needs to be physically cleaned out of sump/cnc

Contamination Control: Housekeeping

- **If It Does Not Belong There It Is Probably "Bug" Food**
  - Cigarette Butts
  - Sandwiches
  - Coffee
  - Floor Cleaners/Sweepings
  - Human Urine

Contamination Control in Coolants

- Remove excessive tramp oils, use skimmers or shop vac to remove tramp oils. (way lubes, hydraulic oil, tapping fluids, gear lubes, etc.)
- Keep chips, fines, and swarf out of the sump to prevent “breeding grounds” for bacteria.
- Provide receptacles for garbage, coffee, tobacco juice and cigarette butts.



Contamination Control: Tramp Oils

- **Non-Coolant (Tramp) Oils**
  - Hydraulic Fluids, Way Oils, Gear Lubes, Oil Based Rust Preventatives
- **Bring Unwanted Additives**
  - Interfere With Coolant Function
  - “Bug” Food
  - Destabilize Emulsion
  - Decrease Corrosion Protection
- **Create Anaerobic Conditions**

Contamination Control: Tramp Oils

- **FIX LEAKS!!!!**
- Use an Oil Separator, Skimmer, Absorbent Pads, Shop vac or other means to remove or reduce tramp oils to a minimum.

Contamination Control: Solids

Screens, filters, magnetic separators and chip conveyors all serve to remove undissolved solid materials such as chips and swarf from the working coolant.

Three C's of Coolant Management For Maximum Coolant Sump Life:

- **Start With a Clean Sump,**
- **Maintain Proper Concentration, and**
- **Minimize Contamination**

Daily Coolant Upkeep: Individual Machines

- Circulate coolant and check concentration with a refractometer. Maintain fluid level. Add water and/or mixture of coolant where needed, use our Coolant Concentration Calculator on our website.
- Check pH using pH color sticks. (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.)
- Run oil skimmers during quiet time to remove excess tramp oil from coolant. A wet/dry vacuum can be used. Dispose of as waste oil.

BRIX READING CALCULATOR

BEST PRACTICE TIP

SUMP LEVEL LOW?

Problems of a low sump level:
Coolant does not have enough time to dissipate heat.

Causes:
Loss of water due to evaporation, carry off on chips and parts and/or chips/swarf are not being removed from system.

The FIX: Set up a pail or drum and label it as “MAKE-UP” Coolant.
Fill container with water first, then add coolant concentrate–**always add only half of the % you normally set concentration**. This will prevent raising the concentration past acceptable levels. It also prevents improper topping off, just adding coolant concentrate is a waste of $ and can lead to high concentrations and skin irritations, and unnecessary spending.
Charging a CNC Sump? Or Mixing Make Up Coolant?:
ALWAYS remember O-I-L or “oil in last” add water first, at least 60-70% of your sump volume before adding
coolant concentrate. Not following this can result in poor emusion quality or a broken emulsion and the
coolant will not function properly.

Proper coolant maintenance is simple:

- Check concentrations regularly
- If your vendor has an analysis program, send samples on a regular basis to track coolant quality
- Keep trash, dirt, etc. out of sump
- Use a skimmer or shop vac to remove tramp oil, remove chips/swarf
- Top off low sump level properly

Following these protocols are key to savings and performance.

Thank you

Questions?

Call Fred Kane 843-333-7974 or email fkane@monroefluid.com I am glad to assist.

- **Coolant is a tool, maintain it properly and it will perform it's role, and save you money!**
- **Choosing the right coolant for your needs is very important.**
- **Discuss your needs with your coolant sales rep. to help in choosing the right product.**

If you have questions, your coolant manufacturer's technical team can help. Depend on their expertise, they are there to support you.

Visit Our Website
www.monroefluidtechnology

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