LUBSOIL®

WHITE PAPER

METALWORKING COOLANT MANAGEMENT

Oil and water do not mix. So how do water based coolants contain oil and water? Emulsifiers!

Emulsifiers are attracted to both oil and water and allow for oil droplets to be suspended in water. The amount and type of emulsifier, type of oil, water quality and especially how the fluid concentrate is mixed with water determine the size of emulsion droplets as well as the initial stability.

"OIL" is the best way to remember "Oil In Last." Which is the proper way to mix coolants.

The addition of water to a metalworking fluid concentrate can lead to an inverted emulsion that is thick and usually unstable, not to mention an artificially high particle size that decreases the fluid's ability to wet on metal and provide lubricity. This is especially true in high oil water-miscible fluids, but can also occur in lower oil semi-synthetic fluids. Since synthetic fluids form a true solution, less precision is needed when mixing concentrate into water.

Best practice is to premix the concentrate into water prior to introduction into a machine reservoir.

This is true for both the initial fill of a system and also for make-up fluid. Generally, since fluid loss is mostly evaporation of water due to heat, it is best to proportion a much lower concentration for make-up to avoid increasing system concentration to higher than recommended levels.

If the concentrate is added directly to machine reservoirs, it is best to add slowly to an area of high agitation as close to the return line from the machining interface.

Example: Concentration goal 8%, initial fill would be 8% coolant concentrate to 92% water. Make up fluid might only need to be 4% coolant concentrate to 96% water to maintain the system at 8%.

PROPORTIONERS are the easiest way to premix coolant before adding it to a machine. There are two main types of proportioning systems:

- **Positive displacement mixers**, driven by water pressure, mix coolant concentrate and water to the desired concentration to a high degree of accuracy.

- **Drum proportioners** are less costly and also mix less precisely than positive displacement systems.

With any of these units, it is important to maintain a consistent water pressure and to verify the resultant concentration on a routine basis.

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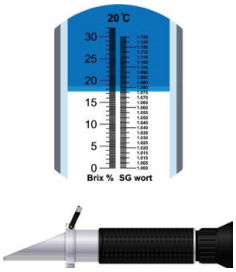
CONCENTRATION CONTROL is critical for the overall performance of water-miscible metalworking fluids.

- **Low concentrations** can result in poor machinability, increased corrosion and poor product stability.
- **High concentrations** can lead to foaming, misting, smoking and increased dermal and respiratory irritation.

Refractometers: Handheld or digital refractometers are the most commonly used method for checking fluid concentration. Perform the following for proper use:

- Clean the lens properly
- Routine calibration
- Only place emulsion on the lens (no free oil)
- Consult the refractometer index or factor to find the accurate concentration



Titration: Fluid contaminants, especially tramp oils, can make the use of refractometers inaccurate due to the blurring of the indicator line. Titration can sometimes add accuracy to concentration determination.

Other routine tests that should be performed, usually by an outside lab.

pH Measurement: Routine measurement of the pH (acidity / alkalinity) of the fluid can often identify the presence of contaminants and provide an indication of emulsion stability as well as presence of biological activity in the fluid.

Biological Monitoring: Any fluid that contains water may contain bacteria and fungus that can degrade the fluid causing poor performance, odors and high fluid usage. Microbial dip slide tests can detect early activity and allow for proactive treatment to increase the fluid life, working conditions and overall product performance.

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METALWORKING COOLANT MANAGEMENT

COOLANT MANAGEMENT - HEALTH AND SAFETY

Machining fluids contain a complex mixture of several potentially hazardous chemicals. The Safety Data Sheet (SDS) details risks associated with machining fluids, but it is important to remember that these risks are identified for the fluid concentrate. Many of these risks are greatly minimized when the fluids are diluted with water for use and properly maintained.

EFFECTIVE FLUID MANAGEMENT

Machining fluids come into contact with skin throughout all stages of the manufacturing process, especially the hands and forearms. These fluids can cause skin irritation and other fluid contaminants can increase the risk of dermal irritation. This is why it is critical to have effective fluid management controls in place. The edges of metal swarf, fines and chips as well as other foreign matter can cause skin abrasions that lead to increased dermal irritation.

HYGIENE

Good personal hygiene is vital to reduce the risk of dermal irritation. Barrier creams should be used in conjunction with proper PPE and only applied to clean, dry skin. Wash exposed areas frequently and consider applying a moisturizing lotion or barrier cream afterwards.

COOLANT MANAGEMENT – CONTAMINANTS

Compared to other types of lubricants, water-miscible fluids need extra care and attention to insure they're kept in good condition. There are many types of contaminants that can have detrimental effects on these fluids with regard to machining performance, housekeeping and Health Safety and Environment (HS&E) considerations.

Bacteria and Fungus: One of the most significant causes of reduced fluid quality and effectiveness is microbial contamination. Due to water content, water quality, airborne compounds, tramp oils and metal fines; microbes can enter into these fluids and cause degradation of the fluid, product instability, odors, corrosion and residues.

There is no way of preventing microbes from entering these fluids, but they can be controlled. Selection of an optimum fluid, keeping correct concentrations, removal of contaminants, tank side additives and preventative system clean outs can all be effective.

Water Quality: A water-miscible fluid usually contains 85-98% water, therefore water quality greatly impacts fluid performance and life. Very soft water (0-20 ppm) can cause foaming, while very hard water (>400 ppm) can contribute to residues, staining and poor emulsion stability. Many water sources are high in chlorides that can lead to rust and corrosion issues. Deionization systems and reverse osmosis systems can be used to achieve higher water quality. Water sources should be checked for the presence of undue amounts of microbial contamination and low (<6.5) or high (>8.0) pH conditions.

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Tramp Oil: Tramp oil is unwanted machine lubricants that have leaked into the coolant system. This is the most common type of contamination. It can contribute significant "bacteria food," float on the surface and deprive oxygen to encourage anaerobic biological growth that releases hydrogen sulfide odors and cause emulsion instability. Tramp oils can be reduced by fixing leaks and using removal devices such as skimmers, weir systems, centrifuges, coalescing units, filters and other means.

Metal Fines, Chips and Swarf: Metal debris should be removed from the fluid on a constant basis when possible. Removal of metal fines maintains sump capacity for the fluid to cool the tools and workpiece. Chip or swarf accumulation can increase biological activity and the formation of insoluble soaps that cause residue and emulsion instability, dermal irritation and can be reintroduced into the cutting zone resulting in tool damage and poor part quality. There are many forms of metal removal including magnetic filters, cartridge, metal, paper or other filters, centrifuges, chip drags and just simple settling.

COOLANT MANAGEMENT - REMOVING CONTAMINANTS

There are many forms and types of contaminants that can be introduced into a machining fluid system. Leaking machine oils (tramp oils), metal chips and fines, hard water residues, pre-process metal coating fluids, bacteria and fungus and general debris from the work environment. Removal of these contaminants is critical to prolong the life of the machine fluid as well as to insure the stability of the fluid and its additives for optimum performance. Removal methods range greatly with regard to design, cost and maintenance required.

Tramp Oil Removal

- Belt Skimmer
- Disk Skimmer
- Decanting Tanks
- Coalescers

Filtration and Metals Removal

- Indexing Paper / Cloth / Fiber
- Centrifuges
- Magnetic
- Cartridge

Tulco has extensive experience in the metalworking fluid industry. Our highly trained and knowledgeable sales staff can assist you in fluid selection, usage and proper maintenance. Contact your local Tulco representative or our corporate office at (800) 375-2347.