

# Please describe the most difficult problem you observed in a manufacturing operation that involved metalworking fluids. How did you resolve the problem?

To continue this issue's focus on MWFs, we are reprinting a Sounding Board that originally appeared in the February 2008 issue of TLT. The questions, supplied by STLE's MWF Technical Committee, focus on readers' greatest challenges with these substances and generated more than 100 responses. Among the most frequently cited operational problems were foaming, rancidity, dermatitis, short sump life, inverted emulsion and premature tool failure. Changing base oils, upgrading the additive package and better training of operators and fluid managers all were offered as solutions. In many cases readers noted a natural conflict between engineers seeking the best product and purchasing departments looking to keep costs down. TLT readers properly noted that the best approach is one that addresses the total lubricant cost. Savings on a lubricant often are offset by tools and sumps that need to be changed more often. Spending more on raw materials may be a tougher sell to senior managers, but as one TLT reader noted, "In the long run it's worth it."



**Long life of coolant** in a comfortable situation with stable performances. Solved by selecting appropriate products and by improving maintenance of the product.

A customer asked for a **water-based grinding fluid** with sufficient lubricity to replace straight oils and reduce fire hazards. This was accomplished through proper selection of chlorine-free lubricants. The resulting product was used at 5% to 10% dilutions.

By introducing a **semisynthetic over an oil-based MWF**, misting was reduced with fewer complaints of rancidity.

**Unsatisfactory sump life and biological rancidity.** Increased the concentration of coolant along with more frequent additions to replenish the stability of the coolant.

The most difficult problem that I had to resolve was an **emulsion-aging issue** which caused an operation failure. I was able to resolve it using trend analysis.

**Tools started breaking** precipitously due to loss of EP lubricant, which was not being replaced.

**Difficulty plating** after parts machined. This required an electro-cleaning process.

Plant had **multiple sumps, and fluid condition varied** across the facility. The plant's people had no idea about fluid conditions. We instituted a sampling and training program to help plant personnel become aware of the importance of fluid condition.

Customer had a **misunderstanding of MWFs** due to lack of trained professionals representing companies that are treating their products as straight commodities. This particular customer finally agreed to in-house training and then applied that knowledge with great success.

**Inverted emulsion.** Dumped and recharged the system.

**Foaming of straight oil.** Solved with an oil defoamer.

**Bacteria and fungus, odor and dermatitis.** Utilizing an effective fluid management program can effectively control these operational issues.

Getting operational staff to understand and **maintain the MWF**. This important step often was forgotten. Training and educating the customer staff and, in some instances, providing services helped resolve the problem.

**Odor and bacteria issues.** Switched fluids.

**Floating fines** in a grinding coolant. We used a surfactant to enable the fines to sink and allow them to be dragged out by the conveyor belt.

**Coolant instability.** We found the water deionizer was not right and was letting all the carbonate go through, eventually splitting the soluble oil out. We ran pH tests of the water immediately out of the unit to see pH at 3.0.

We were working with a drilling operation where the **production speeds needed to meet the contracted timeline** were greater than the tools could tolerate using the existing fluids. We increased specific additive concentrations significantly, which greatly extended the life of the tools. Although this increased the cost of the fluid, it allowed the production schedule to be met and reduced the overall cost due to reduced tool replacement.

Operators **not taking care** of their coolant sumps or systems. Concentrations out of line, tramp oil not taken care of. Continued education helps (hopefully).

Getting **defoamer to go into semi-synthetics**. We solved the problem by using a proprietary system.

**Poor surface finish in cupping operations.** We tested 300 various lubricant formulations to resolve the issue. Lack of lubricity of MWFs was the primary cause of inadequate operation runability.

**Control of microorganisms** in systems that were idle over the holidays. This required multiple additions of biocides to kill the population in the fluid and attached to the walls of the tanks.

Problem: **Emulsion separation** during periods of downtime. Solution: Used distilled water for initial charge and operated pump regularly to stir emulsion.

**Foaming.** Used non-foaming raw materials.

**Staining of magnesium and its alloys.** We are presently evaluating a chemical approach to resolve this problem. It is too early to tell if it will be successful.

**Bacterial growth and dermatitis.** We used synthetic coolant with reverse osmosis water.

The most difficult problem is **applying the fluid properly**. Any fluid works well when it is misapplied. Using premium fluids necessitates the proper nozzles, placement, pressure and flow rates.

Finding a fluid that would **cool and lubricate the cut on a high-power plunge grinder** that penetrated more than an inch into hardened steel in a single pass with low enough foam to allow the pressure required for the fluid to reach the cut zone while also providing good dispersal of the resulting swarf. Fluids were compared in lab tests and simulations and then evaluated in shop trials until suitable ones were identified.

**Poor filtration of the cutting/coolant fluid** that reduced the fluid life cycle and damaged the pump and other components of the equipment. Designed quality-effective, user-friendly filtration systems.

Requirements for **dry machining** pose difficulties because lubricants cannot be used. The problem was solved with PVD coatings.

**Mismatched coolant.** The product in use was overkill. The issue was resolved by conducting a coolant trial, qualifying four candidates and selecting the best. This resulted in a 40% reduction in coolant.

Problem: **Maintaining surface finish with a long-lasting tool**. Solution: Formulate a cutting fluid that works and make sure purchasing doesn't think about how much the raw materials cost. In the long run, it's worth it.

### What attribute do you feel is most significant in contributing to a greener metal-removal operation?

Fluid contains renewable materials such as vegetable oils.	20%
Fluid is highly sustainable, providing long sump life.	60%
Fluid is free of chlorinated-based lubricants and additives.	30%
Fluid can be recycled.	49%
Fluid is biodegradable.	23%
Other	10%

*Based on responses from 117 readers. Total exceeds 100% because respondents were allowed to choose two selections.*

**Do you feel it is acceptable for metalworking fluids with greener attributes to cost more than conventional MWFs that do not offer as much in the way of environmental benefits?**

- No, to be a realistic alternative greener fluid technology should be comparable in cost to conventional fluids.** 54%
- Yes, higher costs is part of the price we pay for using green technology.** 46%

*Based on responses from 117 readers.*

**Keeping active MWF out of the machine tool lube system.**

Developed a tracking system by recording MWF make-up rates and setting limits on each machine. The limits allowed for partial carry-off of the MWF. Once limits were set, upon reaching them we developed a machine tool lube sampling program.

I think there's **not a "most difficult" problem** because every process is different and every application has its own challenges. The problem I think is more difficult to solve relates to staining. The amounts and relations between the additives are very important to prevent staining problems. The way to solve this is by having a very good control in the production of the fluid and in the mixing operations (to add the exact amount of each additive)

I think the most difficult thing is **controlling performance of metalworking fluid during service.** For example, the concentration of water-soluble oil is changed without warning. Every manufacturer of fluid gives technical support, but it is very limited. Then on-site monitoring is very necessary.

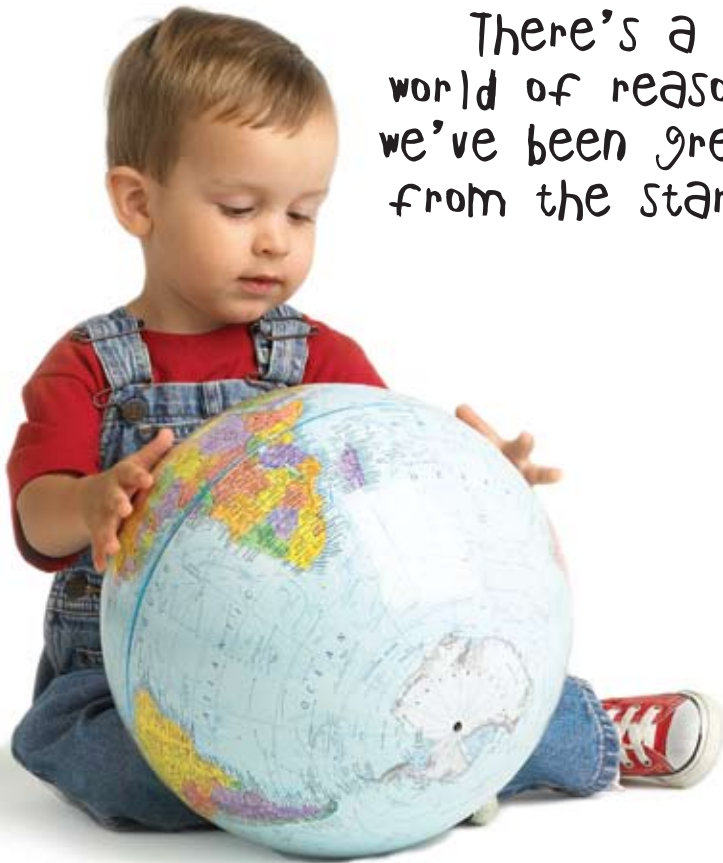
In a tube mill, they started experiencing **problems with rust.** The RP and the fluid had not changed for the past seven years. We found out they had bought some steel from other sources that had a residue that would not come off when the RP was applied.

**Balancing act** between an upscale product that offers greater tool life and less expensive fluids being purchased as a commodity. Engineering is always interested in the former, while the purchasing department does not see the annual tooling savings.

**Honing fluid would retain chips,** causing premature tool wear and tool holder breakage. We added a surface tension-reducing agent.

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The **quality consistency of base oil** used in the product determines its stability. Check certain parameters of the base oil before use and, if required, adjust the product using surfactants.

Main problems are the **stability of the emulsion and the biostability**. Emulsion stability is affected by aging and by accumulation of salts from the water. Biostability is not a surprise for a water solution of organic substances working in an open and often dirty environment. The solution is the combination of good quality formulation and careful maintenance of the fluid (filtration, separation of lubricant oils, correct concentration and regular laboratory checks).

**Machining of titanium alloys**, particularly at high speeds. Machining in an inert atmosphere was a partial solution.

**Getting people to do what they are supposed to do!** SPC, QC, ISO, TS, Six Sigma are all good plans that help, but customer training with documentation works the best.

**Controlling mold bio-films** in soluble oils. We augmented the biocide package with bio-static amines.

The most difficult problem I've met before is the **replacement of chlorinated paraffin chemistry in stainless steel operations**.

Scientifically, I would mention the surface adsorption which is missed at the very indifferent metal surface. The same challenge is to find very severe Al alloys. Different combination of additives can work depending on the alloys and metalworking or metal-forming applications. Combination of ester and phosphorous is one option, but percentage and ratio must be fit for the application.

**Maintaining the condition of MWFs due to bacterial contamination**. Solution is routine draining, flushing and replacement when condition deteriorates beyond acceptable limits, based on routine fluid analysis.

I believe the most difficult problem I observed is the way operations would allow the **MWF to be contaminated** in lieu of making parts. We discussed ways to change procedures and attitudes. **TLT**

**Editor's Note:** Sounding Board is based on an e-mail survey of 7,200 TLT readers. Views expressed are those of the respondents and do not reflect the opinions of the Society of Tribologists and Lubrication Engineers. STLE does not vouch for the technical accuracy of opinions expressed in Sounding Board, nor does inclusion of a comment represent an endorsement of the technology by STLE.

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