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Fighting Foam - *Understanding the Cause & Solving the Problem*

Most water-based metalworking fluids used in machining today contain both oil and water. Oil and water, in general, do not mix without the addition of emulsifiers. Many commonly used emulsifiers are soaps, which as we would expect will increase the tendency of foaming in fluids. Foaming in machining operations can be a major issue for two main reasons:

- Foam overs not only create a mess but cause downtime to clean and allow the foam to dissipate, which leads to a loss in production.
- Air entrapped in the fluid can lower the cooling and lubricating properties that are vital to tool-life and part finish.

Understanding Foam Factors allows a machine shop to be prepared and manage the reduction and elimination of foaming.

Foam Factor 1: Soft Water

Where the water is sourced and how it is treated can vary widely in the range of water hardness levels. The table below illustrates different water hardness in Parts Per Million (PPM).

Water Hardness (PPM as CaCO3)	Description
0-100	Soft
100 – 200	Moderately Hard
200 – 300	Hard
>300	Extremely Hard

Because soft water is known to cause foam the ideal range for water-based coolants is between 100 – 250 PPM hardness. Some manufacturers of machine coolants and cutting oils provide water testing to their customers to help determine the water quality at their specific facility to determine their best coolant formulation.

Soft water solution:

Some shops use reverse osmosis (RO) or deionized (DI) systems to avoid problems caused by hard water. It is best to charge the system using harder tap water first. This will allow for some hardness to help minimize foaming. During the machining process there is always some fluid loss either by leakage, carry-off on the parts, or evaporation. It is important to add new fluid back to the sump to maintain the appropriate fluid level.

Choosing the right cutting fluid is very important, especially if the source is delivering soft water. Some metalworking fluids have a higher tendency to foam than others.

- Synthetic fluids tend to have a lower chance of foaming because they do not contain emulsifier soaps.
- Semi-synthetic fluids have more of a tendency toward foaming because they contain the most emulsifier soaps.

Some of these properties can be balanced with the use of proper antifoam additives in the concentrate.

Foam Factor 2: Flow Rate vs. Sump Size

The combination of a high flow rate and smaller sump will more likely lead to a foaming issue. With a smaller sump, there is not enough time for the foam to dissipate before being recirculated, causing air to be pushed through the pump and back into coolant which bubbles up creating foam build.

Flow Rate/Sump Size Solution:

The best solutions are to lower the flow rate to allow the fluid more down time in the sump and to select the correct product for the specific operation. A product formulated with heavy duty antifoam is ideal to provide necessary foam break.

Foam Factor 3: Filtration Issues

All metalworking fluids go through filtrations to help remove chips and swarf from the fluid to prevent damage to the tool and workpiece. It is imperative that the mesh size of the filter is not too fine causing it to become clogged (like the one pictured here). A clogged filter can separate out the antifoam additives that are meant to help keep foam down. Foaming will increase without the proper antifoam chemistry.

Filtration Solution:

Filter media should be inspected on a regular basis to ensure it is in good working condition and clear of excess debris. If the filter media is under 20 microns, it should be replaced with a larger mesh size to avoid clogging and ensure antifoam additives are not being removed.

Foam Factor 4: Chip Buildup

During a metalworking operation, chips are continuously being produced. These can build up on the workspace, in the sump and in filters (as demonstrated in the picture to the left). It is essential these chips are removed from the workspace and not allowed to build-up in the machine. Excess chips give the fluid and foam more surface area to cling to which prevents the foam from breaking and properly dispersing.

Chip Buildup Solution:

It is important to ensure the conveyor system in the machine is working properly and effectively removing most of the chips. If it is not, the chips may need to be manually pushed down the conveyor to facilitate removal.

Foam Factor 5: Other Causes

Other contributing factors to foam buildup include specific nozzles such as fan nozzles, high pressure systems, through the tool fluid application, sump design and baffle systems, and cascading coolant flow, to name just a few.

It is important to evaluate any foaming problems to determine the root cause in order to prevent any downtime or loss in productivity.