Characteristics of Metalworking Fluids – Product Residue

For the sake of this discussion, residue is the material left behind on the machine and work pieces after the water evaporates from the working solution. For a metalworking fluid to perform one of its key functions, provide in-process corrosion prevention, it is critical that the fluid leave a corrosion resistant (residue) coating. Therefore the question is not "does the fluid leave a residue" but rather "is the residue objectionable?" So once again we are forced to make a value judgment based on the specifics of our manufacturing situation with the understanding that the type of residue that the fluid leaves will affect carryoff and therefore fluid usage, machine function, filtration, machine and part cleanliness, and grinding wheel loading among other processes.

A simple but effective method for checking possible residue effects is to pour 5 ml. of coolant concentrate into a petri dish and leave it exposed to the air at room conditions for a month or more.

One of the less obvious but truly significant issues associated with machine residues is their tendency to capture and hold chips and swarf on the functional surfaces of the machine. When chips or swarf are held by the residue, these chips begin to act as "scrapers" and the swarf as "lapping compound" as they cut and grind away at machine seals, ways, guides, wipers, etc. Yes, they are all time change maintenance items, but there is no need to hurry their demise.

A simple but effective method for checking possible residue effects is to pour 5 ml. of coolant concentrate into a petri dish and leave it exposed to the air at room conditions for a month or more. In general, the longer the exposure to air the better; the more pronounced will be the effects of any oxidation. Properly formulated fluids will resist oxidation virtually indefinitely. The test can be repeated using various types of tramp oil contamination and mineral contamination.

Here at Master Chemical, we classify the results of these residue tests several different ways – first by its type and then by its solubility. These classifications are, admittedly, at least semi-subjective but when used to help compare fluids, can be quite powerful. The form classifications that we use are:

1. **Fluid** – the most desirable type of residue, particularly on machines that rely on splash lubrication for proper functioning
2. **Soft** – this type of residue will not normally affect machine function but can "collect" chips and swarf
3. **Hard** – this type of residue can cause issues in machine function as it can keep limit switches, etc. from functioning properly. With time and exposure to air these "hard" residues tend to get harder
4. **Gummy** – this type of residue can contribute to "slip-stick " issues on machines
5. **Crystalline** – as long as the crystals are easily resoluble, this type of residue does not cause problems on most machine types but can cause problems where "optical" scales are in use for machine positioning
6. **Mixed** – this is typical of more highly formulated fluids where

the many different chemicals present in the formulation can have very different residue characteristics. As always, it is important to find a residue that will work with your machine and processes.

The solubility classifications are:

1. **Water** – any residue that is soluble in water will also be soluble in working solution. If the fluid is soluble in water alone it will be very easily washed off with working solution.
2. **Working solution** – ideally all residues formed on and around a machine tool would be easily resoluble in working solution with minimum "manual" interference.
3. **Solvent** – using solvent to clean machines and/or keep them clean, is very impractical, increases costs and reduces the probability that it will be done on a regular proactive basis.
4. **Not soluble in any of the above alone** – while some residues seem to only be resoluble with sufficient elbow grease, a fair number are partially soluble in water or working solution and another portion resoluble in solvent. On a practical level these are the most disagreeable residues and the most difficult to deal with.

In answer to the question "What can I do about residue in my operation?" the answer is "quite a bit!"

1. Select a fluid that will produce a residue that is acceptable in your application after balancing all the other issues.
2. Run the fluid at the appropriate concentration. You will get twice as much residue if you run the fluid at twice the minimum concentration necessary to do the job efficiently. In other words coolant management will affect residue as it does all other fluid functions.
3. Use the best possible water to mix the fluid. "Hard water" is one of the major sources of cations that react with the fluid components to make water insoluble residues.
4. Remove chips and swarf from the sump as these metals can also be a source for cations.
5. Periodically "wash down" the machine using working solution to put working solution back where the water has evaporated. This also reduces the need for makeup fluid. Doing this on a regular basis makes it easier to keep the machine clean, etc, etc.
6. If there are difficult residues present on the machine, lightly spraying or brushing a compatible surfactant on the machine surface, and allowing it to penetrate before wash down, may be very helpful. (We recommend 10% TRIM® Whamex™ Machine Cleaner).

The residues that the fluid leaves are critical to the long-term success of a fluid and just what the issues will be are very much a function of fluid selection, the water it is mixed with and how it is managed.

NOTES:

1. Master Chemical's "Guide to a Clean Shop," which can be downloaded from our web site or obtained from an authorized distributor, offers more information about residues and how to remove them.
2. For additional information on this subject contact your Master Chemical District Manager, Authorized Distributor, the Tech Line (800 537-3365 North America only) or our web site www.masterchemical.com

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