

## Definitions of Analysis Terms for Water Dilutable Metalworking Fluids

The following describe the different analysis performed on your water soluble metalworking fluid mixes.

### Concentration

Concentration is the percentage of metalworking fluid concentrate in your mix. The concentration can also be expressed as a ratio, the amount of metalworking fluid concentrate to the total volume of mix. Example: Adding four gallons of concentrate to 96 gallons of water yields a 4% or 1:25 mix concentration. ETNA uses up to four different methods to determine concentration based on operation or product;

- Babcock Total oil - Is the percentage of oil or oil-like material present in your metalworking fluid mix. This value includes both product oil and Extraneous ("Tramp") Oil.
- E - S titration - Is a measure of a specific component in the metalworking fluid, such as lubricant or surfactant levels.
- T - A titration - Is a measure of the alkaline materials, both inorganic and organic, in the metalworking fluid mix. A significantly higher than normal T - A value can promote a more irritating mix, promote corrosion of nonferrous metals, and other problems. T - A values tend to increase with the age of the system as they are affected by aging of the lubricant and lubricant additives.
- Refractometer - Is a quick visual method utilizing the fluid's refractive index, which compares the speed of light in pure water and the speed of light in the fluid mix. This method of concentration is only recommended as a

quick estimate because suspended solids and tramp oil will affect the reading.

To maximize your metalworking fluid, maintain the concentration within the recommended operating parameters. If the mix is too rich/strong, various problems can occur. Such problems are foam, excess residue, and mildness. If the mix is too lean/weak, other problems can occur. Such problems are poor tool life, rancidity, and corrosion.

### pH

pH is a measure of the acidity or alkalinity of your metalworking fluid mix. It is a good indicator of the condition of your fluid mix.

Each product has a pH operating range. Most metalworking fluids operate in a pH range of 8.5 - 9.2. If the mix pH is too low, various aspects of your metalworking fluid mix may be affected, such as rancidity control, ferrous corrosion control, and mix stability. If the mix's pH is too high, other aspects of your metalworking fluid mix can be affected, such as mildness, nonferrous corrosion control, and lubricity.

### Conductivity

Any material dissolved in the water of a metalworking fluid contributes to the mix's ability to conduct electricity. However, since all dissolved matter will increase conductivity, the measurement is non-specific and therefore cannot be used as an indicator of mix concentration, water hardness, biocide content, or any other single factor. (It's primary use is as an indicator of a drastic change in the overall health of a metalworking fluid mix metalworking fluid composition.)

A slow rise in conductivity is normal. Exactly when a high conductivity is "too high", must be learned for each product in each particular system

and water type. However, a conductivity above 5000 microSiemens is high and can be cause for concern.

### % Extraneous Material Buildup

Extraneous Material Buildup is the total amount of free-floating or emulsified material comprised of oil from an external source, insoluble product components, or lubricant components that are no longer functioning as intended. Extraneous Material Buildup is a calculated value determined from both the ES concentration and the Babcock concentration. The calculation for Extraneous Material Buildup is presented in the following equation.

Total Oil % in the Mix - [(Mix Conc. %) x (Amount of Product Oil)] = Extraneous Material Buildup %

EXAMPLE: For each 1% of a fresh mix, 0.46% oil and oil-like material is present according to the Acid Split Determination Method. A field sample had 3.5% Total Oil by the same method and a 4.1% concentration determined by the appropriate Titration.

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3.5% Total Oil – ((4.1%)\* 0.46%) =  
3.5% - 1.9% = 1.6% Extraneous Material  
Buildup

A high Extraneous Material Buildup percentage can promote problems, such as residue, drop in tool life, and microbial growth. Significant negative tramp material buildup values, such as less than -0.5%, can indicate either mix instability or contamination by a material that is picked up on the concentration determination method. Performance problems can be expected when Extraneous Material Buildup levels reach half the metalworking fluid concentration.

#### **% Free Oil**

Free oil is the percentage of oil or oil-like material which is not emulsified and floats on the surface of your metalworking fluid mix. The source of free oil is usually the machine lubricating oils which leak into your mix but could also be insoluble lubricant components no longer functioning as designed. A high Free Oil percentage in your mix can lead to such problems as microbial growth, smoke, and residue. Free oil should be kept to a minimum. An acceptable level less than 1%. NOTE: A significantly

higher Free Oil than Extraneous Material Buildup value often indicates mix instability.

#### **% Fines**

% Fines is the percentage of solids in your metalworking fluid mix that separates from the mix after settling or centrifuging. High % Fines values usually indicate either inadequate filtration or filter problems. A high % Fines value can affect the performance of your metalworking fluid and lead to such problems as residue, poor finish, poor tool life, and microbial growth. When sampling a mix in a machine or system, always take the sample after filtration or from a supply line prior to the actual application.

#### **Dissolved Copper, ppm**

Copper held in your metalworking fluid mix by its atomic charge is called dissolved copper. Dissolved copper can react with lubricant components and affect the performance of your metalworking fluid. High dissolved copper values can lead to such problems as

residue, poor finish, poor tool life and an unstable emulsion.

#### **Biological Infection**

##### **Bacteria Count**

Bacteria count is a measure of the bacteria in your metalworking fluid mix. A high Bacteria Count can lead to offensive odors and failure of your metalworking fluid mix. Most metalworking fluids can tolerate a bacteria count of  $10^3$  or 1,000/mL.

##### **Mold/Yeast Count**

Mold count is a measure of the Mold/Yeast in your metalworking fluid mix. A high Mold/Yeast Count can lead to offensive odors, plugged fluid lines, and failure of your metalworking fluid mix. NOTE: Unlike Bacteria Counts which mirror the growth of bacteria in the system, Mold/Yeast Counts often do not detect the mold present in or around the system. Mold is more likely to cling to surfaces and, therefore, may be well established in a system without being detectable in a small fluid sample.

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