

CIMCOOL[®]

Technical Report

Milacron Marketing Co. | Consumable Products Division | Cincinnati, Ohio 45209

CONCENTRATION MEASUREMENT:

How do you measure the “concentration” of a CIMCOOL[®] Metalworking Fluid?

The “concentration” of a CIMCOOL[®] Metalworking Fluid is the measurement of specific parameters or components in the product. For a given product there can be several different measurements of “concentration” that provide different numbers. Many times it is important to test concentration by more than one concentration test method. Each concentration method measures a specific chemical, group of chemicals or fluid characteristic. Typical concentration measurements are:

Total Alkalinity (TA)

Total alkalinity is a pH based titration that uses 0.1N HCl to titrate to a pH of 4. The result is reported in percent concentration by alkalinity. This concentration method measures all alkaline type materials (which are chemicals that have a pH above 7 and up to 14) in the mix. Some of the typical alkaline materials in metalworking fluids are amines, biocides, caustic soda (NaOH), and corrosion inhibitors. Alkaline components tend to stabilize biological control and enhance ferrous corrosion control. Excessive alkalinity will decrease mildness of the product. Additives such as caustic soda (NaOH), Additive 63, Additive MC, etc. increase the alkalinity.

This concentration test method is available in either a “long form” using a burette or a “mini kit” which is an “eye dropper” type kit measurement. The mini kit used for alkalinity is Mini Kit III. Alkalinity is used as the primary concentration measurement for some synthetic fluids (many use the BCG concentration-see below), but it is also used as a secondary method for semisynthetic and soluble oil type fluids.

Typically alkaline materials tend to concentrate in metalworking fluids, so over time the alkalinity concentration will increase. Contaminants such as floor cleaners, parts washer chemicals, or rust inhibitors contribute to higher alkalinity. A large increase in alkalinity would be an indication of adding new concentrate or a possible contaminant. A

large decrease in alkalinity may be an indication of a system being diluted with water.

Non Solvent Titration (NS)

This titration method measures the fatty acid component of metalworking fluids. Fatty acids are a key component of semisynthetic and soluble oil type fluids. Fatty acids are mixed with alkaline ingredients to make them water-soluble. The NS titration determines the fatty acid content, which represents lubrication, emulsification, and corrosion-inhibiting properties of the fluid. High water hardness and certain metals will react with fatty acids to create “soap scum”. This results in depletion of the fatty acid, requiring additional concentrate makeup.

The nonsolvent titration method is available in the “long form” but not in “mini kit” form. The NS titration is the primary test method for soluble oil and semisynthetic products, especially for central system applications.

BCG Titration (BCG)

The BCG titration method measures short chain length fatty acids. This specialized fatty acid test is used on some synthetic fluids. This method analyzes corrosion inhibiting and lubrication properties of the fluid. Hard water or metal soaps can deplete the fatty acids in the product.

The BCG test method is available in a “long form”, but not in a mini kit form.

Refractometer

The refractometer is a hand held optical instrument that is used to measure the refractive index of a liquid. The refractive index is the degree that light is bent when passing through a liquid. The various components of metalworking fluid mixes (oil, organic and inorganic chemicals, total dissolved solids, etc.) provide a unique number on the refractometer scale, typically from 0 to 15 % (Brix scale).

The operator places a few drops of metalworking fluid mix on the refractometer prism and then views the scale through the eyepiece. The boundary line from light to dark is read as the refractometer reading. The refractometer reading must be multiplied by the refractometer factor to provide the % mix concentration. For example, many soluble oil mixes have a refractometer factor of one, so if the refractometer scale reading is 5, then the actual mix concentration would be 5%. Most synthetic and semisynthetic fluids have refractometer factors higher than one. For a synthetic, if the refractometer

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factor is 2 and the scale reading is 3, then the mix concentration would be 6%. $MC = F \times SR$, where MC is the mix concentration %, F is the refractometer factor, and SR is the refractometer scale reading.

It is important to calibrate the refractometer with water (typically the same water used for fluid makeup) prior to testing the metalworking fluid, to insure accuracy. Some refractometers are also temperature compensated for greater accuracy. High levels of oil and dirt will make reading the refractometer very difficult. In addition, certain metalworking fluid mixes do not provide clear readings, even as a new mix. The advantage of the refractometer is that it is a simple and quick measurement that requires no additional chemicals. The disadvantage is that contaminants may interfere with the reading and provide a reading greater than the true concentration (especially semisynthetics and soluble oils).

CIMCHEK[®] Test Strips

CIMCHEK[®] Test strips are immersed in the fluid to indicate the fluid concentration. There are seven pads on each plastic test strip that can turn from light to dark blue. The dark blue test pads are counted and compared to the chart on the side of the bottle to convert this number to concentration for a given product. The CIMCHEK Test Strips are best suited for synthetic type products, such as CIMTECH[®] or CIMCLEAN[®] products, but can be used for certain semisynthetic and soluble oil products.

How often should concentration be measured?

For most individual machines, the concentration should be measured each day or a minimum of once per week. Concentrate and water are added as needed to adjust the fluid volume and concentration in the tank. CIMCHEK's and CIMCOOL[®] Refractometer's are typically used for many individual machine concentration checks.

For central systems, the concentration is typically measured each day, ideally by using a titration method recommended for a particular CIMCOOL Metalworking Fluid. For example, the Total Alkalinity method would be recommended for most synthetics and the NS method would be recommended for most semisynthetic and soluble oil products. Milacron also offers a free service where a weekly routine sample is sent to the CIMCOOL Lab to check all routine central system parameters, including concentration. In many cases there is more than one concentration test method reported on the central system sheet.

Why do the fluid concentration tests give different values?

For a metalworking fluid mix, several concentrations may be reported, such as Total Alkalinity, NS, Refractometer, and CIMCHEK. These concentrations may provide similar

numbers when the fluid is a fresh mix. However, over time certain components may increase and others decrease. These components in the fluid may vary over time due to depletion or microbial activity. With proper makeup and control of a metalworking fluid, the components will stay "in balance" so that there will not be a preferential depletion of one component compared to others. Concentration measurement is subject to interferences (oils, cleaners, metals, fines, water hardness, etc.) and measurement error that leads to different readings.

What happens if the concentration is not within specifications?

For each application there is an ideal concentration range to provide the optimum fluid performance. Since each particular fluid system undergoes continuous change (carry-off and evaporation losses), the concentration measurement is a "moving target". The goal is to maintain the fluid within a range of values. As a fluid ages, it may be necessary to change the control limits that are listed on the central system sheet.

Are there specific components in a metalworking fluid that require testing?

Milacron's CIMCOOL Technical Service Engineers along with the CIMCOOL Lab may determine that certain fluid components need to be checked in addition to concentration. For example, "M-time" (bactericide test), Extreme Pressure additives (such as chlorine or sulfur), and ions (such as chlorides and sulfates) are examples of special tests for central systems. These can be tracked over time to predict performance properties or changes in the fluid.

Any additional questions or concerns?

You may want to confirm with your CIMCOOL Technical Service Engineer that you are using the best concentration method for your particular CIMCOOL Metalworking Fluid. It is also important to insure that the correct sample size and control factors are used for the titration method used.

Is there a single concentration check best for my metalworking fluid?

For most individual machines, a Refractometer test or a CIMCHEK test is all that's needed for concentration control. For central systems, typically a chemical titration, such as the NS or TA, is the primary test method used to control the fluid system. For central systems, several concentration tests are typically used to monitor the fluid.

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