



Customer Success

Chemtool Incorporated Formulates Metalworking Fluid with Dow UCON™ Oil-Soluble PAG (OSP) to Clean Up Cast Iron Machining Operation

A novel metalworking fluid based on new oil-soluble polyalkylene glycol (OSP) base fluid technology from Dow has solved a chronic residue build-up problem in the cast iron machining operations of a Midwestern U.S. manufacturer. Formulated by Chemtool, Incorporated, the new fluid has virtually eliminated build-up of hard-to-remove cast iron residue that coated CNC mills, lathes and surrounding enclosures, obscured operator visibility and increased the potential for wear, which created maintenance and resulting downtime issues.

Sticky Situation

The manufacturer produces flow control actuators and gearboxes used by the petroleum and processing industries. The company's production operations include machining ductile cast iron on CNC mills and lathes as well as drilling and tapping. A fully synthetic metalworking fluid initially used in the company's mill and lathe cutting operations produced a sticky residue when combined with cast iron particles and graphite produced during machining. This residue was broadcast to the machine bodies, chucks, seals, enclosure walls, way covers and enclosure windows where it accumulated

in a thick coating that could only be removed by shutting down the machines for arduous manual cleaning.

The manufacturer's water source and sump system contributed to the challenge. The water is relatively hard (25 grains), contains 21 ppm of chlorides, and some bacterial load. The fluid sumps are small, with the largest only 80 gallons. Because the company's machining operations run fast and hot, 24 hours per day, there is little time for fines to settle, causing build-up in the sumps and premature filter clogging. Water evaporation from the sumps causes hardness and chloride levels to increase, which can lead to fluid emulsion breaks and corrosion problems in the system.

Chemtool Incorporated is On the Case

The manufacturer called on Chemtool Incorporated to help solve its residue problem. The Rockton, Illinois, company is one of the world's largest privately held manufacturers and custom formulators of lubricants and specialty products. Chemtool Incorporated produces a wide range of lubricants, cutting fluids, mold-release compounds and sealants for manufacturing and maintenance operations.

According to Rick Butler, Technical Manager for Fluids Development, "our initial suspicion was that the rust inhibitor in the prior metalworking fluid was interacting with the other formulation components and creating a high viscosity residue that was binding up fines. We've seen this before in cast iron machining operations where cutting produces fine iron particles as well as inter-granular graphite. This combination is very susceptible to agglomeration and cutting fluid chemistry can increase this tendency."

As an initial step, Chemtool Incorporated recommended a trial of a semi-synthetic polyalphaolefin (PAO) base fluid, which contained an extreme pressure additive with increased surfactant content to improve rinse results. Machining performance during the trial remained acceptable, but the formulation still left a greasy film on the machine and surrounding surfaces. A subsequent trial was performed using a synthetic hydrocarbon fluid with an even higher level of detergency. Results improved – the residue produced by the system was less tenacious and could be removed by manual wipe down. Still, there was a need for a more effective solution that would eliminate the residue problem altogether.

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OSP Base Fluid Provides the Answer

Chemtool Incorporated turned to new oil-soluble polyalkylene glycol (PAG) base fluids from Dow. Polyalkylene glycols are polymers made from the reaction of starter molecules with alkylene oxide monomers, e.g. ethylene, propylene oxides. They typically offer favorable properties including high viscosity index values, low pour points, and excellent film forming properties. Because of their polar nature PAGs solubilize polar decomposition products, resulting in no varnish or sludge deposits. The non varnishing characteristics of PAGs keep operating systems clean.

UCON™ OSP Base Fluids also overcome a disadvantage of traditional PAG chemistry – incompatibility with mineral oils. Oil solubility expands the versatility of PAG-based lubricants and allows formulators to create new lubricants with unique properties or replace more expensive synthetics with PAG-based alternatives. UCON™ OSP Base Fluids have lowest aniline points in the range of -30° to -40°C which help formulators to solubilize additive components easily and increase the longevity of the finished formulation. Dow introduced UCON™ OSP Base Fluids in 2010 and recently added three additional viscosity grades to the fluid line.

Initial laboratory work by Chemtool Incorporated suggested UCON™ OSP 680 Base Fluid offered the necessary combination of viscosity index, solvency, polarity and oxidative stability to perform under the conditions in the machining operation. This work also indicated that UCON™ OSP 680 Base Fluid could help meet another important formulation goal – avoid the ongoing

need for a tank side additive for residue control. Chemtool Incorporated formulated a metalworking fluid containing the OSP Base Fluid as well as PAO in a system with a very low emulsion particle size. UCON™ OSP 680 Base Fluid is an easy product to emulsify, so only a very small amount of surfactant was used, yielding a system with very good wetting, lubrication, and hard water stability properties, even at the higher temperatures typical of the manufacturer's operation.

Putting the Fluid to the Test

A fluid trial was initiated in March, 2010, using a milling machine specially prepared to test residue levels. The back wall of the enclosure,

a window and back ways were manually cleaned but residues were left in place on the remainder of the machine surfaces to allow for clear visual comparison of residue build up. Operators reported good machining performance with no real differences compared to machining achieved using the previous fluids.

After two weeks of operation, the cleaned areas of the walls, windows and ways remained free of residue and operators continued to report consistent machining performance. During these operations, tests showed that pH remained very stable (see below).



The back wall and back ways of the milling machine enclosure were cleaned beforehand to observe residue levels as the test proceeded. Some residue was left in place for comparison (right-hand photo). After two weeks of operation, surfaces remained free of residue.

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About two months into the trial, the results remained highly favorable and the manufacturer converted its lathe operations to the new fluid from Chemtool Incorporated. As the test progressed, no additional residue buildup was observed. In fact, the fluid actually began to remove the residues left by the previous fluids, which was due to the inherent detergency characteristic of the UCON™ OSP 680 Base Fluid molecule (see below).



Five months after the trial began, the Chemtool Incorporated fluid based on UCON™ OSP 680 Base Fluid continued to provide excellent performance. No cast iron residue buildup was noted on walls, tooling or chucks. Results were especially good on lathes, where no buildup was noted, even on chucks that had been plagued by residue.



As with milling machines similar cleanup and residue control were noted in lathe enclosures, where residue had been a problem with previous fluids.

Promise of Future Success

Dr. Govindlal Khemchandani, Senior Technical Specialist for Lubricants, The Dow Chemical Company, said "We're very pleased with the results that Chemtool Incorporated has achieved for their customer with their formulation based on UCON™ OSP Base Fluid. We believe these innovative fluids represent a breakthrough in PAG base fluid technology that creates numerous options for formulators to create the next generation of products, which can leverage the advantages of PAGs with hydrocarbon oils in semi-synthetic systems capable of addressing difficult application challenges."

Learn More...

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To learn more about Dow UCON™ OSP Base Fluids and PAG synthetic lubricant technology, please visit us online or contact the Dow location for your area, listed below:

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