METALWORKING CUTTING FLUIDS MANAGEMENT

Author: ***Matúš ČUMA***
Workplace: ***Department of Manufacturing technologies, Faculty of Manufacturing Technologies of TU Košice with the seat in Prešov***
Address: ***Štúrova 31, 080 01, Prešov, Slovak Republic***
Email: ***matus.cuma@tuke.sk***

Abstract:

Cutting fluids are used in machine shops to improve the life and function of cutting tools. They are also a key factor in machine shop productivity and production of quality machined parts. Today's cutting fluids are special blends of chemical additives, lubricants and water formulated to meet the performance demands of the metalworking industry.

INTRODUCTION

Cutting fluids play a significant role in machining operations and impact shop productivity, tool life and quality of work. With time and use, fluids degrade in quality and eventually require disposal once their efficiency is lost. Waste management and disposal have become increasingly more complex and expensive.

In the past, it was commonplace for machine shops to dispose of their metalworking fluids as soon as they showed signs of degradation and decreased performance.
Fortunately, cutting fluid life may be extended significantly by implementing an effective fluid management program. The primary objective of fluid management is to maintain fluid quality and performance through administration, monitoring, maintenance and recycling practices. This allows machine shops to make the most cost-effective use of their fluid. It is also the best pollution prevention technology available.

The new metalworking cutting fluids generation brings also higher requirements for the system of fluid performance monitoring and control.

THE SELECTION OF TEST METHODS FOR EMULSION CONDITION VALUATION

Modern machining methods demand that emulsions should have multi functional properties such as: cutting, cooling, cleaning, lubricant and emulsifier including corrosion protection, microbiological contamination resist, suitable stability, operation lifetime, low aggressivity towards machine surface coating, skin irritation, disposal ability, low foaming, suitable for micro and ultra filtration. Because no chemical substance includes all this properties, concentrates of metalworking cutting fluids are prepared by mixing various substances. The final emulsion concentrate is a subject of long term study and progress and the formulation of emulsion concentrate is strictly confidential.

The control and testing of emulsion should be solved as an analysis of complex multi substance system. Indirect methods are applied that comes out of model calibrating curve and it is assumed that the structure changes progress evenly. The fluid testing is complicated by flowing in bigger amount of machines (tramp) oils into origin fluid. By choosing a suitable testing method and service process it is necessary to consider also other factors:

- for objective metalworking cutting fluids comparison it is necessary to create a system of comparison tests, because a lot of emulsions offers and they are on different quality level and different price
- fresh implemented emulsion has different properties than fluid after using for few months
- there is different way of testing fluids in sump for each machine than a testing of fluid in central sump system with distribution for all machines

By buying and implementing new emulsions concentrates it is necessary within limits to do as complex qualified check in control as possible. The term qualified means that there are specified conditions and methods for valuating and comparing emulsion properties within machining process of quality evaluation and choosing a supplier which meets requirements.

The goal of qualified control is to document the fluid conditions at the beginning which has the function of "etalon". This etalon is used to compare the fluid conditions during manufacturing process within audit, operational failures or when changing emulsion. After verification and confirmation already implemented new emulsions are chosen the most suitable test for ordinary inter operational control. It is usually enough to make 3-5 basic tests per month in production conditions.

IMPLEMENTATION OF STATISTICAL METHODS FOR PROCESS STABILITY ASSURANCE

Technological properties of metal working cutting fluids in machining process of production affect the process quality. In the companies that have installed or install quality management according to ISO/TS 16 949:2002 is monitoring of emulsion physical properties automatic and as a part of operative control of manufacturing process.

Couple years achievements from hundreds machines monitoring show that the most simple and most economic is to detect pH, concentration and corrosion ability of emulsions taken from machine sumps in 1-2 months intervals, including intermittent checks of microbiological values (fungus, bacteria, mould). According to statistical elaboration it is possible to detect the amount of different results, to create a regulating diagrams, to write down statistics notes which are useful by determining the process stability, to rate the maintenance level.

It isn't easy to keep the system of maintenance and control even there where the is the quality of manufacturing control care relatively good. For example in one workshop for annual was the value of corrosion ability 10 % and in other one 60% even though regular monitoring and maintenance. For the companies with high quality management such as ISO/TS 16 949:2002 (comb. ISO 9000 GMUDA and QS 9000) certificate owners or small and big companies should be this solution normal. It is necessary to solve the revisions, eventually implementation of particular notional and European norms.

MONITORING AND MAINTENANCE

In the past, it was commonplace for machine shops to dispose of their metalworking fluids as soon as they showed signs of degradation and decreased performance. This practice resulted from fewer environmental regulations in place at the time. It was simply easier and more economical to "dispose and replenish" than to manage fluids, extend fluid life and prevent pollution. With the arrival of tighter environmental regulations, more strict sanitary

sewer discharge limits, rising fluid costs, additional environmental liability concerns, and increasing disposal costs, the environmental and economic advantages associated with prolonging fluid life became apparent.

Fluid management has become an even more attractive pollution prevention alternative since increased automation in the metalworking industry allows costs to be kept at an acceptable level. These combined factors have resulted in the Effective programs can keep metalworking fluid as clean as the initial raw product, significantly prolonging its service life. In addition to waste reduction, a number of other incentives exist for establishing a fluid management program. The three components of a successful fluid management program are:

- Administration
- Fluid Monitoring and Maintenance
- Fluid Recycling

The objectives of this section include:

- Educate fluid management personnel on processes that affect fluid performance and contribute to fluid failure
- Identify corrective action procedures that can be utilized to maintain fluid performance and extend fluid life
- Provide management personnel with a useful reference for implementing an effective fluid management program

Administration

Without disciplined administration, a fluid management program is doomed to fail from the beginning. In order to be successful, the cooperation and support of management, employees, fluid suppliers and equipment vendors must be obtained. Management must commit to acquiring the equipment and other resources necessary to implement and sustain the program. Management must also educate employees on the importance of fluid management in an effort to gain their commitment to the program. This includes involving employees in the decision making process for implementation and upkeep of the program. Fluid and equipment
suppliers must be capable of providing the necessary technical and laboratory support.

A detailed log book documenting fluid usage information should be maintained fluid management logs for each machine should include the following information:

- Brief description of the machine and sump/reservoir capacities
- Type of fluid used
- Fluid mixing ratios and initial parameter readings
- Water quality data
- Monitoring data including pH readings, biological monitoring data, fluid concentration measurements and inspection observations
- Adjustments made as part of fluid maintenance
- Fluid recycling and/or disposal frequencies, including dates of coolant change out and reason for change out
- Equipment cleaning and maintenance activities, dates and comments
- Quantity of coolant added (both change out and periodic additions)
- Documentation of problems that occur
- Comments, notes

Fluid usage information should be compiled for the entire facility. This allows tracking of the quantity of fluid purchased, recycled and disposed on a yearly basis. It also provides a check on the efficiency of the management program and identifies areas of the program that can be improved.

CONCLUSION

Monitoring and maintaining fluid quality are crucial elements of a successful fluid management program. A fluid must be monitored to anticipate problems. Important aspects of fluid monitoring include system inspections and periodic measurements of fluid parameters such as concentration, biological growth, and pH.

Changes from optimal fluid quality must be corrected with appropriate adjustments (such as fluid concentration adjustments, biocide addition, tramp oil and metal cuttings removal, and pH adjustment). It is important to know what changes may take place in your system and why they occur. This allows fluid management personnel to take the appropriate steps needed to bring fluid quality back on-line and prevent fluid quality problems from recurring.

Reviewer: prof. Ing. Jozef Zajac, CSc

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