Ingredient-Wise Study of Flux Characteristics in the Ceramic Membrane Filtration of Uncontaminated Synthetic Metalworking Fluids

A ceramic membrane filtration system can be an effective tool to increase the lifespan of medalworking fluids and reduce biological hazards. However, the usefulness of the membranes may be reduced by different additives and only a slight difference in chemical makeup of the metalworking fluids.

Part 1: Experimental Investigation of Flux Decline

When researchers compared the flux of the metalworking fluids to water when passed through the aluminum oxide ceramic membrane, they found that the metalworking fluid flux was significantly less than the water flux. These decreases are due to a number of different metalworking fluid properties:

- Specialty additives that make up less than 5% of the fluid mixture cause the lower flux, not the base fluid that composes the majority of the solution.
- Specialty additives interact with aluminum oxide and cause a physical change to the surface of the ceramic membrane that does not affect the water flux but does affect the base fluid flux even after cleaning.

The researchers recommended that these specialty additives be optimized to achieve profitable metalworking fluid recycling. Part 2 discusses the mechanisms behind the flux decrease.

Part 2: Analysis of Underlying Mechanisms

Field emission–environmental scanning electron microscopy images revealed that the special additives cause a pore-size reduction in the aluminum oxide ceramic membrane, causing reduced flux. The cause of the pore size reduction was due to only one lubricant, a diblock copolymer used as a hydrodynamic lubricity additive. Specifically, the lubricant caused the organosiloxane defoamer additive to stick to the surface of the aluminum oxide pores, thus causing the reduction in pore size. Without the presence of the lubricant, the defoamer forms a layer on the surface of the membrane that leaves the pores open. The researchers stated that the reduced base fluid flux after the membrane was exposed to specialty additives and cleaned was not due to the lubricant and defoamer, posing a mystery for further research.

Contaminants

Aquatic Plastic Debris

Metals

Metalworking Fluids

A Turbidimetric Method for the Rapid Evaluation of Metalworking Fluids Emulsion Stability

An Evaluation of the Colloidal Stability of Metalworking Fluid

Development of a Novel Metalworking Fluid Engineered for Use with Microfiltration Recycling

Engineering of Ultrafiltration Equipment in Alkaline Cleaner Applications

Formulation and Testing of a Microfiltration Compatible Synthetic Metalworking Fluid

Impact of Environmental Contaminants on Machining Properties of Metalworking Fluids

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Modeling the Effect of Tramp Oil Contamination on Selective Component Depletion in Metalworking Fluid Systems

Partial Pore Blocking in Microfiltration Recycling of a Semisynthetic Metalworking Fluid

Purification of SemiSynthetic Metalworking Fluids by Microfiltration

The Effect of Chip Adsorption on Selective Depletion from a MultiComponent Synthetic Metalworking Fluid

Per- and Polyfluoroalkyl Substances (PFASs)

Agricultural Chemicals

PPCPs in the Environment

PCBs & PBDEs

Polycyclic Aromatic Hydrocarbons (PAHs)

Energy

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Publications

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- **Part 1: Experimental Investigation of Flux Decline**
- **Part 2: Analysis of Underlying Mechanisms**