

UKLA PSG TOPIC REVIEW 7

Biofilm Formation in Metalworking Fluid Supply Systems.

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Introduction: This review summarises evidence on the role of microbial biofilms that form in machining Metalworking Fluid (MWF) supply systems. It considers how biofilm growth may hinder the management of water-mix MWF quality and that the presence of biofilm in MWF supply systems increases respiratory disease risks in machinists. The review identified different approaches to reduce biofilm formation, as well as methods for cleaning MWF supply systems to remove biofilm.

Research Methods: This review synthesised published studies on microbial contamination in MWF, including biofilm formation, detection, and removal. It also examined research on biofilms in other systems, such as water supply networks, covering formation mechanisms, resistance to biocides, and monitoring methods. The review included international studies on biofilms in machine MWF supply systems published between January 1980 and March 2025, together with reports from technical bodies and government sources. The evidence came from Europe and the United States.

Main Findings: The uncontrolled growth of bacteria and fungi in MWF accelerates the deterioration of MWF quality, leading to increased corrosion and earlier disposal of MWF supplies. The published evidence to date does not support the view that the presence of biofilm in an MWF supply system poses an additional risk to machinists' health. However, it suggests that biofilm can accelerate the degradation of water-mix MWFs, reduce machining performance, and may increase operators' exposure to microorganisms in the MWF supply. Biofilm in MWF supply systems may contain pathogenic bacteria, such as *Mycobacterium* spp., but there is insufficient evidence that their presence in biofilm has caused cases of respiratory disease. Preventing the formation of biofilm in MWF supply systems will require practical screening methods, but the physical inaccessibility of the supply system is a challenge. Non-invasive monitoring methods for the early detection of biofilm formation in public water supply systems may be applicable to water-mix MWF supply systems.

Discussion and Analysis: Microbial growth in MWF supply systems is typically controlled with specialised cleaning agents and biocides, but these often do not eliminate biofilm because its matrix protects bacteria and fungi. A clear understanding of microbial interactions, biofilm development, and biofilm behaviour is therefore essential for designing effective methods to prevent and remove biofilm in machine coolant systems. This review also examined advances in prevention strategies and technologies for detecting, disrupting, and monitoring biofilm formation.

Conclusion and Knowledge Gaps: The review concludes that managing MWF quality is essential to protect machinists and to minimise biofilm formation. This requires a multi-faceted approach: better biofilm monitoring, innovative cleaning, and, in the future, the development of antimicrobial surfaces inside fluid supply systems. Future research should validate these strategies in industry and expand data to understand better the formation and control of biofilm in MWF systems.