Symposium on the Recovery and Enumeration of Mycobacteria from the Metalworking Fluid Environment

Microbial Contamination of Metalworking Fluids Increases the Aerosolization of Fine Particles

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Most of the microbial research on metalworking fluids (MWF) so far has focused on the components of microorganisms in the MWF reservoir. Although some studies have addressed the aerosolization of mists from MWFs, no sufficient information has yet been collected on the composition and concentration of microorganisms aerosolized from MWFs. The latter was investigated in this study using a newly developed laboratory-scale set-up simulating grinding operation. Mist particles and microorganisms were aerosolized when a liquid pump ejected MWF through a nozzle against a rotating aluminum rod. The tool rotation speed varied from 800 to 8000 rpm and the fluid application rate varied from 0.4 to 1.6 $l\ min^{-1}$. An optical particle counter (OPC), a condensation nucleus counter (CNC), and an electrical low-pressure impactor (ELPI) were used to measure the number concentration of particles and microorganisms aerosolized from MWF. In addition, the total mass concentration of aerosol particles was measured by a photometer. *Pseudomonas fluorescens* was selected as the test bacterial species as it is a common contaminant in MWFs. Three different fluids were tested in this study: pure semisynthetic MWF (without any microbial contamination), *P. fluorescens* bacterial suspension in water, and *P. fluorescens* bacterial suspension in semisynthetic MWF. The viability of *P. fluorescens* in the three different fluids was studied by performing the culturable and total count at different time points after the preparation of the suspension (t = 0, 0.5, 1, 2 and 3 hours). As was anticipated, the results showed that the concentration of particles aerosolized from pure MWF increased with the increase in the tool rotation speed and the fluid application rate. After the MWF was contaminated with *P. fluorescens*, there was no significant increase in the total number concentration (0.3-20 μm) and in the total mass concentration (0.1-10 μm) of the aerosolized particles. However, there was a pronounced increase in the fine particle concentration. For example, at the tool rotation speed of 8000 rpm, the fine particle concentration (0.02-1.0 μm) aerosolized from the *P. fluorescens* suspension in MWF was 50-fold higher than that from pure MWF and 5-fold higher than that from pure *P. fluorescens* suspension in water. The viability of *P. fluorescens* cells decreased after mixing them with MWF whereas it remained constant when the cells were mixed with water suspension. We anticipate that the increase in the fine particle aerosolization may have been caused by the cell rupture when *P. fluorescens* cells were mixed with MWF. The results indicate that MWF mist may contain high concentrations of microbial fragments, which are difficult to detect with traditional microbial analysis methods, such as cultivation or microscopic counting. Future experiments will include endotoxin measurements in the fine fraction of aerosolized particles.

Program and Abstracts

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