

ABSTRACT OF THESIS

EVALUATION OF ENDOTOXINS IN THORACIC PARTICULATE MASS AEROSOL SAMPLES AND METALWORKING FLUIDS IN SMALL MACHINING OPERATIONS

Research indicates that exposure to endotoxins within aerosols generated from metalworking fluids (MWF) contributes to adverse respiratory health problems among machinists. Much of the current research conducted in this field is performed in the automobile manufacturing industry; however, limited research exists in small machining operations. It is estimated that of exposed workers, 70-80% of exposures occur in small machining shops.

Although the thoracic particulate mass (TPM) fraction of aerosols may represent a smaller total mass, because of the size and the amount that actually enters the bronchiolar region, they can cause severe respiratory health problems. Studies indicate that exposure to endotoxins within these aerosols contributes to the respiratory health effects shown in workers. Illnesses attributed to endotoxin exposure include hypersensitivity pneumonitis, chronic bronchitis, impaired lung function, asthma, and chronic respiratory disease. In addition, endotoxins are known to account for 70% of epithelial inflammation in the bronchiolar region of the lung.

This study was conducted to investigate endotoxin concentrations in MWFs and airborne thoracic particulate mass. Thus, the study was important in determining the potential for exposure to endotoxins in small machining operations. The assumption was that as endotoxin concentrations in bulk liquids increase, the airborne thoracic endotoxin concentrations would also increase. Also, the study investigated a relationship between endotoxin concentrations levels in the MWF and the age of the fluid.

Personal thoracic mass cyclones were placed on workers performing metal machining operations in small machine shops. Samples were collected as long as the work was being performed for each individual job. Also, bulk liquid samples of the MWF were collected from the sump pump region. Data were collected at five shops all of which volunteered to be involved. After the gravimetric analysis of the filters, filters and bulk liquid samples were sent to the National Institute of Occupational Safety and Health (NIOSH) laboratory for the endotoxin analysis. Sample concentrations from the NIOSH laboratory were reported as endotoxin units (EU). Depending upon the sample type, either airborne or bulk liquid, the measurements were EU/m³ and EU/ml, respectively.

Thoracic Particulate Mass filter concentrations from all of the shops ranged from 0 to 1.9 mg/ m³. Thoracic endotoxin concentrations from the filters ranged from 32.9 to 165.5 EU/ m³ while endotoxin concentrations from bulk liquids ranged from 0 to 2,656,250.0 EU/ml. An 8-hour time-weighted average (TWA) was calculated for the MWF concentrations measured by TPM and the thoracic endotoxin concentrations so that comparisons could be made with published guidelines, if compared to the NIOSH recommended exposure limit of 0.4 mg/ m³ for MWFs measured by TPM, a total of 10 out of 23 samples exceeded this limit. In addition, 8 out of 21 samples exceeded the recommended limit of 50 EU/ m³ for the inhalable fraction published by The Dutch Expert Committee on Occupational Standards. It should be noted that the recommended limit of 50 EU/ m³ is for the inhalable fraction, and would be lower if designated for the thoracic fraction. These numbers suggested that there were exposures to MWFs and endotoxins which exceeded the recommended limits set forth by published guidelines.

From the statistical analysis, the regression plot showed that there was a small correlation (55.0%) between the endotoxin concentrations from MWFs and the thoracic endotoxin concentrations from filter samples. This relationship meant that as levels of endotoxins in MWFs increased there was also an increase in the thoracic endotoxin concentration on the filter sample. Also from statistical analysis, the regression plot showed that there was a moderate correlation (64.5%) between the endotoxin concentrations from TPM and the age of the fluid for one of the workers sampled. This relationship meant that as the age of the fluid increased there was an increase in endotoxin concentrations.

Therefore, one can conclude that there was a higher potential for exposure to thoracic endotoxins in MWF in relationship to the age of the fluids and the levels measured in bulk liquids. The TPM fraction represents those airborne particles that by virtue of their aerodynamic size and chemical properties penetrate the bronchiolar region during breathing. Therefore, the TPM fraction represents the worst-case potential exposure of endotoxin-bearing particles.

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