In this study, plume samples were taken during the starting of 11 F–16 fighters at Eielson Air Force Base in Alaska during February of 1999. Samples were taken with tube-and-wire electrostatic precipitators (ESPs) and with an aerodynamic particle sizer, all mounted on stationary housing. The samplers were directly in the plume for some start-ups, but were on the edge or outside the plume for other start-ups, depending on wind speed and wind direction.

Results from the ESP samplers and gas chromatography/mass spectroscopy (GC/MS) analysis indicate that the start-up plumes contain 50 mg/m^3 of unburned JP-8. In addition, the plumes had a consistent aerodynamic particle size distribution with a count median diameter of 0.7 μm and a geometric standard deviation of 1.4. The results suggest that aerosol plumes with high concentrations of respirable JP-8 are being emitted during jet engine start-up in cold weather, resulting in pulmonary exposure of ground crews to JP-8 aerosol.

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ASSESSMENT OF OCCUPATIONAL EXPOSURES TO COPPPER FUMES AND DUST FROM THE SILICON BRONZE THERMAL ARC-SPRAY PROCESS IN AN AUTOMOBILE ASSEMBLY PLANT. D. Dickhaut, University of Michigan, East Lansing, MI; R. Garrison, University of Michigan, Ann Arbor, MI

A silicon bronze thermal arc-spray process as used currently in many North American automobile plants for varying metal-finish applications has a high potential for exposure to metal fume and dust. In order to evaluate the scope of the hazard and the adequacy of the engineering controls and personal protective measures adopted in one body assembly plant, an occupational exposure assessment of all phases of the silicon bronze process was performed. A secondary aim of this research was to determine whether an initial assignment of occupational exposure groups based on task similarity and job description was adequate for determining uniform exposure probability.

Particle-size characterization using a multiple-stage cascade impactor was initially performed to determine the nature of the hazard for the major phases of the process. This was followed by personal and general air sampling based on the initial exposure groups. Results showed high levels of copper fume inside the finish booths and none of the finish grind teams was determined to be possibly part of a compliant distribution, using a one-sided tolerance limit analysis.

The initial groupings required redefinition and refinement to accomplish uniform exposure probability due to differences in work practices that resulted in mean exposure variations of up to 36 times greater within the same booth. ANOVA analysis of logtransformed exposure data demonstrated the uniqueness of the redefined occupational groups as being more predictive of uniform exposure than *a priori* categories based on job descriptions.

Evaluations of booth ventilation and actual inside supplied-air respirator sampling demonstrated adequate protection for silicon bronze teams. Process changes initiated in the midst of this research highlight issues relating to process stability and the predictive validity of exposure assessments.

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ALVEOLAR-DEPOSITED AIRBORNE PARTICLES OF BERYLLIUM AS A PREDICTOR OF THE PREVALENCE OF DISEASE IN A BERYLLIUM PROCESSING FACILITY. M. Kent, Brush Wellman Inc., Elmore, OH; T. Robins, University of Michigan, School of Public Health, Department of Environmental Sciences, Ann Arbor, MI; A. Madl, Exponent, Inc., Oakland, CA; M. Goodman, Exponent, Inc., Landover, MD; D. Paustenbach, Exponent, Inc., Menlo Park, CA

Researchers have reported that individuals with low or infrequent exposures to beryllium have developed chronic beryllium disease (CBD). Given the limited availability of quantitative data, a dose-response relationship between beryllium exposure — assessed by total mass of airborne beryllium per cubic meter and duration of employment — and CBD has not been clearly defined. This study was conducted to evaluate which beryllium aerosol characteristics other than total mass may be more informative in understanding the dose-response relationship between exposure to beryllium and disease.

Personal samplers (n = 53) using Andersen impactors and area samplers (n = 55) using micro-orifice uniform deposit impactors (MOUDIs) were used to collect airborne beryllium samples in five furnace areas at a beryllium manufacturing facility. Prevalence rates of CBD and beryllium sensitization at this facility had been studied previously among 535 employees with significant beryllium exposure.

Concentrations were expressed in terms of total mass per cubic meter and in terms of mass, number, and surface area of particles per cubic meter that are predicted to deposit in the alveolar region of the lung. Tests for linear trend of the relationships of the various exposure metrics measured by the MOUDI sampler to the prevalence of CBD and sensitization showed an association between mass, number, and surface area concentration of particles predicted to deposit in the alveolar region of the lung and CBD.

No relationships between CBD or beryllium sensitization and Andersen impactor measurements were observed. The difference in the MOUDI and Andersen measurements and the relationship with the prevalence of disease might be attributed to the fact that the MOUDI collects a smaller size distribution of particles than the Andersen sampler. These results suggest that the concentration of alveolar-deposited particles is a more relevant exposure metric for predicting the incidence of CBD or sensitization than the total mass concentration of airborne beryllium.

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FILTRATION CHARACTERISTICS OF A MINIATURE DUAL SAW-LIKE ELECTRODES ELECTROSTATIC PRECIPITATOR. S. Huang, C. Chen, J. Huang, National Taiwan University, Taipei, Taiwan Republic of China; W. Lin, Tajun College of Pharmacy, Pingtong, Taiwan Republic of China; T. Shih, Institute of Occupational Safety and Health, CLA, Taipei, Taiwan Republic of China

This study investigates the filtration characteristics of a miniature dual saw-like electrodes electrostatic precipitator (ESP). Parameters such as particle size, rate of airflow through the ESP, voltage of the charge electrode, and discharge polarity were considered to study their influence on aerosol penetration through the ESP. Polydispersed and monodispersed particles with sizes ranging from 30 nm to 10 μm were used as the challenge aerosols.

Experimental results indicated that the aerosol penetration through the ESP decreased (from 96% to 15% for 0.3 μm) as the voltage of the discharge electrode increased (from +4 kV to +8 kV) at a flow rate of 30 L/min. At a fixed electrode voltage (+8 kV), aerosol penetration increased from 15% to 69% for 0.3 μm particles as the flow rate increased from 30 L/min to 120 L/min. The most penetrating particle size was in the range of 0.25–0.5 μm depending on the discharge voltage and the flow rate.

In general, the most penetrating particle size of the ESP decreased with decreasing discharge voltage or with increasing flow rate. At the same voltage level but opposite polarity, the aerosol penetration through the ESP with negative corona was lower than that with positive corona. The difference in aerosol penetration was a factor of about 2 between the negative and positive coronas for 0.3 μm particles, and this difference was found to be independent of discharge voltage.

Regarding energy conservation, use of a negative-polarity ESP was more economical if the same efficiency was required. However, the ozone generated by the ESP with negative polarity was about five times greater than that generated with positive polarity.

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USE OF ACOUSTICAL ENERGY FOR PARTICLE RESUSPENSION. S. Azadi, A. Afshari, D. Frazer, NIOSH, Morgantown, WV

Aerosol generation is a common task in many applications, such as calibration of light scattering and particle characterizing instruments. Commercially available instruments can generate aerosols from soluble material in liquid form, and most are effective for particles under 2 μm. Not all materials are soluble, however, and resuspension of particles from powder samples is often desired. The goal of this study was to design a system for aerosolizing powder of any size. The system was to be simple, inexpensive, and effective over a large range of sizes.

An acoustical generator was designed and constructed using a 6.5-in. speaker set in a support base. A 4-in. diameter aluminum tube was closed off at both ends with latex rubber-dam material and was constructed to fit tightly over the support base. The speaker was excited with a 4-V RMS signal that slowly varied over a frequency range between 20 Hz and 30 Hz. The generated sound waves vibrated the latex material, which in turn vibrated the air column and the particles inside the tube.

Dry microsphere standards with known aerodynamic diameters, a density of 1.05 g/mL, and a refractive index of 1.59 @ 589 nm (25°C) were used. A feeding system introduced the particles into the chamber using HEPA-filtered compressed air pulses. Airflow through the system was maintained at 5 L/min. The input air was passed through a dryer column, a HEPA filter to retain any particles, and a deionizer system to reduce the electrostatic charge on test particles inside the chamber.

A variety of standard particles of known aerodynamic diameters in powder form were aerosolized using the acoustical generator, and samples were analyzed using an aerodynamic particle sizer (APS). The APS results indicated that the generator is capable of resuspending powder of different size particles, and can be used as a calibrating instrument.

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