ABSTRACT OF THESIS

UTILIZATION OF ELUTRIATION FOR SIZING LARGE PARTICLES

This study utilized a modified MRE 11 3A horizontal elutriator gravimetric dust sampler to aerodynamically size particles within the inhalable dust fraction. The MRE 11 3A was designed to collect the respirable fraction with an operating flow rate of 2.5 liters per minute (LPM). Modifications consisted of operating at higher than designed flow rates in the horizontal orientation and a stationary 60° orientation to achieve greater accuracy in particle sizing than is offered by current sampling methodologies. The operation of the elutriator relied on the 50 percent penetration value as the effective cutoff diameter (ECD) for the flow rate and/or angle of orientation. Work was carried out in a wind tunnel operated under relatively constant atmospheric conditions and wind speeds of approximately 1.0 m/s. Two grades of aluminum oxide were used in the study, F600 and F400 with aerodynamic diameters of 21 μm and 34 μm respectively.

The horizontal orientation component of the study was examined with the F600 aluminum oxide. It was expected to exhibit that increasing the air velocity within the channel of elutriator would result in a decrease of gravitational settling effects. Such a decrease would allow for increased penetration of larger particles.

The F400 aluminum oxide was used in the non-horizontal, 60° orientation component. In addition to the increased velocity concept employed in the first phase of the study, the channel angled at 600 created a decrease in relative distance of large particles' flight path resulting in the collection on the end filter.

The resultant size distribution of F600 test dust in the horizontal orientation was a mass median aerodynamic diameter (MMAD) of 22.9 μm and geometric standard deviation (σ_g) of 1.6. A MMAD of 21.5 μm and (σ_g) of 1.3 was determined by Coulter counter and a sedimentation technique via the pipette method. The over-estimation of 6.5 percent by the elutriator could be an implication of utilizing the 50 percent penetration curves as the ECD based on lower slopes created by the elutriator.

The 60° orientation size distribution for F400 test dust resulted in a MMAD of 25.6 μm and (σ_g) of 1.2. Previously studies reported MMAD of 34 μm, therefore the elutriator under-estimated the size distribution by 28 percent. The apparent bias to underestimate size distributions may be attributed to the excessive misalignment of elutriator at the angle of 600, resulting in a reduction in aspiration efficiency.

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