1PF15

COMPARISON OF METHODS FOR CASCADE IMPACTOR DATA ANALYSIS TO PREDICT AEROSOL DEPOSITION INTO PATIENT AIRWAYS. CAROLINE MAJORAL, Alain Le Pape, Patrice Diot, Laurent Vecellio, INSERM U618, Tours, F-37000 France ; IFR135, Tours, F-37000 France ; Université François Rabelais, Tours, F-37000 France

This work compares the usual method of aerosol particle size data processing to an approach which is not based on a specific hypothesis. Particles were sized using an Andersen cascade impactor (8 stages). The way experimental data are treated can influence the interpretation of particle size and result in different predictions of deposition site in the respiratory tract.

The usual method consists in plotting the mass fraction (Fj) deposited on each stage vs. the cut-off diameter (Dcj) corresponding to the stage. According to the European Standard (EN13544-1), a best-fit curve links the points Dcj, Fj. One can as well link the points (Dcj + Dcj+1)/2 (middle of cut-off diameters), Fj+1. The distribution can also be fitted by a log-normal mathematical model.

The usual method assumes that each stage has ideal collection efficiency. This work develops another method of particle size data processing based on cascade impactor calibration, which takes into account imperfect stage collection efficiency. Impactor calibration provides the actual size distribution of particles deposited on each stage. To calibrate the cascade impactor, monodisperse aerosols of diameter Dcali (i = 1 to m) were generated, and the mass fraction deposited on each stage was measured. The mass fraction of monodisperse aerosols of diameter Dcali deposited on impactor stage Dcj is fi,j. Values of Fj and fi,j can be represented by mathematical matrix. To obtain the corrected distribution of aerosol, the particle size distribution of each stage (fi,j) is multiplied by the mass fraction deposited on each stage (Fj), which gives a third matrix.

Results obtained with the usual method were 3.5µm to 6µm for MMAD and 40% to 82% for respiratory fraction (particles between 1µm and 5 µm). The calibration method gave a MMAD between 3µm and 4 µm and a respiratory fraction between 77% and 88%.

Thus the utilization of impactor calibration data facilitated more precise calculation of MMAD and respiratory fraction.

Impactor calibration must be done with many monodisperse aerosols to obtain an accurate estimate of particle size distribution analysis.

1PF16

CFD INVESTIGATION OF PARTICLE INHALABILITY. T. RENEE ANTHONY, Michael Flynn, The University of North Carolina, Chapel Hill, NC

This study uses computational fluid dynamics to investigate particle aspiration at the low air velocities typical of occupational settings. A realistic representation of a human head on a simpler geometric torso was positioned facing the wind (0.2, 0.4 m/s), and breathing was simulated using constant inhalation (1.8, 4.3 m/s). Particles ranging from 0.3 to 116 um were released from fixed positions, and laminar particle transport was simulated to locate the critical area upstream of the mannequin where particles were inhaled. Results from the 0.4 m/s freestream and 4.3 m/s inhalation rate compared well with results from the literature for smaller particles. For particles 68 um and larger, simulations yielded smaller aspiration efficiencies than reported in experiments, and for all velocity conditions studied the aspiration efficiency curve dropped well below the 50% recommended by the ACGIH inhalability curve. While not simulating particle bounce directly, this study also provides an upper limit to particle inhalation due to secondary aspiration. Although an investigation at other orientations is needed to fully define an inhalable curve, a recommendation to reconsider the inhalable particulate mass criterion for large particles is warranted as the facing-the-wind condition reflects the highest anticipated aspiration efficiency.