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DROPLET DEPOSITION IN INDUSTRIAL DUCT BENDS. T. Peters, D. Leith, University of North Carolina, Chapel Hill, NC.

A study of droplet deposition in industrial duct bends is presented. Factors investigated were: (1) flow Reynolds number \(Re = 203,000, 368,000\); (2) particle Reynolds number \(10 \leq Re_p \leq 200\); (3) particle Stokes number \(0.08 \leq St \leq 16\); (4) bend angle \(0 = 45^\circ, 90^\circ, 180^\circ\); (5) bend curvature ratio \(1.7 \leq R_b \leq 12\); (6) orientation [horizontal-to-horizontal and horizontal-to-vertical]; and (7) construction technique [smooth, gored, segmented].

Measured deposition was compared with models developed for bends in small diameter sampling lines \((Re < 20,000, Re_p < 13)\).

Whereas deposition measured in this work generally agreed with that estimated with models for particles smaller than 30 \(\mu m\) (\(St < 0.7\)), it was significantly lower than that estimated for larger particles. As the flow around larger particles became increasingly turbulent, the models progressively under-represented drag forces and over-estimated deposition. For particles larger than 20 \(\mu m\), deposition was slightly greater in the horizontal-to-horizontal orientation than in the horizontal-to-vertical orientation due to gravitational settling. Penetration was not a multiplicative function of bend angle as theory predicts due to the developing nature of turbulent flow in bends. Deposition in a smooth bend was similar to that in a gored bend; however, a tight radius bent segment \((R_b = 1.7)\) exhibited much lower deposition.

For more gradual bends \((3 \leq R_b \leq 12)\), curvature ratio had negligible effect on deposition.

A new model was constructed to explain these results and is applicable to a broad range of industrial situations. Using this model, engineers can optimize ventilation systems to better protect workers—increased protection from harmful contaminants, reduction of duct fires, and/or reduced explosion risks—ar at reduced operating costs and/or less frequent system maintenance intervals. Moreover, this model will enable health officials to evaluate bio-terrorism threats, such as deposition of anthrax in ducts.

INDOOR AIR PURIFICATION BY IONIC EMISSION. S. Grinshpun, B. Lee, M. Yermakov, University of Cincinnati, Cincinnati, OH.

Among various techniques that reduce the indoor concentration of respirable particles, ionic emitters have been increasingly used in office, industrial, and residential environments. Some ionization-type air cleaners incorporate corona effect to the airborne particles that make the unipolarly charged particles repel and migrate toward the indoor surfaces. In this study, five ionic air purifiers were evaluated in a 25-m³ nonoccupied, unventilated room. The study was conducted with the particles of typical virus and bacteria sizes \((aerodynamic diameter = 0.04 \text{ to } 2 \mu m)\). The particle concentration and size distribution were measured as a function of time with the electrical low pressure impactor that has a real-time measurement capability. The aerosol concentration decay occurring due to the ionic emission was compared to the natural decay. It was found that the ionic flow in the tested air environment increased the electric charge of aerosol particles by one to two orders of magnitude, depending on the particle size. The operation of the unipolar ion emitter producing about \(10^7\) ions/cm³ reduced the aerosol concentration by a factor of 2 in 5 minutes and by a factor ranging from 15 to 30 in 30 minutes. The ionic air purification efficiency was found to be primarily dependent on the ion emission rate and the indoor air volume.

SEARCH FOR THE OPTIMAL PLEAT COUNT FROM THE PERSPECTIVE OF FILTER QUALITY. C. Chen, T. Hsiao, National Taiwan University, Taipei, Taiwan, Republic of China; C. Chen, S. Huang, Institute of Occupational Safety and Health, Taipei, Taiwan, Republic of China.

Pleated filter panels have been used in a variety of industrial sectors. The present optimization of pleat filter design is based on minimizing the pressure drop at a certain approaching velocity. However, the filtration efficiency, an equally important indicator, is rarely being contemplated together with the air resistance in the optimization process.

In this work, filter quality, instead of pressure drop, is used as the optimization criterion. Dioclylphthalate was used as the test agent to challenge fibrous polypropylene filters. The filter media were dipped in isopropyl alcohol to remove possible electrostatic charges. Nine customarily made filter holders were fabricated to hold just one pleat of filter with different spacing, simulating different peak count range from 0.25 to 5.0 pleat/cm. The approaching velocity was fixed at 100 cm/sec. A scanning mobility particle sizer was used to measure the aerosol number concentrations and size distributions upstream and downstream of the pleated filter. The pressure drop across the filter media was monitored by using an inclined manometer.

The results showed that filter quality curve (as a function of peak count) is almost independent of aerosol size. For submicrometer-sized particles, aerosol penetration decreased with increasing peak count because more filtering materials were available for aerosol deposition. For micrometer-sized particles, aerosol penetration decreased with decreasing peak count due to higher inertial impaction. For the filter tested in the present study, the optimal peak count for filter quality was always slightly higher than that for pressure drop. For example, the optimal peak count was 1.88 pleat/cm, from the standpoint of pressure drop, but to have the highest filter quality, the peak count needs to increase to 2.23 pleat/cm.

EFFECTS OF FACIAL FEATURES ON VELOCITY FIELD FOR INHALING MANNEQUINS. T. Anthony, M. Flynn, University of North Carolina, Chapel Hill, NC.

CFD and numerical investigations of particle inhalability and contaminant exposure have used simple geometrical surrogates for a breathing human form, but the effect of elimi-