Agglomerate Filtration and Loading

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Nanoparticle agglomerates are pervasive in atmospheric sciences, air pollution, and manufacturing of powdered materials, yet studies for filtration properties of nanoparticle agglomerates are still scarce compared to those for spherical particles. Filtration efficiency tests were conducted with silver NP agglomerates, with the agglomerate structure controlled by altering the temperature of a sintering furnace. The agglomerates were essentially fully coalesced at 600 ^{o}C allowing direct comparison of the filtration behavior of the agglomerate to that of a sphere with the same mobility diameter. Agglomerate filtration modeling with no adjustable parameters has been investigated in terms of diffusion, impaction and interception. The model results agree qualitatively with the experimental results in the particle size range of 50 to 300 nm. The results indicated that the larger interception length of agglomerates is responsible for the lower penetration through a fibrous filter in comparison to spherical particles with the same mobility diameters.

Also, we investigated loading of soot nanoparticle agglomerates on fibrous air filter media. The soot agglomerates were generated from a diffusion burner, and the pressure drop increased approximately linearly with the loading mass. We found that the model of Endo et al. (1998) for cake loading was applicable to soot agglomerate loading, since the cake could be regarded as formed by primary particles in soot agglomerates. When the size distribution of the primary particles was used in the model of Endo et al., good agreement between the experimental and computed results was obtained.