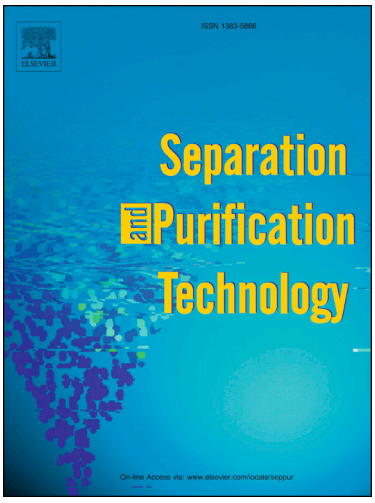

Effect of pore size and layers on filtration performance of coalescing filters with different wettabilities

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Effect of pore size and layers on filtration performance of coalescing filters with different wettabilities

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Abstract

The effect of pore size on filtration performance of coalescing filters was investigated experimentally, using four oleophilic and three oleophobic glass-fiber filter materials. The filters were fabricated into sandwiches composed of a varying number of layers, each of the same filter materials. The results showed that both trend and extent of variation of the excess channel pressure drop with number of layers were dominated by the pore size. As the pore size decreased, the excess channel pressure drop exhibited the increasing, stable, and decreasing trends with increasing number of layers for oleophobic filters, respectively, while it kept growing with number of layers for oleophilic filters. The jump pressure drop controlled by liquid film was inversely proportional to the mean pore size, with an empirical fit equation established to allow quantitative analysis of relationship between film thickness and mean pore size for oleophilic filters. The pore size was a dominant factor in improving steady-state filtration efficiency, as a large-mean-pore-size filter was unable to efficiently separate sub-micrometer-sized droplets even with a high number of layers. Conversely, it was found that re-entrainment of micrometer-sized droplets was prone to occur in small-mean-pore-size oleophobic and large-mean-pore-size oleophilic filters, resulting in the pronounced reduction of steady-state filtration efficiency. Based on quality factors at steady state, a filter with large mean pore size was much superior in separation of micrometer-sized droplets, while a filter with moderate rather than smallest mean pore size, should be applied to separate sub-micrometer-sized droplets.

Keywords: Filtration; Aerosol; Pore size; Wettability; Coalescing filters