

30d Medium Swelling and Pleat Crowding Effects in Cartridge Filters

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Abstract

A two-dimensional mathematical model has been developed describing hydrodynamics in pleated cartridge membrane filters to evaluate design and operating characteristics. The fluid dynamical behaviour of creeping non-inertial porous flow regime has been represented by the Darcy's law. The absorption of the filtering fluid by the porous structure results into the medium swelling increasing its intrinsic permeability. In a pleated cartridge, an apparent loss in the filtration area is observed due the high pleat density and medium deformation due to hydrostatic force exerted by the fluid. The combined effects of medium swelling and losses in effective filtration area causes deviations from the Darcy's law. To interpret these effects, permeability-pressure drop models have been developed based on experimental data obtained from a flat sheet of synthetic membrane used in cartridge fabrication. The inclusion of these permeability models into the hydrodynamic model reveals percentage losses in filtration area and increase in the permeability of the medium. The simulated results have been validated by comparing against the known experimental data.

Keywords: Pleated cartridge, absorptive swelling, pleat crowding, filtration area, Darcy's law