S2.3.3 Parameter and Stability Studies of Analytical Models for Cross Flow Filtration

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In previous work the authors have presented analytical solutions for cross flow filtration models in both cylindrical and rectangular geometries: [N.H. Andreas and C.L. Cox, "New Cross Flow Filter Module Design Parameters: A Theoretical Analysis of Cross Flow Filter Performance Limits", Filtration, 13(4), 247-256, (2013)] and [N.H. Andreas, C.L. Cox, T. Kato, and M. Tamura, "A Model for Transient Cross Flow Filtration in a Narrow Rectangular Domain", Separation and Purification Technology, to appear]. Simultaneous solution of the continuity equations for the carrier and dispersed phases and a modified Darcy equation [Andreas, Advances in Filtration and Separation Technology, 7, 1993, 102-105] result in analytical solutions for permeate flux, carrier fluid flow rate, and pressure, which depend on axial distance and time. Key process governing parameters, including maximum filter length and operating time, arise during the analysis.

The current effort is aimed at (1) studying the relationship between filter parameters and time-averaged output (e.g. permeate flux), and (2) examining the stability of analytical solutions with respect to deviations due to reasonable expected errors in the input values of filtration process parameters. Effects of filter geometry, both cylindrical and rectangular cases, will be considered, along with the influence of other filtration process parameters, including process type (solid/liquid or solid/gas). The expected range of variation of output permeate capacity of a filter will be deduced by perturbation/sensitivity analysis, and the impact of filter design parameter and initial condition deviations from assumed values will be quantified for the zero fouling case and for selected transient processes.

A brief overview of cross flow filtration and analytical solutions will be given. Stability and parameter studies for a variety of physically practical cases will be presented.