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Modeling for Design of a Polymer Process Filter

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In this work we use numerical simulation to examine the effects of filter, debris, and melt parameters on filtration efficiency as reflected in the increase over time of the pressure drop through the filter. The numerical simulations are based on model equations for particle transport and deposition via flow of non-Newtonian fluids through a porous medium. We use truncated normal distributions to provide information on the sizes and concentrations of the debris particles, and the filter behavior is represented primarily by retention functions assigned to layers of variable length.

The porosity of the filter is allowed to change as debris particles are deposited. The mass flow rate through the filter is assumed to be constant. This assumption, coupled with the decrease in porosity, results in increasing pressure drop through the filter over time. Finite element and finite difference methods are applied to the system of equations consisting of mass conservation for the flow of the suspension, Darcy's law (modified for non-Newtonian flow) and evolution equations for filter porosity and debris concentration.

Through numerical simulations we are able to characterize the relationship between filter efficiency and parameters governing the filter, fluid and debris. We provide numerical results and discuss plans for continuing work. The filtration model is one component in an integrated model software package being developed by the Center for Advanced Engineering Fibers and Films (CAEFF).