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INVESTIGATION OF THE EFFECT OF SOLUTION DESTABILIZATION ON FLUX ENHANCEMENT IN FILTRATION

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Summary

A simple model for the filtration of a destabilized colloidal suspension is proposed. It takes into account the effect of flocculation on the properties of the deposited layer. It is shown that the cake permeability is a function of the quantity ωt_R, where ω is the flocculation rate (collision frequency) and t_R is the residence time defined by the time from which the particle enters the membrane channel to the time that it attaches onto the membrane surface.

Introduction

According to the classical constant-pressure filtration theory, the rate of flux decline, $\partial v_w/\partial t$, at short times (i.e., while $\Delta v_w/v_w \ll 1$ so that the flux reduces linearly with time) is directly proportional to the solids volume fraction, ϕ, in the feed. The relation is given by

$$\lim_{t\to 0} \frac{\partial v_w}{\partial t} = \frac{v_w^2}{(1-\epsilon) R_m k_f} \phi \tag{1}$$

where ϕ is proportional to the particle number density for a unimodal distribution, v_w is the solvent permeation velocity or the solvent flux per unit membrane area, ϵ is the effective cake porosity or void volume fraction, R_m is the membrane hydrodynamic resistance to flow, and k_f is the cake permeability. Disagreements, however, with the above-mentioned linear characteristic can be observed if the colloidal solution is destabilized in order to promote rapid colloid coagulation.

Figure 1 clearly identifies such a situation. Obtained from Cohen and Probstein [1], it represents a series of experiments carried out under identical flow, pressure, and temperature conditions, but different solution stability criteria. It should be mentioned that the ordinate of Figure 1, α, which is defined as the "specific transmembrane force", is directly related to the rate of flux decline, $\partial v_w/\partial t$ (see Ref. [1]). Here, the disagreement with eqn. (1) is clearly repre-

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