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Analytical Models for Porous Media Impairment by Particles in Rectilinear and Radial Flows

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Summary

One-dimensional rectilinear and radial macroscopic phenomenological models along with analytical solutions and applications for impairment of porous media by migration and deposition of fine particles, and effects on the injectivity decline during flow of particle–fluid suspensions, are presented in this chapter. The mechanism and kinetics of the fine particle deposition in porous medium for two different models are described and compared. The present approach considers the rate of deposition at a given location to be proportional to the particle flux, with the proportionality factor being a function of the cumulative particles passing by the location per unit volume. The popular model by Herzig et al. [Herzig, J.P., Leclerc, D.M., and Le Goff, P., Flow of suspensions through porous media — application to deep filtration, *Industrial Eng. Chem.*, 62(5), 8–35, 1970.] stems from the assumption that the proportionality factor, called the filtration coefficient, is a variable depending on the deposition function itself. The present new system of equations has a similar appearance to that developed by Herzig et al., but the equivalent constitutive relations are subtly different.

The formulation and analytic solution for the constant and time-dependent injection-rate cases are carried out. A methodology for determination of the parameters of the deep-bed filtration process is provided. Typical scenarios

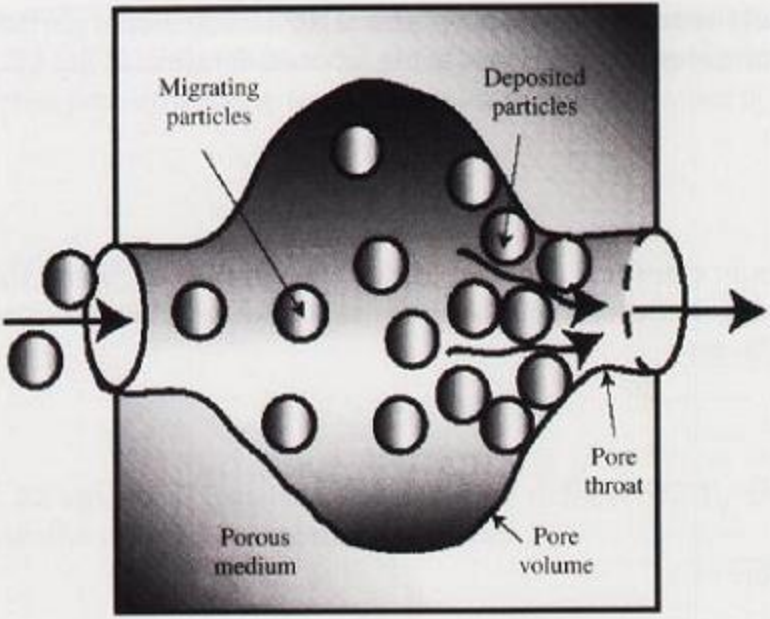

FIGURE 12.1
Fine particle migration and deposition in a typical pore volume.