Particle Rejections in UF and MF Systems: How Important is Particle Shape?

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Microfiltration and ultrafiltration separations are typically characterized with the rejection coefficient which is dependent on hydrodynamic, steric and long range particle-membrane interactions. Incomplete particle rejections are of particular concern for membrane applications in biotechnology and wastewater treatment processes. Theoretical efforts to describe particle rejections date back several decades (Brenner and Gaydos (1977), Anderson (1981), Ennis (1996) and Deen (1987)) and were primarily focused on spherical particles in cylindrical pores, often with only short range (steric) interactions governing particle transport.

Our research groups have collaborated on a number of studies of membrane separations, with a particular focus on non-spherical particles. The Chellam group has measured rejection coefficients of capsular and tailed viruses from track etched polycarbonate membranes that contain uniform sized cylindrical pores. Results were interpreted using theoretical models developed in the Baltus lab that describe particle transport for capsule shaped particles in the confined space of a pore. Our groups have also investigated the bulk phase diffusion of non-spherical viruses from both theoretical and experimental perspectives.

This talk will begin with some historical perspective on hindered transport modeling. Results from the recent work from the Chellam and Baltus groups will be presented and discussed. The importance of particle shape on particle transport and rejection will be addressed. Implications for the design of membrane and other separations involving non-spherical particles will also be presented.