

## **Transport and capture of charged colloidal particles in filtration**

Mark Hurwitz and Don Koch

We are interested in improving the performance of filters used in pharmaceutical production to remove biological particles such as bacteria, viruses and phages from solutions of valuable proteins. The obvious approach of making the pores smaller than the particles is impractical because of rapid plugging. Instead, filter materials have large pores and capture relies on each particle encountering a large number of capture sites.

The interaction of fluid, particles, and porous medium is not well understood. Current models for air filtration (very low concentration) are the most complete but filter design is still an iterative experimental process. Brown (1993) and Colbeck and Lazaridis (2014) provide good summaries. In these models, each particle is considered alone and assumed to be carried into contact with fixed surfaces along streamlines or by migration across streamlines through diffusion, inertia or electrostatic attraction.

Capture is similar in liquids but we wish to explore two significant differences. First, electrostatic interactions are usually complicated by the Debye screening effect of dissolved salts. For example, Hou et al (1980) showed positively charged filters were much more effective in capturing viruses and endotoxins than negatively charged filters of similar pore size and structure. Second, the accumulation of captured particles affects the filter permeability and significantly increases capture probability. (See for example the network fouling model of Griffiths et al 2014).

We will add a means of accounting for the screening effect of dissolved electrolytes to the single particle capture model and modify the capture probability expression to account for the presence of already captured particles. The resulting differential equations will then be solved either approximately or numerically to show the effect of charge and particle accumulation on filtration performance.

### References:

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