S1.3.2 PORE-SCALE, SYSTEM-SCALE AND ACROSS-SCALE MODELING OF FILTER MEDIA: THE COMPUTATIONAL CHALLENGES IN MULTISCALE POROUS SYSTEMS

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Filtration processes take place in complex highly hierarchical heterogeneous systems and typically exhibit non-linear dynamics and lack of scale separation. Flow and transport phenomena through membranes and filter media can be modeled on multiple scales. These range from fine-scale geometry-resolving (e.g. pore-scale) simulations to continuum models, which replace complex structures with their equivalent (continuum) representations. Continuum-scale models are largely phenomenological and rely on a set of assumptions and simplifications. They are not appropriate for physical and chemical phenomena in which macroscopic equations break down locally. Pore-scale models entail no simplifying assumptions, yet their use is limited to small systems and requires the detailed knowledge of fine-scale geometry. Furthermore, the dynamics at the pore-scale is often coupled to the system-level response. This is typical during filtration when concentration polarization and pore-scale clogging inhibits the membrane performance at the system scale. In this talk, the current challenges the numerical modeling of transport in filter media will be highlighted and novel computational solutions discussed.