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"The Physics, Chemistry, and Topology Behind Particle Transport and Retention in Aqueous Saturated Porous Media: How Natural Water Filtration May Relate to Drug Delivery"

Abstract: Whereas drug delivery science/engineering concerns targeted delivery of particles to (for example) organs or tumors, and therefore involves maintaining particle stability and minimizing losses to non-target surfaces, many of the same types of concerns apply to hydrogeologic processes. For example, similar concerns govern bioaugmentation, the targeted delivery of bacteria with novel metabolic properties to degrade xenobiotic contaminants in the subsurface, as well as improved prediction of set-back distances of drinking water wells from septic systems. In all of these contexts, there is a need to understand particle transport and retention at a sufficiently mechanistic level to optimize design of the process, e.g. optimal sizes, concentrations, surface moieties, etc. relative to the media being traversed. The coupling of micro-scale direct observations to "whole organism" observations and numerical simulations has transformed understanding of particle transport and retention in porous media, and these coupled approaches in the natural water filtration context has potential application in the drug delivery context. The talk will review the unique physicochemical attributes of particles relative to solutes that govern particle interactions with surfaces and the near-surface flow field, and will suggest means to capitalize on these attributes in targeted delivery.

Brief Bio: Dr. Johnson's research focuses on the physics and chemistry of natural water treatment by filtration in granular aquifers (groundwater). His research also examines the fate and transport of trace elements, and the partitioning behavior of organic compounds, in aquatic systems. He has been principal investigator on more than ten federally funded research grants (predominantly National Science Foundation), and has led five state-funded projects examining the fate and transport of selenium and mercury in the Great Salt Lake and surrounding wetlands. Dr. Johnson has produced eighty five peer reviewed publications in top-tier journals, with over 2100 citations of this work to date.