How suspended particles influence liquid flow dynamics

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One of the most prominent publications in physics, *Physical Review X*, accepted an article by Sangwoo Shin, a University of Hawai‘i at Mānoa assistant professor in mechanical engineering. The article is titled Accumulation of Colloidal Particles in Flow Junctions Induced by Fluid Flow and Diffusiophoresis.

Shin examines how underground aquifers, hydraulic fractures, coastal habitats and water filtration systems all deal with the flow of water that contains suspended particles. Typically, these particles are expected to move along with the fluid flow unless the particles are large enough to clog the channel or sticky enough to adhere to boundaries.

However, this is not always the case when there are solutes dissolved in the fluid. Shin and his team show that the particles can get trapped and clog large flow channels rapidly because of the dissolved solutes.

When two flows with different solute concentrations are in contact near a junction, a sharp solute gradient is formed at the interface, allowing the particles to move against the flow direction.

Consequently, the particles accumulate near the pore entrance, rapidly occupying the pore. This behavior has important implications for the clogging of a porous medium, where particles that are orders of magnitude smaller than the pore width can accumulate and block the pores within a short period of time.

Possible practical examples of this particle trapping include developing microbial biofilms and biofilm streamers in certain natural habitats, as well as interrupting oral and gastrointestinal microbial infections in the human body.

The team's research also shows that this effect can be utilized as a useful tool for separating biomolecules such as DNA for biomedical applications.

Shin was among the world's 100 leading scientists at a November global gathering of forward-thinking individuals from more than 75 countries.

More information: Sangwoo Shin et al. Accumulation of Colloidal Particles in Flow Junctions Induced by Fluid Flow and Diffusiophoresis, *Physical Review X* (2017). DOI: 10.1103/PhysRevX.7.041038

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