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When does aggregation affect magnetic separation? ALMUT EISENTRAEGER, DOMINIC VELLA, IAN GRIFFITHS, University of Oxford — Magnetic separation is an efficient way to remove magnetic and paramagnetic particles suspended in a carrier fluid, and can be used to remove heavy metals from drinking water. Particles are filtered by moving along the gradient of a strong outer magnetic field towards a collection site. Experimental evidence suggests that aggregation of particles to form chains or clusters plays a vital role in determining the efficiency of separation. In diffusion-dominated systems, aggregation may even be required to induce any collection at all. Modelling approaches so far largely consider aggregation in a uniform outer magnetic field, neglecting collective motion, and hydrodynamic interactions between particles and chains. However, long-range hydrodynamic interactions between particles, which gives rise to the concept of hydrodynamic diffusion, have been considered. Here we combine these ideas to investigate how the average velocity and the relative motion of chains and particles during collection influences chain aggregation rates. A one-dimensional model system provides insight into the relative importance of magnetic and hydrodynamic interactions during aggregation and collection, which may be validated by microfluidic experiments.

Almut Eisentraeger
University of Oxford

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