THE DIFFUSION COEFFICIENT OF A SWOLLEN MICROGEL PARTICLE

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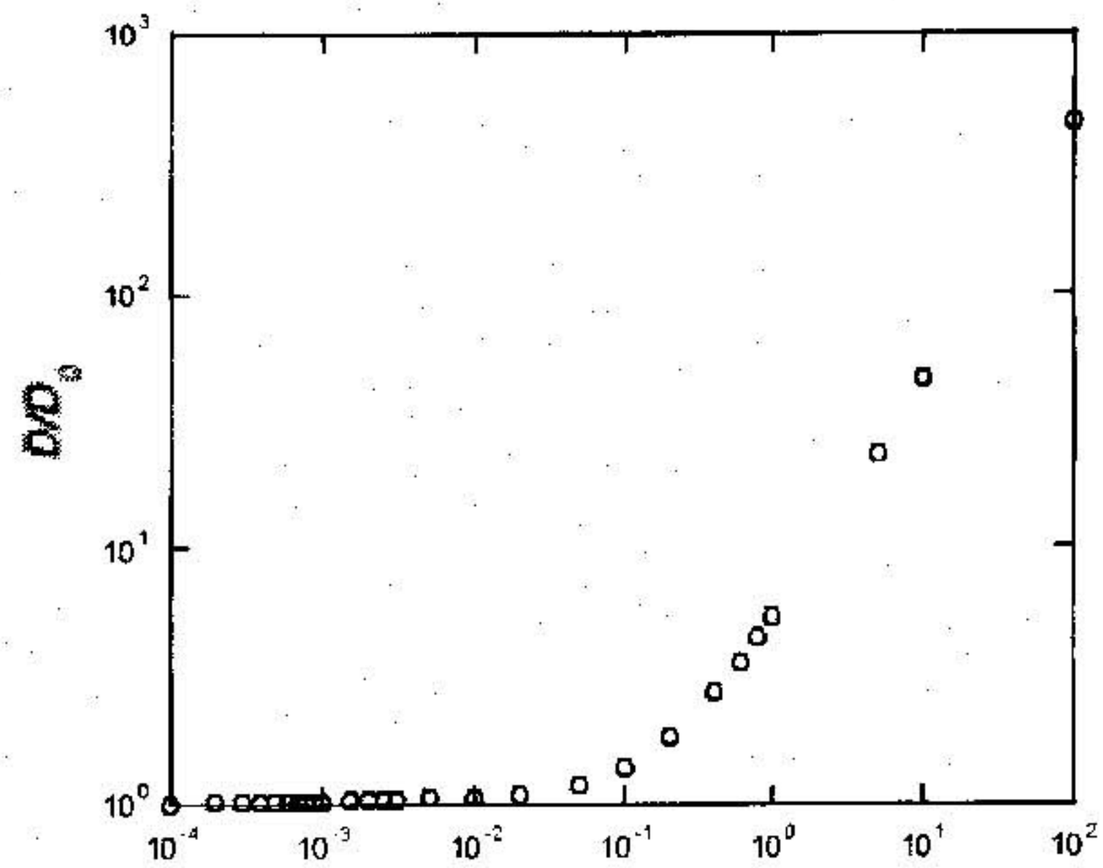
Microgels are cross-linked latex particles that display swelling under certain conditions. These particles are traditionally sized using dynamic light scattering. This technique measures a diffusion coefficient and the Stokes-Einstein diffusion coefficient is used to solve for a size. Inherent in this is an assumption of no flow at the particle surface. For porous particles the physically realisable boundary condition is actually a balance of the external flow to a flow through the particle. This means that dynamic light scattering is not necessarily valid for sizing non-hard particles.

We use a Brinkman-Darcy model for flow through the particles and obtain an analytic solution for the flow. Balancing the flow at the particle boundary with a Stokes solution allows the derivation of the drag force on a particle as a function of the Darcy number. This dimensionless group is the permeability of the gel to the particle size squared. Once the drag force is derived we determine the diffusion coefficient. For values of the Darcy number below 10^{-2} the Stokes-Einstein diffusion coefficient is a very good approximation. For higher values of the Darcy number the particles are more mobile and the diffusion coefficient increases dramatically.

Darcy numbers for many polymer–solvent types will be given.



The diffusion coefficient of particles, normalised with the Stokes-Einstein diffusion coefficient as a function of Darcy number.