Use of the Weibull equation to approximate diffusive release from particles in a closed system

Abstract

We consider the problem of Fickian diffusion of a solute (or heat) into or out of a suspension of particles, in a well-mixed solvent. By combining a simple numerical scheme with a Laplace transform method, we are able to efficiently solve this problem for different particle volume fractions (including accumulation of solute in the liquid phase), shapes (spheres, cubes and cylinders of different aspect ratios) and particle size distributions (assumed to be log-normal). We approximate the results by a Weibull function, and thereby provide a physical calibration for the parameters in this function when used as an approximation for our solutions. We test our calculation by measuring salt release profiles from different size distributions of agar cubes, and then use the predicted Weibull equation to deduce the diffusivity of salt in this material.