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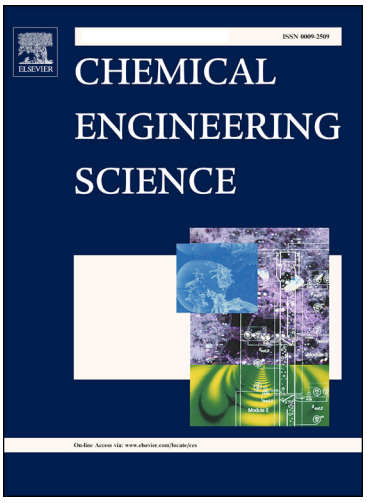

A Model for the Depletion Layer Prediction in a Dilute Suspension of Rigid Rod-like Particles under Shear Flows in the Entire Range of Peclet Numbers

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A Model for the Depletion Layer Prediction in a Dilute Suspension of Rigid Rod-like Particles under Shear Flows in the Entire Range of Peclet Numbers

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Abstract

We derived a model to predict the concentration profile, or the center-of-mass distribution, of rod-like particles near a wall under shear flows. Various excluded volume mechanisms of a rod near a wall for each Peclet number (a ratio of shear rate and diffusivity) regime were incorporated into the model through a steric factor concept. At low and moderate Peclet numbers, the steric factor is mainly determined by the ratio of the restricted/unrestricted rod orientation distributions. However, at high Peclet number, the ratio between the rod penetration time in a depletion layer and the Jeffery orbit frequency mainly affects the steric factor. The predicted concentration profiles showed a good agreement with the results from previous works.

Keywords: Rod-like Particle, Orientation Distribution, Depletion Layer, Excluded volume effect, Microchannel Flow

2010 MSC: 82-80, 76-10, 76D07, 76T70

1. Introduction

A depletion layer is where particle concentration near a solid wall becomes lower than the average cross sectional concentration. Since such depletion layers have been observed in rod-like particle suspension flows [1], many studies

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