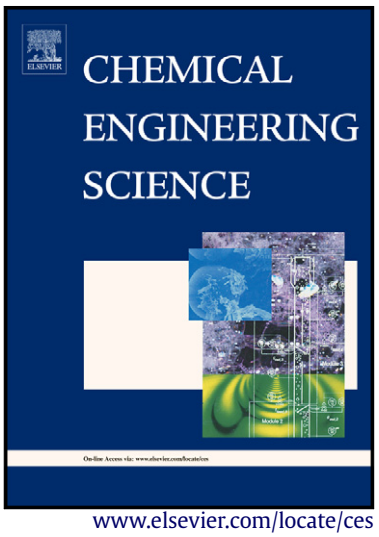

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Numerical investigation of subgrid mixing effects on the calculation of biological reaction rates

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Abstract

The consequences of substrate concentration heterogeneities at the cell level, on the behaviour of microbial populations have been identified some years ago. However, subgrid effects are rarely considered in bioreactor modelling. In this paper, this central issue is investigated with Direct Numerical Simulations (DNS) coupled with Lagrangian particle tracking and scalar field calculations in the case of statistically steady homogeneous and isotropic turbulence. From these calculations, the exact distribution of substrate uptake rates of a microorganism population is calculated and compared, favourably, to analytical solutions. A metabolic model considering anabolism, oxydative catabolism and dissimilation is invoqued to quantify the consequences in terms of overall reaction rates at the population scale. It is shown that imperfect mixing reduces the growth rate and increases the by-product formation while leaving the total uptake rate unchanged. This work provides a

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