

A generic model-based methodology for quantification of mass transfer limitations in microreactors - DTU Orbit (09/11/2017)

A generic model-based methodology for quantification of mass transfer limitations in microreactors

Microreactors are becoming more popular in the biocatalytic field to speed up reactions and thus achieve process intensification. However, even these small-scale reactors can suffer from mass transfer limitations. Traditionally, dimensionless numbers such as the second Damköhler number are used to determine whether the reaction is either kinetically or mass transfer limited. However, these dimensionless numbers only give a qualitative measure of the extent of the mass transfer limitation, and are only applicable to simple reactor configurations. In practice, this makes it difficult to rapidly quantify the importance of such mass transfer limitations and compare different reactor configurations. This paper presents a novel generic methodology to quantify mass transfer limitations. It was applied to two microreactor configurations: a microreactor with immobilised enzyme at the wall and a Y-shaped microreactor with one inlet stream containing enzyme and the other containing substrate. The results of the immobilised enzyme microreactor correspond very well with the traditional approach of using the second Damköhler number (DaII). However, the results of the Y-shaped microreactor showed that the second Damköhler number is not applicable in this case, indicating that dimensionless numbers should be applied with care. For both configurations, the mass transfer limitations could be quantified and linked with appropriate dimensionless numbers, illustrating the power of the proposed methodology.

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