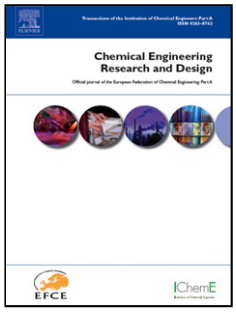

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Water-in-oil emulsification in a bifurcated tree-like network: flow distribution properties and their impact on the emulsion polydispersity

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Abstract

This paper presents a numerical study on the water-in-oil emulsification process through the parallelization of micro/mini-channels. Firstly, the single-phase fluid flow distribution uniformity in the bifurcated tree-like fluidic network is discussed. Secondly, the separate roles of the oil viscosity and the interfacial tension on the plug details are clarified. Finally, the impact of flow distribution non-uniformity among the parallel mini-channels on polydispersity of the produced emulsion is evaluated by modelling.

The obtained results show that for bifurcated tree-like fluidic network, the single phase flow distribution is the flow distribution non-uniformity increases linearly with the increasing mean Re_{ch} once a transitional Re is reached. The water plug length and volume increase with the increasing interfacial tension and the decreasing oil viscosity under our tested conditions. Correcting factors relevant to the modified liquid properties have to be added in the predictive correlations for plug length and volume. For water-in-oil emulsification in parallel channels, its polydispersity P_w is affected by the single phase flow distribution uniformity, the total water/oil flow-rate ratio and most importantly by the flow-rate ratio distribution non-uniformity. An empirical correlation has been proposed to predict the emulsion P_w based on these influencing factors.

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