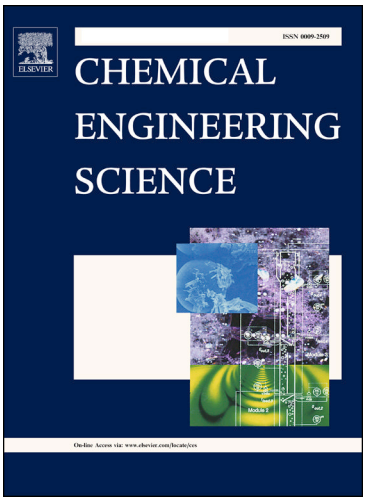

Effect of the contact angle on the morphology, residence time distribution and mass transfer into liquid rivulets: A CFD study

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Effect of the contact angle on the morphology, residence time distribution and mass transfer into liquid rivulets: A CFD study

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Abstract

Droplets and rivulets over solid surfaces play an important role in a number of engineering applications. We use a Computational Fluid Dynamics model consisting in a smooth inclined plate to study the effect of the contact angle on the morphology, residence time and mass transfer into liquid rivulets. Measurements of the contact angle—using the sessile drop method—between aqueous monoethanolamine solutions and two commercial surfaces used for gas separation, are introduced as boundary condition. Reducing the contact angle from 60° to 20° flattens the rivulet, increasing the gas-liquid interface area by 85%. The cumulative residence time broadens, with an increase of 12% in $\tau 10$, and of 37% in $\tau 90$. There is consequently, a theoretical increase of 68% in the total mass transfer rate. A sensible design of the liquid-solid interaction is therefore crucial to good mass transfer performance.

Keywords: rivulet flow; wetting; contact angle; CFD; residence time; sessile drop

1. Introduction

Rivulet flow appears in a number of practical problems such as industrial coating processes [1], rain-wind induced vibrations in cable-stayed bridges [2],

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