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# Multiphase flow studies for microscale hydrodynamics in the structured packed column

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## ABSTRACT

Post combustion carbon capture by solvent absorption in a structured packed column is a promising technology for mitigating greenhouse gas emissions. Computational fluid dynamic (CFD) modelling of such a column is a challenging multiscale problem due to the range in length and time scales. The microscale hydrodynamics play a key role in the overall column efficiency with the interfacial area significantly influencing the mass transfer between the gas and liquid phases. In this context, multiphase flow simulations using the volume of fluid (VOF) method in a representative elementary unit (REU) of the packed column can provide fundamental insights into the microscale hydrodynamics, such as, interfacial area and liquid holdup. The present study systematically examines the impact of various factors (e.g., physical properties and contact angle) on the interfacial area. The results are compared with existing correlations and a scaling analysis is also performed. The solvent physical properties are characterized by the Kapitza number (Ka), a dimensionless number that depends only on fluid properties. So that the Ka number decreases with increasing viscosity. At a fixed liquid load, the interfacial area and liquid holdup are observed to increase with decreasing Ka number. The impact of contact angle (i.e., solid surface characteristics) is effectively investigated by modifying the wall boundary conditions. The interfacial area and liquid holdup are found to decrease with increasing contact angle. Subsequently, a phenomenological correlation for interfacial area is proposed that includes the impact of these parameters. This correlation may be used to predict the interfacial area for gas-liquid flow in a structured packing for rivulet to fully wetted flow regimes.

**Keywords:** structured packing, volume of fluid (VOF), contact angle, interfacial area, liquid holdup