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Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

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COMPUTATIONAL EVALUATION OF THE CURRENT THERMODIFFUSION EXPERIMENTS ONBOARD ISS

Abstract

Computational Fluid Dynamics simulations will be made to understand the expected outcome of the current thermodiffusion experiments of the DCMIX project that is currently being undertaken onboard the International Space Station. The objective of the project is to understand the thermodiffusion process in ternary hydrocarbon mixtures of n-dodecane (C12), tetralin (THN) and isobutylbenzene (IBB). Collectively, these three components represent a simplified model of the reservoir composition. Thus, the outcome of this study will aid in understanding the distribution of crude oil components in an underground reservoir. In this context, we propose to conduct a computational investigation in which two-dimensional simulations of the ternary and binary hydrocarbon mixtures of C12, THN and IBB at atmospheric pressure and at a mean temperature of 25C will be performed. These simulation conditions and the composition of these mixtures correspond to the experimental mixtures that are currently being studied on ISS. As in the DCMIX experiments, a vertical thermal gradient of 10C will be applied by maintaining the horizontal boundaries of the computational domain at different temperatures. Simulations will be made to evaluate the ideal as well as microgravity conditions and the effect of the vibrations, low component frequencies in particular, on the separation behavior of the mixtures. For numerical simulations, a previously validated in-house Fortran-based computational fluid dynamics code that is coupled with thermodynamic models for the Fickian diffusion and Thermodiffusion processes will be employed.