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INFLUENCE OF GRAVITY ON DYNAMICS OF ABSORPTIVE LIBR–WATER SOLUTION

Abstract

Absorption technology can play a vital role in solving global warming problems. Among all the components of absorption machines, the absorber stands out as the main factor contributing to the reduction in heat and mass transfer. Since the 1990s, the concept of using Marangoni convection to enhance heat and mass transfer on an absorbing interface has become widespread. Marangoni convection is a flow driven by surface-tension gradients, which result from interfacial inhomogeneities in either temperature or solute concentration. To highlight the influence of Marangoni convection in absorption problems, various soluble as well as dissolved in gas-phase surfactants were used in experiments and numerical simulations. The addition of a surfactant to the absorbing interface locally induces solutal convection, further accompanied by thermal and buoyant convection. The overall conclusion of previous research was that the existing research recognized the critical role played by the Marangoni convection, but there is still uncertainty about the physical background.

Solutal Marangoni convection is an intricate phenomenon exhibiting complex and unsteady flow patterns. The interplay of solutal, thermal, and buoyant convection in the presence of absorption adds further complexity.

To clarify the role of Marangoni convection we present the results of comprehensive numerical simulations in presence [1] and absence of gravity. The conventional solution used in an absorber is the binary mixture of LiBr–water. Thus, we investigate the convective instability in a LiBr–water binary mixture, triggered by a local perturbation of uniform absorption. The decrease in mass fraction initiates solutal convection, leading to a local temperature change that, in turn, induces thermal Marangoni convection. We explore fluid dynamics, heat and mass transfer, revealing different regimes. The level of absorption and pattern formation are strongly influenced by gravity.

[1] P. F. Arroiabe, M. Martinez-Agirre, A. Nepomnyashchy, M. M. Bou-Ali, and V. Shevtsova The effect of small perturbation on dynamics of absorptive LiBr–water solution. Phys. Fluids 36, 022119 (2024)