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INFLUENCE OF THERMOGRAVITATONAL COLUMN GEOMETRY ON STABILITY OF SEPARATION

Abstract

DCMIX2 presents experiments in ternary solutions (Toluene-Methanol-Cyclohexane) related with determination of their diffusion and thermodiffusion coefficients on Earth laboratories and International Space Station. On the International Space Station, Soret coefficients, which are linked to thermodiffusion and diffusion coefficients, were obtained using Soret cells. Themodiffusion coefficients could be obtained by thermogravitational column [1] for positive Soret coefficients. However, when Soret coefficients are negative, heavier mixtures will move to hot wall and with convective currents formed by thermal gradient, create adverse gradient of density [2]. This will affect stabilty of the flow and prolong steady state separation time. In the present work, the influence of the temperature gradient and geometry is studied, since these factors affect thermogravitational stability and mixture separation time. There are two different geometries of thermogravitational column used in laboratories, cylindrical and paralelepipedic. In this work, we investigate the effect of the curvature radius on stability of the flow in cylidnrical configuration, and the dimension normal to the temperature gradient in paralelepipedic one. In addition, different temperature gradients are applied with the aim of studying their effect on the flow. Therefore, the work is focused on the negative Soret coefficients which are used in the numerical simulation for different geometries and temperature gradients. The binary subsystem considered is toluene/methanol, with concentration of toluene higher then 90% assuring that Soret coefficient is negative [3]. This study will give additional information about the stability of the subsytem in DCMIX2 mixture recently conducted in the ISS.

[1] O. Ecenarro et al., Thermogravitational Column as a Technique for Thermal Diffusion Factor Measurement in Liquid Mixtures, (1989), Sep.Sci. Technology, vol. 24, 555-568

[2] M.M. Bou-Ali et al., Stability of convection in vertical binary fluid layer with an adverse density gradient (1999), Physical Review E, vol. 59, 1250-1252

[3] E. Lapeira et al., Transport properties of the binary mixtures of the three organic liquids toluene, methanol, and cyclohexane (2017), The Journal of Chemical Physics, vol. 146