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Solutal Marangoni instability in a binary liquid layer evaporating into air: the importance of transients in the gas for highly unstable cases HATIM MACHRAFI, Universite de Liege, ALEXEY REDNIKOV, PIERRE COLINET, Universite Libre de Bruxelles, PIERRE DAUBY, Universite de Liege — This study considers an evaporating horizontal binary-liquid layer (aqueous solution of ethanol; mass fraction 0.1) in contact with air with an imposed transfer distance. Fully transient and horizontally homogeneous solutions for the reference state are first calculated. Then, the linear stability of these solutions is studied using the frozen-time approach. Solutal and thermal Rayleigh-Bénard-Marangoni instabilities are taken into account together with the Soret effect, although the solutal Marangoni mechanism appeared to be the most important one. Considering several gas-to-liquid thickness ratios (H), we calculate the critical times for the instability onset in a liquid layer of a given thickness. We also uncover the minimum liquid thicknesses under which no instability can ever occur. We subsequently observe that two distinctly different types of minimum thicknesses exist depending on H, examining each one of them. Then a closed-form analysis of the instability at small times has been developed. Finally, it has also been observed that, regardless of the gas-to-liquid thickness ratio, an asymptotic value of the critical time exists as the liquid layer increases, this critical time being approximately 1 μs.

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