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Stability of evaporating thin liquid film OLEG SHKLYAEV, ELIOT FRIED, Washington University in St. Louis — In this study, we revisit the problem of an evaporating thin film in the presence of a surfactant. Instead of the conventional Hertz-Knudsen-Langmuir equation we impose a configurational momentum balance. This balance, which supplements the conventional conditions enforcing the balances of mass, momentum, and energy on the film surface, arises from a consideration of configurational forces within a thermodynamical framework. In addition to classical term involving the difference between the temperatures of the film surface and the adjacent vapor, the configurational momentum balance includes two additional terms. One of these terms involves the pressure at the film surface relative to the pressure of the vapor. The other term involves the difference between the surfactant concentration at the film surface and the saturation value of the surfactant concentration. We find that time-dependant base state of evaporating liquid film is affected by the effective pressure and the surfactant activity terms. Both effects reduce the disappearance time. In particular, we find that the effective pressure strongly affects the film rupture processes and is an important factor in the consideration of liquid films with thicknesses of one or two monolayers. These factors lead to a revised understanding of the stability of an evaporating film. Parameter domains where the contributions of the newly introduced terms is important are determined.

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