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Absolute and convective instabilities in turbulent gas-laminar liquid film flows RAJAGOPAL VELLINGIRI, Department of Chemical Engineering, Imperial College London, UK, DMITRI TSELUIKO, Department of Mathematical Sciences, Loughborough University, UK, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London, UK — Gas-liquid flows are important from a fundamental fluid mechanics point of view, but are also central in a variety of engineering applications, such as distillation, absorption and cooling of electronic devices. Our prototypical system for such flows consists of a thin laminar liquid film flowing down an inclined plate in the presence of a countercurrent turbulent gas. The liquid flow is influenced by the gas through the tangential and normal stresses acting at the interface. We develop low-dimensional models for the liquid-flow problem: a long-wave model and a weighted integral-boundary layer (WIBL) model. These models, along with the Orr-Sommerfeld problem derived from the full Navier-Stokes equations and associated boundary conditions are used to explore the linear stability of the liquid-gas system. For a given liquid flow rate, we show that the wave velocity decreases with increasing gas shear before changing direction at the "flooding point." The appearance of this point is linked to the onset of absolute instability, where a localized disturbance gets amplified and contaminates the whole domain. This is also marked by the collision of two spatial branches at a saddle point. We supplement our stability analysis with time-dependent computations of the WIBL model.

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