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The key role of inertia in the Plateau-Rayleigh instability for liquid-vapour water system

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Liquid/vapour water flows are encountered in several fields, such as in Proton Exchange Membrane Fuel Cell (PEMFC), a promising technology to electrify the energy system. In PEMFC, electricity is produced by recombining oxygen and hydrogen fed via gas channels. Water is also generated and should be evacuated via the channels. As the temperature is low (60-80°C), water is observed both as liquid and vapour, creating a two-phase flow in the capillary-size GFC. Formation of liquid plugs is then possible due to the Plateau-Rayleigh instability. While lubrication theory is commonly used to describe it, in such liquid/vapour water systems, due to the moderate viscosities, the inertial terms of the Navier-Stokes equations may become significant. Understanding the role played by inertia in the plug formation is the aim of this work. TRUST-TrioCFD/Front-Tracking code is used to perform 2D-axisymmetrical simulations of plug formation. A linear stability analysis is performed to demonstrate the role of inertia at the inception of the instability and Front-Tracking simulations are used to observe its later stages. This work will be pursued by investigating the effects of an imposed flow.

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