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Peculiarities of Liquid Melt Filtration in a Porous Matrix

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ABSTRACT

Liquid melt filtration ahead of a self-propagating high-temperature synthesis (SHS) flame zone in porous specimens could strongly affect the mechanisms of flame propagation. Liquid melt could be performed ahead of the reaction zone by expanding gaseous reaction products, or by choosing the orientation of the gravity vector. In both cases, in displacing a viscous fluid with a less viscous one, or heavy fluid on top of a light one, could result in inherent flow instabilities. The role of these instabilities on SHS front propagation could be essential.

Our goal was to investigate the instability of viscous fluid displacement by a less viscous one in a two-dimensional channel and to determine characteristics of displacement quality and entrapment zones. Experiments on miscible displacement of fluids in Hele-Shaw cells were conducted under microgravity conditions. Extensive direct numerical simulations allowed us to investigate the sensitivity of the displacement process to a variation of values of the main governing parameters. Results of numerical simulations, as well as physical experiments, show that the presence of a definite length scale inhomogeneity could stabilize unstable displacement and could destabilize a stable one.