Static layers and zones in displacement flows

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Abstract

Displacement flows occur in numerous industrial applications involving pipes and machinery, e.g. in the food industry, in pipelining and in chemical processing. It is very common that displacement of one fluid by another is inefficient and/or incomplete, which often has practical consequences. Here we outline one particular area of application in which the displaced fluids have a yield stress. For such fluids incomplete displacement is often characterised by regions of fluid that are static and attached to the boundaries of the flow domain. The problems of interest in this area fall into two categories: (i) how to reliably predict the extent of the static regions in the flow; (ii) how to remove static residual fluid from the walls. We outline the mathematical description of these problems, describe the progress to date and present recent puzzling results on the effects of flow pulsation.