ICTS Fluid Dynamics seminar

Title : Computational Study of Fingering Instability due to an Instantaneous Chemical Reaction in a Porous Medium

Speaker : Priya Verma (Indian Institute of Science, Bengaluru)

Date : Friday, 1st March 2024

Time : 02: 00 PM (IST)

Abstract : A hydrodynamic instability called viscous fingering (VF) arises when a less viscous fluid displaces a more viscous one in a porous medium. It is ubiquitous in various transport phenomena such as the petroleum industry, contamination in aquifers, and CO2 sequestration, to name a few. A chemical reaction may modify the viscosity of the fluids flowing in a porous medium and induce VF. A range of fields, from macro-scale to micro-scale, can use VF caused by chemical reaction to increase mixing. In order to understand the chemo-hydrodynamic instability, we consider a radial displacement of two miscible and reactive fluids undergoing an infinitely fast chemical reaction. VF induced by chemical reaction is a non-linear phenomenon that is modeled by a coupled system of partial differential equations comprising Darcy's law and three convection-diffusion-reaction (CDR) equations. The reaction term of the CDR equations contains a non-dimensional parameter Damköhler number, which for an infinitely fast reaction tends to infinity. We introduce a suitable transformation to deal with an infinite Damköhler number. This results in only one convection-diffusion equation coupled to flow equations to be solved, reducing the computational cost significantly. We discuss the transformation and the numerical technique based on the hybrid of compact finite difference and pseudo-spectral method. A scaling relation for onset time of instability depending on Péclet number and the log-mobility ratio between reactants and product is established and discussed.

Venue : Offline: Obaid Siddiqi Meeting Room

Online: Please click the below link to join the seminar.

https://icts-res-in.zoom.us/j/98459857896?pwd=T3pWTlRpQm9jekpnNUZ1SFZIK21TUT09

Meeting ID: 984 5985 7896

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