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Stabilizing Effect of Inertia on Viscous Fingering in Miscible Displacements in Porous Media

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Miscible displacements in porous media are investigated through nonlinear numerical simulations. At a relatively larger flow rate or a wider gap of Hele-Shaw cell, the inertia must be considered and its role needs to be carefully investigated. In the present study, the Reynolds number is used to quantify the inertial forces. Its effect is measured by examining the variations of viscous fingering under unfavorable viscosity ratio. It is found that the inertia has a stabilizing effect on miscible displacements compared with the cases without considering inertia. The larger the Reynolds number, the more stabilizing effect can be observed, implying the importance of consideration of inertia when analyzing miscible displacements. Moreover, we investigated the step-size time-dependent injection rate on viscous fingering for the cases with and without considering inertia. The average total amount of fluid injected is the same for constant injection rate and time-dependent rate for a certain length of time. The results show that inertia has an even stronger stabilizing effect on miscible displacement at a variable displacement rate. Meanwhile, its influence also depends on the whether the displacement starts with an injection or extraction. For different cases, the stabilizing effect of inertia is therefore quantitatively measured by analyzing the concentration field at the same time for constant injection case.

References

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