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Heat and Mass Transfer in Oscillatory Squeeze Flow of a Maxwell Fluid RUI YANG, Department of Civil and Environmental Engineering, Technion – Israel Institute of Technology, IVAN CHRISTOV, School of Mechanical Engineering, Purdue University, IAN GRIFFITHS, Mathematical Institute, University of Oxford, GUY RAMON, Department of Civil and Environmental Engineering, Technion – Israel Institute of Technology — Taylor–Aris dispersion occurs in periodically driven flows, due to the interactions of out-of-phase velocity and temperature/concentration gradients. We study the scalar transport in an oscillatory axisymmetric squeeze flow of a Maxwell fluid, driven periodically by the motion of one of the confining, parallel planes. Using multiple-scales homogenization, we derive a one-dimensional advection–diffusion–reaction equation. The homogenized equation shows that time-averaged transport can be understood as a combination of three effective mechanisms: diffusion, advection and reaction. We discover that the effective diffusion always helps transport, and it can be sharply enhanced when the dimensionless plate oscillation frequency (specifically, the Womersley number, which is the ratio of the transient inertial to the viscous forces) approaches a resonant value, at which the velocity amplitude peaks. However, the effective advection and reaction mechanisms may carry heat/mass from low-temperature/concentration regions to high-temperature/concentration regions, or vice versa, depending on the Womersley, the Prandtl/Schmidt and the Deborah numbers. We show that the interplay of these effective mechanisms determines whether the transport is enhanced or diminished.

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