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Correlation between particle diffusion and effective heat transfer in a sheared suspension[1] XIAOLONG YIN, Petroleum Engineering, Colorado School of Mines, BLOEN METZGER, IUSTI CNRS, Polytech Marseille — We show that enhanced solute or heat transport observed in sheared suspensions of neutrally buoyant particles with low Reynolds numbers are well correlated to the particle diffusion. Experiments were conducted in a Couette cell where the effective heat transfer coefficients were extracted from the decay of a heat pulse applied to a bounding wall. The particle diffusion coefficients were measured by particle tracking enabled by laser-induced fluorescence and refractive index matching. A numerical method based on a combination of the lattice Boltzmann method and Brownian tracers was developed to simulate the convective transport process. Effective heat transfer coefficients were obtained from matching the tracer profile with a transient analytical solution of the heat transfer equation. Heat transfer barriers were identified near the walls and the particle surfaces due to lack of convective motion in the direction normal to the surfaces. Both experimental and numerical data show that the effective heat transfer coefficient increases substantially with increasing shear rate, and the dependence on the volume fraction shows a peak at about 35% volume fraction that coincides with the peak in the particle diffusion coefficients.

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