

Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Theory for Indirect Conduction in Dense, Gas-Solid Systems

AARON LATTANZI, CHRISTINE HRENYA, University of Colorado — Heat transfer in dense gas-solid systems is dominated by conduction, and critical to the operation of rotary-kilns, catalytic cracking, and heat exchangers with solid particles as the heat transfer fluid. In particular, the indirect conduction occurring between two bodies separated by a thin layer of fluid can significantly impact the heat transfer within gas-solid systems. Current state-of-the-art models for indirect conduction assume that particles are surrounded by a static “fluid lens” and that one-dimensional conduction occurs through the fluid lens when the lens overlaps another body. However, attempts to evaluate the effect of surface roughness and fluid lens thickness (theoretical inputs) on indirect conduction have been restricted to static, single-particle cases. By contrast, here we quantify these effects for dynamic, multi-particle systems. This analysis is compared to outputs from computational fluid dynamics and discrete element method (CFD-DEM) simulations of heat transfer in a packed bed and flow down a heated ramp. Analytical predictions for model sensitivity are found to be in agreement with simulation results and differ greatly from the static, single-particle analysis. Namely, indirect conduction in static systems is found to be most sensitive to surface roughness, while dynamic systems are sensitive to the fluid lens thickness.

Aaron Lattanzi
University of Colorado

Date submitted: 28 Jul 2016

Electronic form version 1.4