84a Modeling of Heat Transfer in Granular Flow in Rotating Vessels

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Heat transfer in particulate materials affects a wide variety of applications ranging from multi-phase reactors to kilns and calciners. In catalyst manufacturing, heat transfer through granular media (catalyst) occurs in the impregnation and calcinations stages. We resort to the discrete element model (DEM), to simulate flow, mixing,and heat transport in granular flow systems in rotary calciners and impregnators. DEM explicitly considers inter-particle and particle-boundary interactions, providing an effective tool to solve the transient heat transfer equations that arise during the time of contact heat transport. Granular flow and heat transport properties are taken into account in order to generate accurate simulations and develop a fundamental understanding of the effect of granular properties and system geometry on impregnation and calcination performance. Our model also incorporates granular cohesion, static and dynamic friction. Simulations show that rotation speed increases both the heat transfer and temperature uniformity of the granular bed for both calciner and impregnator. As expected, materials with high conductivity and low heat capacity warm up faster. Depending on baffle size, baffles can either increase or decrease heat transfer in the double cone impregnators. The granular bed with lower fill fraction heats up faster. Granular cohesion does not affect heat transfer in the ranges of values examined.