Simulation of a Dynamic Scraped Surface Heat Exchanger for Non-Newtonian Fluids

S. Birla[1]

[1]ConAgra Foods, Omaha, NE, USA

Abstract

Scraped surface heat exchangers (SSHEs) are commonly used in the food, chemical, and pharmaceutical industries for heat transfer, crystallization, and other continuous processes. One of the factor posing difficulties to heat transfer is viscosity. Highly viscous fluids tend to generate deep laminar flow, a condition with very poor heat transfer rates and high pressure losses involving a considerable pumping power, often exceeding the exchanger design limits. This problem becomes worsened frequently when processing non-newtonian fluids. The dynamic scraped surface heat exchangers (DSSHE) have been designed to face the above-mentioned problems. They increase heat transfer by: removing the fouling layers, increasing turbulence in case of high viscosity flow, and avoiding the generation of ice and other process by-products. The DSSHE incorporate an internal mechanism which periodically removes the product from the heat transfer wall. The product side is scraped by blades attached to a moving shaft or frame. The blades are made of a rigid plastic material to prevent damage to the scraped surface.
In this study a 3D model was developed using the nonisothermal rotating machinery physics interface from the Mixer Module of the COMSOL Multiphysics® software. This model was validated with experimental heat and momentum profile of peanut butter and starch solutions.