World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:15, No:07, 2021

Experimental and Numerical Determination of the Freeze Point Depression of a Multi-Phase Flow in a Scraped Surface Heat Exchanger

Authors : Carlos A. Acosta, Amar Bhalla, Ruyan Guo

Abstract : Scraped surface heat exchangers (SSHE) use a rotor shaft assembly with scraping blades to homogenize viscous fluids during the heat transfer process. Obtaining in-situ measurements is difficult because the rotor and scraping blades spin continuously inside the mixing chamber, obstructing the instrumentation pathway. Computational fluid dynamics simulations provide useful insight into the flow behavior around the scraper blades for a variety of fluids and blade geometries. However, numerical solutions often focus on the fluid dynamics and heat transfer phenomena of rotating flow, ignoring the glass-transition temperature and freezing point depression. This research studies the multi-phase fluid dynamics and freezing point depression inside the SSHE with non-isothermal conditions in a time dependent process using an aqueous solution that contains 13.5 wt.% high fructose corn syrup and CO_2. The computational results were validated with in-situ pressure, temperature, and optical spectroscopy measurements. Results from the numerical model show good quantitatively agreement with experimental values.

Keywords : computational fluid dynamics, freezing point depression, phase-transition temperature, multi-phase flow
Conference Title : ICMFHTTP 2021 : International Conference on Multiphase Flow, Heat Transfer and Transfer Phenomenon
Conference Location : Berlin, Germany
Conference Dates : July 22-23, 2021