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Fluid Dynamics and Transport Phenomena

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Abstract

The aim of this study is to use a new configuration of porous media in a heat exchanger in continuous hydrothermal flow synthesis (CHFS) system to enhance the heat transfer and minimize the required length of the heat exchanger. For this purpose, numerous numerical simulations are performed to investigate performance of the system with porous media. First, the numerical simulation for the heat exchanger in CHFS system is validated by experimental data. Then, porous media is added to the system and six different thicknesses for the porous media are examined to obtain the optimum thickness, based on the minimum required length of the heat exchanger. Finally, by changing the flow rate and inlet temperature of the product as well as the cooling water flow rate, the minimum required length of the heat exchanger with porous media for various inlet conditions is assessed. The investigations indicate that using porous media with the proper thickness in the heat exchanger increases the cooling rate of the product by almost 40% and reduces the required length of the heat exchanger by approximately 35%. The results also illustrate that the most proper thickness of the porous media is approximately equal to 90% of the product tube's thickness. Results of this study lead to design a porous heat exchanger in CHFS system for various inlet conditions.

Keywords: Continuous hydrothermal flow synthesis, Heat exchanger, Heat transfer enhancement, Porous media, Numerical simulation,

1. Introduction