The College of Graduate Studies and the College of Engineering Cordially Invite You to a

Master Thesis Defense

Entitled

THERMO HYDRAULIC PERFORMANCE OF POLYMER DOUBLE-PIPE HEAT EXCHANGER FOR SINGLE PHASE HEATING/COOLING APPLICATION

by

Ahmed Mohamed Gafar

Faculty Advisor

Dr. Bobby Mathew, Department of Mechanical Engineering,
College of Engineering

Date & Venue

8:00 PM

Wednesday, 19 April 2021

https://teams.microsoft.com/l/meetup-join/19%3ameeting_YTZiMzQ3ZTItMjVkNi00OTI2LWE4N2MtM2IwNzRhMzAxNzIz%40thread.v2/0?context=%7b%22Tid%22%3a%2297a92b04-4c87-4341-9b08-d8051ef8dce2%22%2c%22Oid%22%3a%22ad62b117-c86e-47b8-b094-10e55a7a2027%22%7d

Abstract

This thesis details the model-based study carried out for understanding the thermal and hydraulic performance of double pipe heat exchangers with and without pin-fins; both counter and parallel flow configurations are considered in the study. The pin-fins are located on the outer wall of the inner pipe thereby extending into the annulus and in this study the hot fluid is assumed to pass through the annulus. The model consists of multiple governing equations such continuity equations, Navier-Stokes equations, and energy equations. Fluent module of Ansys Workbench is used for conducting the model-based study. Double pipe heat exchanger constructed using ABS and AlSi10Mg are considered in this study and water is used as the hot and cold fluid in this study. Studies are done for hot fluid Reynold number varying between 50 and 1750. Studies reveal that the effectiveness of both ABS and AlSi10Mg double pipe heat exchangers, with and without pin-fins, decreases with increase in hot fluid Reynolds number. Additionally, the studies reveal that the effectiveness of AlSi10Mg double pipe counter/parallel heat exchanger with pin-fins is almost same as AlSi10Mg double pipe heat exchangers without pin-fins at low hot fluid Reynolds numbers. On the other hand, at high hot fluid Reynolds numbers the effectiveness of AlSi10Mg double pipe heat exchanger with pin-fins is higher than the effectiveness of double pipe heat exchanger without pin-fins. The effectiveness of ABS double pipe heat exchanger with pin-fins, at low hot fluid Reynolds numbers, is slightly smaller than the effectiveness of ABS double pipe heat exchanger without pin-fins. Regarding the effectiveness of ABS double pipe heat exchanger, with pin-fins, at high hot fluid Reynolds numbers, it is same as the effectiveness of ABS double pipe heat exchanger without pin-fins. The effectiveness of ABS double pipe heat exchanger with pin-fins, at low hot fluid Reynolds number is slightly smaller than the effectiveness of ABS double pipe heat exchanger without pin-fins. Geometric parameters of pin-fin such as its height, length, and subtended angle do not have any effect on the thermal performance of the ABS double pipe heat exchanger. Effectiveness of AlSi10Mg double pipe heat exchangers with pin-fins is almost similar to the that of AlSi10Mg double pipe heat exchangers without pin-fins at low hot fluid Reynolds numbers. On the other hand, the effectiveness of AlSi10Mg double pipe heat exchangers with pin-fins is higher than the effectiveness of AlSi10Mg double pipe heat exchangers without pin-fins at high hot fluid Reynolds numbers. The enhancement in effectiveness of AlSi10Mg double pipe heat exchangers achieved by incorporating pin-fins is dependent on the height of the pin-fins while being independent of the length and subtended angle of the pin-fins. The pressure drop associated with the hot and cold fluids increase with increase in hot fluid Reynolds numbers for all double pipe heat exchangers with and without pin-fins. The pressure drop of the hot fluid in ABS and AlSi10Mg double pipe heat exchangers with pin-fins is greater than the hot fluid pressure drop in the corresponding double pipe heat exchanger without pin-fins. The pressure drop of hot fluid in all double pipe heat exchangers, with pin-fins, is dependent on geometric parameters such as height, length, and subtended angle of the pin-fins.

Keywords: Double Pipe Heat Exchanger, Effectiveness, Heat Capacity Ratio, Heat Transfer Enhancement, Pin-Fins, Pressure Drop, Reynolds Number.