Mechanical Engineering Thesis Defense

3D-Printed Heat Exchangers: An Experimental Study

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abstract

As additive manufacturing grows as a cost-effective method of manufacturing, lighter, stronger and more efficient designs emerge. Heat exchangers are one of the most critical thermal devices in the thermal industry. Additive manufacturing brings us a design freedom no other manufacturing technology offers. Advancements in 3D printing lets us reimagine and optimize the performance of the heat exchangers with an incredible design flexibility previously unexplored due to manufacturing constraints. In this research, we explore additive manufacturing technology and the heat exchanger design to find a unique solution to improve the efficiency of heat exchangers. This includes creating a Triply Periodic Minimal Surface (TPMS) geometry, Schwarz-D in this case, using Mathematica with a flexibility of control the cell size of the models generated. This model is then encased in a closed cubical surface with manifolds for fluid inlets and outlets before 3D printed using the polymer nylon for thermal evaluation. In the extent of this study, the heat exchanger developed is experimentally evaluated. The data obtained are used to derive a relationship between the heat transfer effectiveness and the Number of Transfer Units (NTU). The pressure loss across a fluid channel of the Schwarz D geometry is also studied.The data presented in this study is part of initial experimental evaluation of 3D printed TPMS heat exchangers. When compared with heat exchangers with similar performance, the Schwarz D geometry is 35% smaller compared to a shell and tube heat exchanger.

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