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Entitled

HEAT TRANSFER PERFORMANCE OF SINGLE-PHASE CIRCULAR HEAT SINK WITH MICRO PIN-FIN STRUCTURES

by

Mouza Abdulla Mohammed Al Shamsi

Faculty Advisor

Dr. Bobby Mathew, Department of Mechanical & Aerospace Engineering

College of Engineering

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Abstract

This thesis presents a numerical study of laminar forced convection in a novel design of a microscale single phase water cooed circular heat sink with pin fins developed and analyzed to serve as a miniaturized cooling system. The developed heat sink in this study aims to achieve efficient heat dissipation from high electronics integration that generates high heat flux and non-uniform temperature distribution, which leads to the reduction of life and reliability of electronic devices.

Numerical analysis of ten different configurations of the circular heat sink has been carried out for the heat flux of 1000 kW/m^2 at range of Reynolds number from of 100 to 350 using Fluent module of Ansys Workbench 2021 R2. The mathematical model of the heat sink satisfies the Navier–Stokes, continuity, energy and the heat equations that will be numerically solved using a finite volume method approach applying boundary conditions. The influence of geometric parameters on the heat sink hydraulic, thermal performance and coolant flow characteristics considered in this study. It focuses on evaluating the overall thermal performance in terms of thermal resistance and pumping power for circular heat sinks with pin-fin structures when subjected to different parameters modifications such as diameter of the pin-fins, the pitch angle between the pins in radial direction, number of arrays and the fluid cavity on the overall performance is examined in this work for laminar flow regime.

The simulation results analyzed considering both the pressure drop presented in the pumping power along with the thermal resistance in evaluating the overall performance of the circular pin-fin heat sink. The convective and caloric thermal resistance contribution in the overall thermal resistance illustrated as well. The observation from the results is all the parameters reduced the thermal resistance compared to the un-finned circular heat sink and raising the pumping power except the cavity height. As heat sink with fluid cavity H = 0.2 mm and 0.15 mm reduced the reduction in pumping power by 74-81% and 53-59% respectively. Therefore, both designs have less pressure drop as compared to heat sink with H = 0.1 mm. Nevertheless, overall thermal resistance increased by 8-37% and 3-12%