Mechanical Engineering Thesis Defense

3D Conjugate Heat Transfer for Single Phase Immersion Cooling of CPU

School for Engineering of Matter, Transport and Energy

Kathan Malaybhai Gajjar
Advisor: Huei Ping Huang

Abstract

This research aims to develop a single-phase immersion cooling system for CPU processors. To achieve this, a heat pipe with a dielectric liquid is designed to be used to cool the CPU, relying only on natural convection. A Tesla valve phenomenon is used to achieve the one-directional, recirculating system. A comparative study was conducted between two different single-phase dielectric fluids Mineral Oil and FC 3283, utilizing natural convection and Boussinesq correlations. ANSYS Fluent was used to conduct CFD analysis, demonstrating natural convection and recirculating flow in the heating direction. A comparison was made between the traditional cooling method of air and the developed immersion cooling system, with the results indicating that the system is capable of reducing the operating temperature of the CPU by 40-50 degrees Celsius, depending on the power consumption. The results of the experiment conducted showed that a processor cooled by Mineral oil would operate at 56 degrees Celsius, while a processor cooled by FC 3283 would operate at 47 degrees Celsius. By comparison, a processor cooled by the traditional air-cooled system would operate between 80 and 100 degrees Celsius. These results demonstrate that the Mineral oil and FC 3283 cooling systems are significantly more efficient than the traditional air-cooled system. This could prove to be a valuable asset in the development of more efficient cooling systems. Further research is necessary to evaluate the longevity, cost-effectiveness, and benefits of these systems in comparison to traditional air cooling.

April 7, 2023; 3 PM; DH L1-06;
Zoom Link: https://asu.zoom.us/j/4949754655