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Performance Analysis of Cylindrical Heat Pipe using Nanofluids – An Experimental Study

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Abstract

The present work analyzes the thermal performance of a cylindrical copper mesh wick heat pipe using water based CuO nanofluids. The studies are extended further by varying the heat pipe inclination angle and heat input. Thermophysical properties of CuO/DI water nanofluids are also effectively analyzed. The reduction in thermal resistance ratio is about 23.83% and 10.43% respectively for 1.0 and 1.5 wt.% of CuO nanofluid compared with low concentration. Evaporation and condensation heat transfer coefficient ratios are improved by the use of CuO nanofluid and the maximum enhancement obtained is 30.50% and 23.54% respectively for an optimum tilt angle of 60°. Thermal efficiency of heat pipe tends to increase with the heat load and inclination angle and an improvement of 33.34% is observed for 120 W heat load at 60° inclination angle compared with the horizontal heat pipe. After the experimentation, characterizations of mesh wick structures are carried out. It is found that the deposition of CuO nanoparticles creates a thin coating layer on the wick surfaces in evaporator section. This increases the surface wettability and enhances the thermal performance of heat pipe.

Keywords: heat pipe; nanofluid; screen mesh wick; heat transfer coefficient; thermal resistance ratio.

1. Introduction

Extraction of heat from the confined spaces especially from high heat flux components are the requirement of the day and cooling of the electronic components are the well-known example.

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