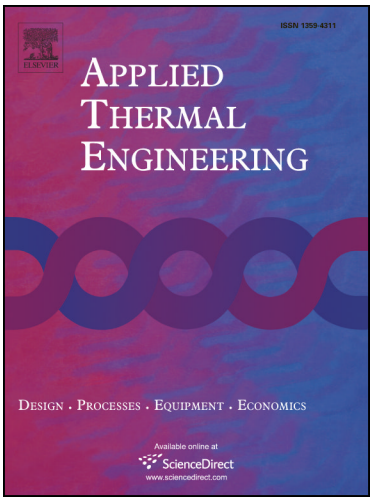

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Effect of non-condensable gas on the behaviours of a controllable loop thermosyphon under active control

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Abstract

Controllable loop thermosyphon (CLT) can be used as a significant temperature management component in solar- and electric-powered cool-storage refrigerators. However, the behaviours of CLT with non-condensable gas (NCG) under active control require further investigation. In this study, air is mixed in working fluid R134a as NCG to evaluate the steady-state and start-stop performances of CLT for selected control modes. CLT with 0% to 0.62% NCG is tested. The larger the amount of NCG is, the lower the heat transfer rate is. When the mass ratio of NCG reaches 0.62%, the steady-state heat transfer rate varies from 245.0 W to the minimum 118.6 W for different heat sink temperatures. This finding means that CLT loses efficacy due to the excess NCG. In addition, the start-up performances of the two modes decrease as the mass ratio of NCG increases to 0.31% and become entirely unacceptable when NCG reaches 0.47%. By contrast, the stopping time of CLT remains less than 100 s in various conditions. Results indicate that the mass ratio of NCG should be less than 0.47%, and CLT with NCG is suggested to be controlled by the valve in the vapour line.

Keywords: *loop thermosyphon, refrigerator, non-condensable gas, start-stop*

1. Introduction

Two-phase heat transfer devices, such as heat pipes, capillary pumped loops, loop heat pipes, and thermosyphons, are reliable, highly effective, compact, and cost-effective and thus widely used in heat transfer. With technological advancement, the application of such devices in several crucial