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EFFECTIVENESS STUDY OF COMBINED SUBCOOLER-CAPILLARY BLOCKER DEVICE IN LHP FOR SPACE APPLICATIONS

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Abstract

Critical condition of reliable and stable operation of a loop heat pipe is complete condensation of working fluid in a condenser with following subcooling of liquid before entering in a compensation chamber. Usually, final part of the condenser operates as a subcooler. The design of the loop heat pipe with separated subcooler which also acts as a vapor/gas bubbles stopper (capillary blocker) is proposed. The subcooler-capillary blocker (SCB) is introduced after the condenser. Its purpose is to capture of the non-condensed vapor bubbles, subcooling of working fluid below the saturation temperature and the elimination of a countercurrent in the loop heat pipe. SCB model was developed and thermal-hydraulic calculations of efficiency of the proposed SCB in comparison with the smooth-wall subcooler (geometric efficiency coefficient) were performed. Influence of the mass flow rate (Reynolds number), diameter of the channel and porosity of a capillary structure on SCB efficiency has been investigated. Emission in a vacuum was used as the boundary condition (modeling of space environment). It was proposed to use aluminum or silver fibers as SCB capillary structure material to facilitate heat exchange (subcooling) and to minimize the pressure drop in SCB. Typical for space application LHPs working fluid: ammonia was selected for analysis.