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A STUDY ON MECHANISM AND EXPERIMENT OF PUMP-ASSISTED CAPILLARY PHASE CHANGE LOOP

Abstract

Aiming at solving problems including unsuccessful start-up, temperature oscillation and limited heat transfer capacity in capillary phase change loop, pump-assisted capillary phase change loop is proposed, which is an active-passive two phase circulation device utilizing both sensitive heat and latent heat of the working fluid to transfer heat. This system mainly utilizes evaporation of the working fluid to transfer heat. A mechanical pump is used for pumping the fluid to increase heat flux and transport distance. At the same time, the vapor phase in the compensation chamber of evaporator is eliminated to enhance operating stability of the system. A steady operating model of pump-assisted capillary phase change loop has been established to investigate its mechanism of heat transfer and flow. Physical mechanism and mathematical model reflecting temperature and pressure fluctuation caused by the vapor-liquid interface oscillation has been constructed to investigate the effect of eliminating vapor phase in the compensation chamber on stability of the system. An experimental prototype has been fabricated to study its operating characteristics including start-up from the cold state, transient state and steady state at different heat loads and to analyze the effects of the flow rate of the liquid, the species of working fluid, the liquid charge ratio and the heat sink temperature on its operating characteristics. Meantime, the experimental results have been used to check and modify the theoretical model.