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A NUMERICAL ANALYSIS AND MEASUREMENT OF RADIATION HEAT FROM A LIQUID DROPLET STREAM UNDER GRAVITATIONAL ENVIRONMENT

Abstract

A high efficiency system for disposing of large quantities of waste heat is needed to realize large structures in space such as solar power satellites, space factories in orbit and bases on the moon. The Liquid Droplet Radiator (LDR) can be the system instead of a conventional radiator with solid plates. In previous studies, the performance tests of a droplet generator, a linear droplet collector, and a gear pump have been conducted under micro-gravity environment. The radiation heat from liquid droplet streams is due to be measured by a part of research of a LDR. It is needed to conduct an experiment to measure the radiation heat from liquid droplet streams under micro-gravity environment to know properties of a LDR. As a first step for the experiment under micro-gravity environment, an experiment for measuring the radiation heat from a liquid droplet stream was conducted under gravitational environment. In order to take the influence of absorption or dispersion into consideration, a numerical analysis of inside an experimental device was also performed. The appropriateness of a result of the experiment ware evaluated by comparing a experimental value with results of numerical analysis. Working fluids are squirt as liquid droplets into a vacuum inside a shroud that is cooled by liquid nitrogen under 79 K. The radiation heat from a liquid droplet stream is measured by using a radiation sensor (Captec RF-100) pasted on inside wall of the shroud. The shroud is 700 mm high and 100 mm in diameter. Silicon oil (Shin-Etsu Chemical Co., Ltd. KF-96 10 cSt) is used as the working fluid. The experimental value are between 0.617 and 0.739 W/m$\hat{2}$ when the center-to-center distance and diameter of liquid droplets are changed. The more the center-to-center distance and diameter is decreased, the more experimental results are increase. A trend of the results of numerical analysis fitted in the trend of experimental values. A biggest difference is less than 7% between experimental values and the results of numerical analysis when the radiation factor is 0.70 in the numerical analysis. It can be said that the radiation heat from a liquid droplet stream is measured correctly. Additionally the radiation factor of a liquid droplet can be estimated by using a method of this research.