Development of the Heat Pipe Performance Simulation Program – HPPS by Capillary Wick Theory

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ABSTRACT

The heat pipe performance not only depends on the geometry parameters such as pipe wall thickness, pipe material but also depends on the working fluid thermo properties such as viscosity, latent heat and vacuum pressure etc. This article is based on the capillary wick theory to develop a friendly user software for the simulation of the heat pipe performance (HPPS), the program include various setting of the heat pipe material geometry parameters, different working fluids, the vacuum pressure, filling ratio, operating temperature etc. An experimental maximum heat transfer measurements in vertical heat pipe at different vacuum pressure and filling ratio was taken. The experimental result is also compared with the simulation, the impact of those parameters on the heat pipe performance is also discussed.

The experiment results shown for water working fluid, the maximum heat transfer is 150W while the optimal filling ratio is 25% . If the working fluid is methanol, the maximum heat transfer is 130W while ithe optimal filling ratio is 20%. the prediction error is within10%. Theoretically, in high vacuum pressure ($P_{vac}<10^{-2}$ torr), when the NCG pressure increase ten times torr, the maximum heat transfer rate will decreased 20W. In low vacuum pressure ($P_{vac}>10^{-2}$ torr), when the NCG pressure increase ten times torr, the maximum heat transfer rate will decreased more than 30W.The error between experimaental result and theoretical value are within 20%. The HPPS software designed is hopefully to provide the industry's a very friendly program to predict maximum heat transfer of the heat pipe.

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