

Thesis Title	A Study of Size and Aspect Ratio Effects on Heat Transfer Characteristics of an Inclined Low-Temperature Thermosyphon		
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Abstract

Effects of size and aspect ratio (ratio of evaporator length to diameter) on thermal characteristics of an inclined low-temperature closed two-phase thermosyphon at normal operating state were investigated in this research. The thermal characteristics of the thermosyphon includes heat transfer and overall thermal resistance.

The thermosyphons used in the experiment were made of copper tubes with 3 sizes of diameters of 7.5, 11.1 and 25.4 mm. Each size had 5 aspect ratios of 5, 10, 20, 30 and 40. The variations of inclination angles were 0, 5, 10, 20, 30, 40, 50, 60, 70, 80, and 90 degree against horizontal axis. Water, ethanol and R134a were used as working fluids. The selected filling ratio were 80%, 50% and 30% of the evaporator section. Hot water was used to heat up the evaporator, and the low temperature solution (water with ethylene glycol) was used to transfer heat transfer from the condenser section. In the experiment, 5 points of the temperature on the surface wall of the thermosyphon were recorded. These were 2 points on the evaporator, 1 point on the adiabatic and 2 points on the condenser section. The mass flow

rate, the inlet temperature and the outlet temperature of the solution were recorded, and used to calculate the heat transfer rate and the overall thermal resistance were calculated.

It was found from the results that, the ratio of peak heat transfer rate at any angle to heat of the right angle (Q/Q_{90}) of the thermosyphon with water, ethanol and R134a as working fluids were 1.17, 1.24 and 1.36 at the angle of 70° , 50° and 60° respectively. The filling ratio did not affect the thermal characteristics of the thermosyphon. However, the property of fluids affected on the thermal characteristics of the thermosyphon. That is, the working fluid with high latent heat of vapourization gave the low Q/Q_{90} . On the other hand, the working fluid with low latent heat gave high Q/Q_{90} . The aspect ratio affected the heat transfer characteristics of the thermosyphon such that the aspect ratio of 10 was an important figure to change the Q/Q_{90} . At the aspect ratio of 10 or higher, Q/Q_{90} will be constant at about 1.38, but at the aspect ratio less than 10, will be inversed proportion to the aspect ratio. This might be because, the inside phenomena changed. However the aspect ratio had no effect on the angle at which the maximum heat transfer rate occurred. The Bond number, which included the effect of the thermosyphon size, affected on the thermal characteristics of the thermosyphon as a function:

$$\frac{\text{Maximum heat transfer rate at inclined position}}{\text{Maximum heat transfer rate at vertical}} = 1.16 \text{ Bo}^{0.047} \quad 2.7 < \text{Bo} < 28$$

However, the Bond number had no effect on the angle at which the maximum heat transfer rate occurred.