The working fluid with slug flow pattern can be observed when the evaporator section length is short i.e. for ex 50mm as in study. Vapour plug in slug flow form in a core of tube surrounding with liquid film. Since the liquid films contacts around the tube wall in the evaporator section, heat input can be transferred to the liquid film directly and evaporation rate consequently increases. This causes the thermal performance to increase.

On contrary working fluid flow pattern in closed loop pulsating heat pipe with longer evaporator section length will change into churn flow in which the vapour shape is not stable liquid working fluid can be entrained as droplet into vapour core. Heat input cannot conduct through vapour core to liquid droplet easily. The thermal performance according to the flow pattern will be low.

In addition it was found that an increase in internal diameter not only causes heat transfer area between the heat pipe and working fluid to increase but also causes the crossectional area of the working fluid flow inside close loop pulsating heat pipe increases. When closed loop pulsating heat pipe has larger internal diameter or wider crossectional are of the flow passage vapour plug evaporating in evaporator section consequently flow towards condenser section more continuously with higher working fluid quantity. The pressure loss of working flow decreases. From this physical reason closed loop pulsating heat pipe can transfer more heat and thermal performance increases. it can be seen from experimental results that geometrics of heat pipe strongly influence on thermal performance of closed loop pulsating heat pipe. The closed loop pulsating heat pipe with low aspect ratio has higher thermal performance.

Approximation to Predict the Thermal Performance

The method of dimensional analysis is used to get the approximate solution for the given problem as all the dimensionless number discussed above can be correlated so as to get more precise thermal performance for closed loop pulsating heat pipe.

$$K_u \, is\ function\ of\ (Pr, Bo, Ja, Ka, Li/Di)$$

$$\mathrm{K_u = f(Pr, Bo, Ja, Ka, Li/Di)}$$

2. Conclusion

Effects of dimensionless numbers on thermal performance of the closed-loop pulsating heat pipe have been thoroughly investigated. Thermal performance was represented in a term of Kutateladze number (Ku), which is a dimensionless number involving in the heat transfer in heat pipes. It can be concluded that when Prandtl number of liquid working fluid (Prl), and Karman number (Ka) increases, thermal performance increases. On contrary, when Bond number (Bo), Jacob number (Ja), and Aspect ratio (Le/Di) increases, thermal performance decreases.

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