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Experimental investigation of a stainless steel two-phase closed thermosyphon

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Abstract

An experimental investigation has been carried out to study the heat transfer characteristics of a stainless steel two-phase closed thermosyphon. Three compatible working fluids were tested: water, ethanol and acetone. Since the filling ratio is expected to have a predominant effect on the steady-state thermal performance of a thermosyphon, three cases were considered: the underfilled, overfilled and optimally-filled sets. The effects of the input heat flux at the evaporator and the cooling fluid temperature at the condenser were also investigated. The steady state wall temperature was then monitored at various locations along the thermosyphon. The obtained results showed that the dry-out occurrence at the evaporator bottom resulted in an obvious temperature rise, especially for the underfilled case. The experimental heat transfer coefficient at the evaporator was estimated and compared with pool boiling correlation data. A good agreement between the experimental results and the prediction values was obtained for ethanol. A reasonable agreement was found for water and acetone.

Keywords: Thermosyphon; Filling ratio; Working fluid; Thermal characteristics

Nomenclature

C_{pl}	specific heat (J/kg°C)
cond	condenser
d_i	innner diameter (m)
evap	evaporator
f	cooling fluid
FOM	figure of merit
FR	filling ratio (%)
g	gravitational accelation (m/s^2)
h	heat transfer coefficient (W/m^2 °C)
h_{fg}	latent heat of vaporization (kJ/kg)
k_l	thermal conductivity of liquid (W/m °C)
L	length (m)