Abstract

Temperature measurements are performed to clarify the effects of sub-millimeter bubble injection on the thermal boundary layer thickness in water flowing in upward direction along a cylindrical shape 0.7m length and 0.065m diameter test section. The test section is subjected to constant heat flux of (24,000w/m2).

In particular the research focuses on the relationship between the bubble injection rate and their effect on decreasing thermal boundary layer thickness. This effect led to enhance the heat transfer rate and decrease test section wall temperature. Three pairs of bubble injection electrodes are used in the experiments fixed at equally spaced distances of 0.2m between each pair of them. The experiments based on Reynolds number of (6780) which simulates low water velocity for better distinguishing the enhancements governed the experimental results. Water temperature at seven radial positions from test section center to the wall are measured along the test section in addition to the measurement of water bulk and wall temperatures at these points. K-type 100 lm thermocouples with ±0.12oC accuracy are used for temperature
measurements. The results showed thermal boundary layer thickness is inversely proportional to the hydrogen injection rate and that local heat transfer coefficient is proportional to the later with different proportionality rates. The results showed maximum percentage decrease of thermal boundary layer of (40%) and maximum percentage increase in heat transfer rate of (15.7%). Accordingly the boiling safety factor based on maximum wall temperature showed maximum increase of (9%). These results covered the adopted values of heat flux, Reynolds number and hydrogen bubble injection rate.

References

Keywords

Thermal boundary layer, Hydrogen bubbles, heat transfer coefficient, boiling safety factor