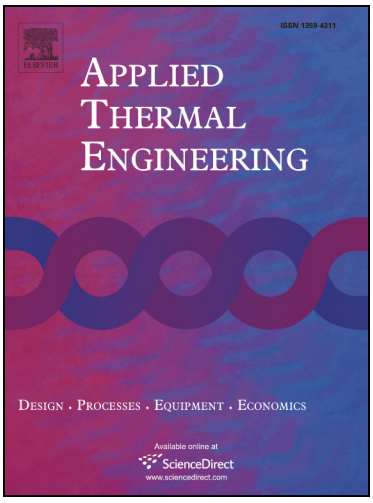

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Experimental Test and Empirical Correlation Development for Heat Transfer Enhancement under Ultrasonic Vibration

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Abstract:

In order to examine and predict the enhancement of heat transfer performance under ultrasonic vibration, experimental tests were carried out and empirical correlations have been developed in this study. A stainless-steel circular heater rod was first tested for heat transfer performance with and without ultrasonic vibration in a thermostat water tank. The loaded heat flux was about $7.6x10^3$–$7.1x10^4$ W/m^2, which covered the heat transfer regimes from natural convection to subcooled boiling. The size of water tank was 165x310x100 mm, and the liquid subcooling was controlled as 50–70 K during the tests. The ultrasonic vibration was generated by three transducers attached to the tank bottom with a total power of 150 W and an ultrasonic frequency of 40 kHz. Effects of height, heat flux and liquid subcooling were investigated and analyzed. In the present test ranges, the maximum heat transfer increment can be up to 1557 W/m^{2}K, and the maximum h-increment ratio can be about 3.01 (301 %). Furthermore, the present data were used to develop empirical correlations for heat transfer enhancement, and the present correlations can predict the experimental database with an averaged error of 14.1 %. The present study can provide the experimental evidences and a prediction method for heat transfer enhancement under ultrasonic vibration.

Keywords： Heat transfer enhancement, ultrasonic vibration, subcooled boiling, natural convection