ABSTRACT

The objective of the work performed in the present investigation is to study the enhancement of the heat transfer coefficient in the refrigeration and air conditioning equipment. The target is the energy saving during pool boiling in these systems. Therefore, the experimental measurements were preformed for nucleate pool boiling over the heating surface under investigation treated by non-conventional techniques. Fifteen test specimens were designed and manufactured for this purpose. Four specimens having mirror surface are made from copper, aluminum, brass and steel respectively. The reminder eleven ones are made from brass that having cavities of different aspect ratios (l/d) ranged from 0.4 to 2.3 created by laser machining. These surfaces have different cavities density (a/A) ranged from 0.108×10^{-3} to 0.432×10^{-3} with different aspect ratios. R134-a as a working refrigerant is chosen here for boiling under saturation conditions at different pressures (P^*= 0.1 to 0.41). The experimental measurements were performed for different heat fluxes (q) up to 100 kW/m^2.

Generally it was found that the average heat transfer coefficient increases with the increase of heat flux. The results indicated that, the average heat transfer coefficient depends on the interaction between the heating surface and boiling fluid. The heat transfer coefficient increases as the cavities density on heating surface increases. There is a so-called optimum aspect ratio for the cavities beyond which heat transfer coefficient decreases. The measurements showed that the average heat transfer coefficient is independent on the normalized pressure (P^*).

An empirical correlation is deduced based on the experimental measurements performed here to correlate the average heat transfer coefficient as a function of the material of the boiling surface, cavities density, heat flux, pressure and cavity aspect ratio. The deduced correlation fits the experimental measurements with $\pm$ 14 deviations. The variation of the enhancement factor in heat transfer coefficient with these parameters is also indicated. The experimental results obtained using mirror specimens compare favorably with the results corresponding published obtained using mirror surface.

Both enhancement of the average heat transfer coefficient and saving of energy due to the use of surfaces treated by non-conventional techniques are shown.