Chapter 5

R134a Flow Boiling Heat Transfer in Small Diameter Tubes

Xiaorong Huo[1], **Yong Sheng Tian**[2] and **Tassos G. Karayiannis**[3]

[1] Cambridge Refrigeration Technology, Cambridge UK
[2] Aspen Tech Inc., Berkshire UK
[3] School of Engineering and Design, Brunel University, West London, Middlesex UK

Boiling heat transfer in small diameter tubes has been experimentally investigated using R134a as the working fluid. The heat transfer experiments were conducted with two stainless steel tubes of internal diameter 4.26 mm and 2.01 mm respectively. Other parameters were varied in the range: mass flux 100 – 500 kg/m^{2}s; pressure 8 – 14 bar; quality up to 0.9; heat flux 13 - 150 kW/m^2. The heat transfer coefficient was found to be independent of vapour quality when the quality was less than about 40% to 50% for the 4.26 mm tube and 20% to 30 % for the 2.01 mm tube. Above these quality values, the heat transfer coefficient decreases with vapour quality. Furthermore, at high heat flux values this decrease occurs for the entire quality range. The heat transfer rates were compared with existing correlations.

INTRODUCTION

Flow boiling heat transfer has been studied extensively in the past. More recently and in view of the benefits of process intensification, researches turned their attention to the study of small to micro passages. This was encouraged by an increasing use of compact heat exchangers in a great number of applications including refrigeration and heating/cooling systems.

The effects of geometry and size on two-phase flow and heat transfer were examined by Kew and Cornwell (1997). Small tubes with diameters of 1.39 – 3.69 mm were tested using R141b. Their results showed that in 3.69 and 2.87 mm tubes, the boiling heat transfer coeffi-