Seminar

Institute for Plasma Research

Title : Condensation heat transfer and frictional pressure drop in a horizontal circular mini-channel

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Time : 3.30 PM

Venue : Online - Join the talk: https://meet.ipr.res.in/Dr.TejendraPatel_PDFtalk

Abstract :

The introduction of mini-channels in the field of the heat transfer is one of attempts to dissipate heat from limited space, where high heat flux is generated. Mini-channels are increasingly utilized with Compact Heat Exchangers (CHE) to acquire high rates of heat transfer. Mini-channels find applications in the domain of vehicle air-conditioning, residential air-conditioning, cooling of electronic devices and heat pipes. To design a mini-channel condenser, it is essential the precise prediction of the Heat Transfer Coefficient (HTC) and the Frictional Pressure Drop (FPD) associated with condensation, which attracts vast attention and interest of researchers. The considerable interest in the use of mini-channels arises due to its compact construction as well as reduction in the amount of refrigerant to be charged. The reduction of refrigerant charge benefits towards diminishing serious concern of the global warming. As reported in a literature Hydro fluorocarbon (HFC) refrigerants have high Global Warming Potential (GWP), and will be phased out in a coming future. The new Hydrofluoroolefin (HFO) refrigerants having minimum GWP have been found suitable replacement to HFC refrigerants.

Hence in present work relative assessment of HTC and FPD models as well as numerical and experimental investigation of HTC and FPD in mini-channels has been carried out using HFO refrigerants. Relative assessment of the condensation flow regime maps, void fraction models, HTC models and FPD models has been carried out to obtain best fitting model using previously published experimental results. The present numerical simulation has been performed using the Volume of Fluid (VOF) method; in ANSYS 15 commercial software using geometrical data and operating conditions of published literature. The experimental investigation has been carried out to study the condensation of a new low GWP R-1234yf refrigerant and R-134a refrigerant in a horizontal circular mini-channel of hydraulic diameter made of copper material. The effect of various operating parameters viz. mass flux, vapour quality and saturation temperature on HTC and FPD has been studied for both refrigerants R1234yf and R134a and results are compared. The experimental and numerical results of present study are also compared with results of various predictive models. Models which show minimum deviation from experimental and numerical results were used to develop new modified model with minimum Mean Relative Deviation (MRD) and Mean Absolute Relative Deviation (MARD).