State-of-the-art on Flow and Heat Transfer Characteristics of Supercritical CO_2 in Various Channels

N. Thiwaan Rao , A.N. Oumer' , U.K. Jamaludin
Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

ABSTRACT
Supercritical carbon dioxide ($scCO_2$) is being used in many engineering applications due to the fact that, at supercritical stage, it has unique thermal properties with enhanced heat transfer and flow characteristics. The main purpose of this article is to provide an overview of the published studies that are relevant to the flow behavior and heat transfer characteristics of $scCO_2$. The review of available works display that the heat transfer and pressure drop characteristics of heat exchangers using $scCO_2$ as working fluid rely on many parameters such as tube shape and size, mass flux, inlet temperature and pressure, type of process (heating or cooling) etc. Moreover, application of $scCO_2$ in cooling and heating processes and the available empirical correlations for heat transfer are also discussed. Overall it is observed that as the inlet pressure increases, the density and viscosity increases. Thus, when the temperature is higher than the critical temperature the pressure drop decreases with increasing inlet pressure. On the other hand, in heating, the heat transfer rate ($\dot{Q}$) of $scCO_2$ decreases as the inlet temperature increases above the critical temperature for all supercritical pressures. In cooling, $\dot{Q}$ of $scCO_2$ reaches peak value at near critical pressure and decreases as the inlet pressure increases. This review paper can provide information for further investigations on $scCO_2$.

KEYWORDS: Supercritical carbon dioxide; Heat exchanger; Heat transfer; Pressure drop

DOI: 10.1016/j.supflu.2016.05.028