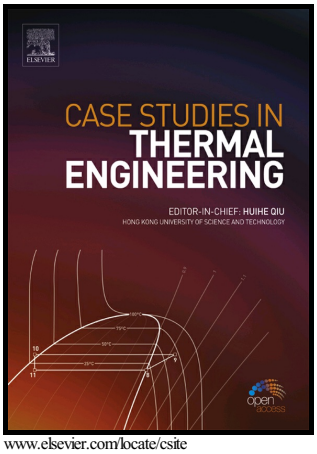

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M.A. Ahmed, M.M. Yaseen, M.Z. Yusoff

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Numerical Study of Convective Heat Transfer from Tube Bank in Cross Flow Using Nanofluid

M. A. Ahmed [a *], M. M. Yaseen [a], M. Z. Yusoff [b *]

[a] *Department of Mechanical Engineering, College of Engineering, University of Anbar Ramadi, Anbar, Iraq*

[b] *Department of Mechanical Engineering, College of Engineering, Universiti Tenaga Nasional (UNITEN) Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia*

Abstract

In this paper, laminar convective heat transfer of Al_2O_3 -water nanofluid flow over tube banks under constant wall temperature conditions has been numerically investigated. The circular-tube banks with staggered arrangement are considered in this study. The governing equations have been solved using finite volume approach based on SIMPLE technique in body-fitted coordinates. The numerical simulations have been conducted for Reynolds number ranging from 100 to 600 with nanoparticles volume fraction ranging from 0 to 0.05. The effect of longitudinal pitch, transverse pitch and nanoparticle concentration on the streamwise and temperature contours, average Nusselt number, friction factor and thermal-hydraulic performance factor have been investigated and discussed. Results showed that the best performance is obtained at longitudinal pitch ratio of 1.5, transverse pitch ratio of 2.5 and nanoparticles volume fraction of 5% over the ranges of Reynolds number.

Keywords: Tube bank, Nanofluid, laminar flow, Thermal-hydraulic performance, Finite volume method,

1. Introduction

The forced convection flow over tube banks are widely employed in many industrially important processes of most engineering applications. Tube bundles are used to design more compact heat exchanger and to give higher thermal performance of such device. Furthermore, improving the thermo-physical properties of heat transfer fluids can enhance the heat transfer rate as well. Therefore, adding nanoparticles to the working fluids such as water lead to significant enhancement in performance of heat exchangers. However, using nanofluids as working fluids to enhance the rate of heat transfer have been experimentally and numerically studied by many researchers [1-4]. Santra et al. [5] conducted a numerical study on the heat transfer enhancement in channel using nanofluid and results showed that the average Nusselt number increases with the concentration of nanoparticles.

*Corresponding authors

Tel: +603 8928 7600 & +9647831054434 Email: zamri@uniten.edu.my & drmohaad@gmail.com