Modeling and Heat Transfer Analysis of Double Pipe Heat Exchanger Using Computational Fluid Dynamics (CFD)

Murali Ponnusamy

Dr.A.P.J.Abdul kalam Centre for Advanced research, Adhi College of Engineering and Technology, Kanchipuram, Tamil Nadu, India
murali.mech@adhi.edu.in

Abstract

Present study demonstrate that a two dimensional analysis of heat transfer distinctive of double pipe heat exchanger (also called pipe-in-pipe exchanger) beneath different parameters such as mass flow rate and direction, tube materials, with fins etc., used to predict the performance. However, heat exchanger is numerically modeled for tempestuous as well as laminar fluid flow condition. Notably, Heat transfer rate, overall heat transfer co-efficient, Reynolds number, Nussle numbers are to be calculated by analytical method aimed at both parallel along with counter flow heat exchanger. On the other hand, Computational Fluid Dynamics (CFD) analysis has been made to visualize the temperature as well as velocity distribution. The computational simulation model of heat exchanger will be developed with FLUENT and validated with experimental results.

Keywords: Heat exchanger, Laminar and turbulent flow, Heat transfer characteristics, CFD, Modelling and analysis.

1. INTRODUCTION

The heat exchanger is an expedient that is used to transfer thermal energy among two or more fluids or a solid surface and a fluid, or solid particulates and fluid, at different temperatures and thermal contact. Heat exchangers raise or lower the temperature of these streams by transferring heat to from the stream. Transfer of heat happens by three principle means: Radiation, Conduction and Convection. In the use of heat exchangers radiation does take place. However, the comparison of conduction and convection to radiation does not play a major role. Conduction occurs as the heat from the higher temperature, fluid passes through the solid wall to maximize the heat transfer, and the wall should be thin and made of a very conductive material. The biggest contribution to heat transfer in a heat exchanger is made through convection. In a heat exchanger forced convection allows for the transfer of heat of one moving stream to another moving stream. It maintains a temperature gradient between the two fluids. Heat exchangers are used in wide variety of applications; it includes power production process, chemical and food industries, electronics, environmental engineering, waste heat recovery and manufacturing industry.

Heat exchanger may be classified according to following main criteria: 1) Recuperates and regenerators 2) Transfer process: Direct contact and Indirect contact 3) Geometry of construction: tubes, plates, extended surfaces 4) Heat transfer mechanism: single phase and two phase 5) Flow arrangements: Parallel, counter and cross flow.

CLASSIFICATION ACCORDING TO TRANSFER PROCESSES

Indirect-Contact Heat Exchangers: In an indirect-contact heat exchanger, the fluid streams remain separate and the heat transfers continuously through an impervious dividing wall or into and out of a wall in a transient manner. Thus ideally there is no direct contact between thermally interacting fluids. **Direct-Contact Heat Exchangers:** In a direct-contact exchanger, two fluid streams come into direct contact, exchange heat, and are then separated. A common application of a direct-contact exchanger involves mass transfer in addition to heat transfer, such as in evaporative cooling and rectification; applications involving only balanced heat transfer are rare. The enthalpy of phase change in such an exchanger generally represents a significant portion of the total energy transfer. The phase change generally enhances the heat transfer rate. Compared to indirect contact recuperators and regenerators, in direct-contact heat exchangers, (1) very high heat transfer rates are achievable, (2) the exchanger construction is relatively inexpensive, and (3) the fouling problem is generally non-existent, due to the absence of a heat transfer surface (wall) between the two fluids. However, the applications are limited to those cases where a direct contact of two fluid streams is permissible. These exchangers may be further classified as follows.

a. Immiscible Fluid Exchanger
b. Gas-liquid exchangers
c. Liquid–Vapor Exchangers