



A review of flow and heat transfer characteristics in curved tubes

Paisarn Naphon, Somchai Wongwises*

*Fluid Mechanics, Thermal Engineering and Multiphase Flow Research Lab. (FUTURE),
Department of Mechanical Engineering, King Mongkut's University of Technology Thonburi,
Bangmod, Bangkok 10140, Thailand*

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Abstract

The performance of heat exchangers can be improved to perform a certain heat-transfer duty by heat transfer enhancement techniques. In general, these techniques can be divided into two groups: active and passive techniques. The active techniques require external forces, e.g. electric field, acoustic or surface vibration, etc. The passive techniques require fluid additives or special surface geometries. Curved tubes have been used as one of the passive heat transfer enhancement techniques and are the most widely used tubes in several heat transfer applications. This article provides a literature review on heat transfer and flow characteristics of single-phase and two-phase flow in curved tubes. Three main categories of curved tubes; helically coiled tubes, spirally coiled tubes, and other coiled tubes, are described. A review of published relevant correlations of single-phase heat transfer coefficients and single-phase, two-phase friction factors are presented.

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* Corresponding author. Tel.: +66 2470 9115; fax: +66 2470 9111.

E-mail address: somchai.won@kmutt.ac.th (S. Wongwises).

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1. Introduction

Heat exchangers are devices that are commonly used to transfer heat between two or more fluids of different temperatures. They are used in a wide variety of applications, e.g. refrigeration and air-conditioning systems, power engineering and other thermal processing plants.

Besides the performance of the heat exchanger being improved, the heat transfer enhancement enables the size of the heat exchanger to be considerably decreased. In general, the enhancement techniques can be divided into two groups: active and passive techniques. The active techniques require external forces, e.g. electric field, acoustic, surface vibration. The passive techniques require special surface geometries or fluid additives. Both techniques have been used for improving heat transfer in heat exchangers. Due to their compact structure and high heat transfer coefficient, curved tubes have been introduced as one of the passive heat transfer enhancement techniques and are widely used in various industrial applications. Helical and spiral coils are well known types of curved tubes which have been used in a wide variety of applications, for example, heat recovery processes, air conditioning and refrigeration systems, chemical reactors, food

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