Chapter 9

Unsteady Mixed Convection from Two Isothermal Semicircular Cylinders in Tandem Arrangement

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Additional information is available at the end of the chapter

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Abstract

In this chapter, two-dimensional mixed convection heat transfer in a laminar cross-flow from two heated isothermal semicircular cylinders in tandem arrangement with their curved surfaces facing the oncoming flow and confined in a channel is studied numerically. The governing equations are solved using the control-volume method on a nonuniform orthogonal Cartesian grid. Using the immersed-boundary method for fixed Reynolds number of $Re_D = u_D D/\upsilon = 200$, Prandtl number of $Pr = 7$, blockage ratio of $BR = D/H = 0.2$ and nondimensional pitch ratio of $\sigma = L/D = 3$, the influence of buoyancy and the confinement effect are studied for Richardson numbers in the range $-1 \leq Ri \leq 1$. Here, u_D is the average longitudinal velocity based on the diameter of the semicylinder. The variation of the mean and instantaneous nondimensional velocity, vorticity and temperature distributions with Richardson number is presented along with the nondimensional oscillation frequencies (Strouhal numbers) and phase-space portraits of flow oscillation from each semicylinder. In addition, local and averaged Nusselt numbers over the surface of the semicylinders are also obtained. The results presented herein demonstrate how the buoyancy and wall confinement affect the wake structure, vortex dynamics and heat transfer characteristics.

Keywords: bluff bodies, tandem arrangement, blockage ratio, interference effects, wall effects

1. Introduction

The flow and heat transfer past bluff bodies of various cross-sectional geometries is important because of advances in heat exchanger technology, cooling of electronic components and chips