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Study of Pressure Drop in Single Pass U-Type Plate Heat Exchanger

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Abstract

The present work deals with the experimental investigation of the flow maldistribution in a single pass U-type chevron plate heat exchanger using water as a working fluid. Results are presented in terms of total pressure drop, mean channel pressure drop, channel pressure drop and channel velocity for Reynolds number, Re = 800 - 5900, chevron angle, β=60°, and fixed port size of d_p =0.0254 m for different set of plates, namely, 21 and 27 under two conditions viz. (i) isothermal and (ii) non-isothermal. The present results are also verified with the analytical results of Bassiouny and Martin [5]. Channel pressure drop is observed to be higher for a higher number of plates set. Results also show that the channel pressure drop decreases along the successive channels of the PHE. Deviation of channel pressure drop from mean channel pressure drop verifies the existence of non-uniformity in the flow distribution from port to channels. Higher temperature promotes greater turbulence in the channels leading to higher frictional losses and hence, higher pressure drops. Based on the experimental data, correlations have been developed for friction factor, non-dimensional channel pressure drop and non-dimensional channel velocity

Keywords: Chevron plate heat exchanger, flow maldistribution, pressure drop, channel velocity, friction factor

1. Introduction

Plate heat exchangers, which were specially designed for hygienic application such as dairy, brewery, pharmaceuticals and food processing industries, have now found their applications in the modern power industries also. Characteristics such as high overall heat transfer coefficients, easy maintenance, compact size, ease of increasing the heat transfer area, compactness, less fouling, smaller hold up volume and hence quicker response to control operations, the capability to recover heat with extremely small temperature difference, etc. have diversified their usage. Pressure drop and thermal performance, of a plate heat exchanger, depends critically on the distribution of fluid, and geometrical properties of the chevron plates,