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ORIGINAL ARTICLE

Comparison of mathematical modeling to determine the fanning friction (*f*) and colburn (*j*) factors for an offset strip compact heat exchanger

K. G. Nithesh[1] · D. C. Savitha[2] · R. Avinash Kumar[3] · S. Deepankumar[4] · Sridhara N. Marathe[1]

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Abstract
The current study involves compiling and validating an extensive mathematical model of a small heat exchanger with offset strip fins. Compact heat exchanger functions as a cooler when the compressor is running. Here, ambient air is used as the coolant for compact heat exchangers. An exchanger with a compact design has its pressure drop and heat transfer coefficient calculated. The mass flow rate, temperature, and pressure of hot and cold fluids are examples of inlet operating parameters. The pressure drop at the heat exchanger outlet, effectiveness, and heat transfer coefficient are the output parameters. Pressure drop is calculated using the Fanning friction factor, often known as the "f" factor, while heat transfer coefficient is calculated using the Colburn "j" factor. We compared our mathematical model with the research observations for the "j" and "f" components, using the dimensions of the London and Kays plate-fin heat exchangers. The London and Kays conclusions are restricted to certain geometry, thus we derived the "j" and "f" factor for a variety of fin shapes using the correlations between Maiti and Sarangi, Joshi and Webb, Manglik, and Bergles. With the data provided, the "j" and "f" factors are computed using our mathematical model, which is a combination of several correlations extracted from the previously listed scholars. The Manglik and Bergles correlations yield values that are comparable to the London and Kays experimental value, with 1.93 and 6.51% variations in the "j" and "f" components, respectively.

Keywords Offset strip fin · Colburn j factor · Fanning friction f factor · Area goodness factor · Volume goodness factor · Heat transfer coefficient · Pressure drop

1 Introduction

Heat exchangers are an important component of several industries. Compact heat exchangers have taken centre stage due to their efficiency and the use of space. As an illustration of a cross flow heat exchanger, a plate fin heat exchanger is being researched. Fluid flow direction is normal to each other, hot and cold fluid will have separate passages one after the other. Considering its bulk, it has a very high heat transfer surface area. The main objective of this paper is to compare a mathematical model that will facilitate the design of compact heat exchanger needed for thermal management of contact cooled rotary compressor application. The contact-cooled air compressor uses this heat exchanger. This is resistant to high pressure and temperature. Cross-flow and parallel-flow heat exchangers are in the middle of the thermodynamic performance spectrum [1]. The performance of the cross flow heat exchanger is measured in dimensionless numbers; the fanning friction (f) and Colburn (j) factors may be used to forecast the pressure drop across the heat exchanger and the heat transfer coefficient (h). Number of research have been made on these dimensionless numbers, few came up with general formula which includes flow rate and fin geometries as an input. In this study we have compared different correlations derived from various experiments for these dimensionless numbers and opted the more reliable and consistent formula.

✉ K. G. Nithesh
nitheshkg@sit.ac.in

1 Department of Mechanical Engineering, Siddaganga Institute of Technology, Tumakuru, Karnataka, India

2 Department of Mechanical Engineering, Global Academy of Technology, Bengaluru, Karnataka, India

3 Department of Mechanical Engineering, PSG Institute of Technology and Applied Research, Coimbatore, Tamil Nadu, India

4 Department of Agricultural Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu, India

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