Karlsruhe Institute of Technology

Institute of Fluid Mechanics
Building 10.23, 6th floor, Kaiserstraße 10, D-76131 Karlsruhe, Germany
http://www.istm.kit.edu

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bachelor thesis – numerical

Numerical simulation of fluid flow and heat transfer in plate heat exchangers

Background

Plate-type Heat Exchangers (PHEs) are a category of heat exchangers composed of patterned thin plates stacked together (Fig 1). On account of their high heat transfer coefficient, compactness and low temperature approaches, PHEs have been increasingly replacing the more conventional options, e.g. shell-and-tube heat exchangers, in a variety of industries.

In order to guarantee a high level of mixing, which brings about considerably high heat transfer coefficients, a majority of PHE manufacturers tend to make use of corrugated plates with crossing angles in their products; consequently, a complicated flow field is resulted inside a PHE. Obviously, it makes CFD modelling and analysis of fluid flow and heat transfer a challenging task in PHEs.

Content of the Thesis

The main goal of this project is CFD analysis of plate heat exchangers using a unitary cell as the computational domain. A unitary cell is defined as one of the many repeatable sub-geometries forming, together with others, the whole geometry. This concept has been already introduced and utilized in the open literature (see for an example Fig 2).

The project consists of three main steps: 1- creating a number of models of plate heat exchanger geometry, 2- generating multi-block structured computational grids using commercial software ICEM-CFD and 3- solving the governing equations of turbulent heat transfer using the suitable CFD solver; for this step, both commercial (FLUENT) and in-house (SPARC) options are available, depending on the progress of the previous steps and preliminary results, either or both of which will be used.

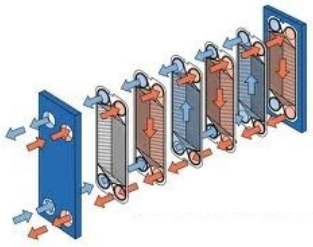

Fig 1. Schematic of a PHE

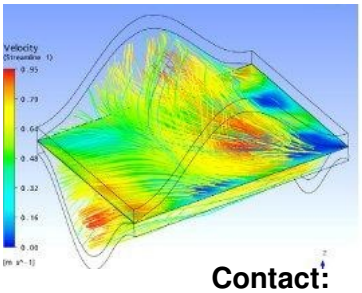

Fig 2. Streamline pattern in a PHE unitary cell

Ref: Freund & Kabelac Int. J HeatMassTr 53 (2010) pp. 3768-3781

Requirements

Knowledge of fundamentals of fluid dynamics and heat transfer; basic familiarity with modelling softwares

Beneficial Skills

Basic knowledge of computational fluid dynamics; experience with CFD softwares

Start: immediately

Contact:

M.Sc. Pourya Forooghi

Institute of Fluid Mechanics
Kaiserstraße 10,
Building 10.23, 6th floor,
Room 603

☎ +49 721 608 45880
✉ p.forooghi@uq.edu.au