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Two Phase Flow Simulation in the Structured Packed Distillation Columns Using Computational Fluid Dynamics

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ABSTRACT

CFD may be considered as a new and useful tool for two-phase flow simulation in structured packed columns. Various researches on single-phase simulation in some process equipments have been reported in the literature. However, there are a few reports of counter current two-phase flow simulation field.

In this paper, counter current gas-liquid flow within Mellapak structured packing’s sheets has been simulated by CFX 10 software, and liquid film thickness has been calculated in different points. After calculation of this parameter, it is possible to determine some important hydrodynamic parameters such as liquid holdup and irrigated pressure drop in structured packed columns. Results of the CFD simulations were compared with the Olujic theoretical model.

The main aim of this study is to construct a CFD model, which allow us to determine the liquid thickness during countercurrent two-phase flow through structured packing.

An element of structured packing is made of an ensemble of large number of triangular flow channels having identical cross sections.

The 3-D computational domain for the CFD simulation of gas and liquid flow in an element of the Mellapak 250Y structured packing is shown in figure 1. Figure 2 shows the contours of liquid volume fraction in the center of the domain.

In this study, mesh preparation of the geometry was made in gambit 2.2.30 and a commercial CFD package, CFX version 10 has been used for solve the basic equations. The model considers the multiphase flow in the Eulerian / Eulerian framework in which each phase is treated as interpenetrating continuum having separate transport equations. The motion in each phase is governed by the Navier - Stokes equations.

Basing on the results of the simulation, it can be stated that the model enables a determination of liquid film thickness in the structured packings. The CFD results in the present study are in reasonable agreement with the Olujic model and the relative error is about 21%. However; these results allow us to claim that the model is capable of determining the liquid film thickness in the structured packings.

Figure (3) shows the Air velocity vectors and water volume fraction. Figure (4) shows changes in the water film thickness on a vertical plan from the inlet in the flow direction. The maximum film thickness occurs in concavities of the sheets, while a minimum is observed near the edge.

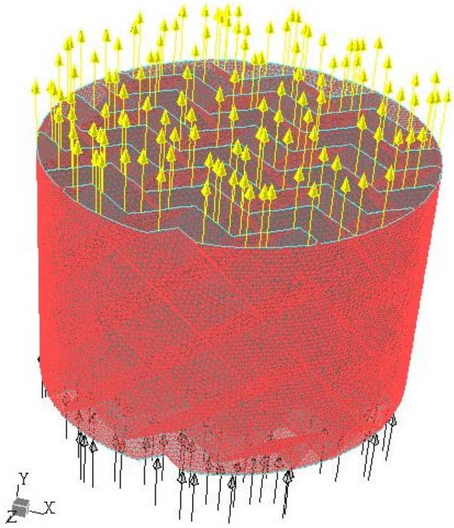

Figure (1). Computational domain

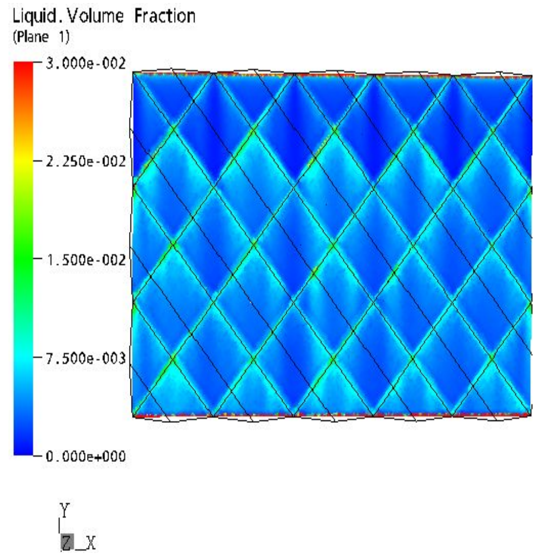

Figure (2). Contours of liquid volume fraction

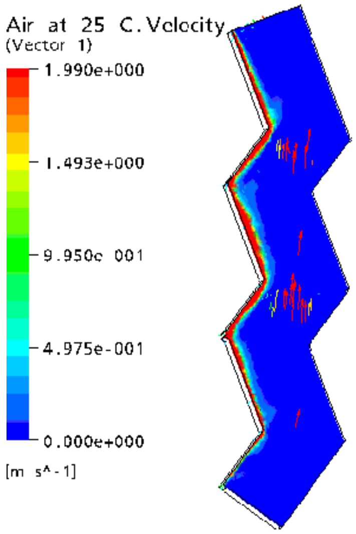

Figure (3). Air velocity vectors

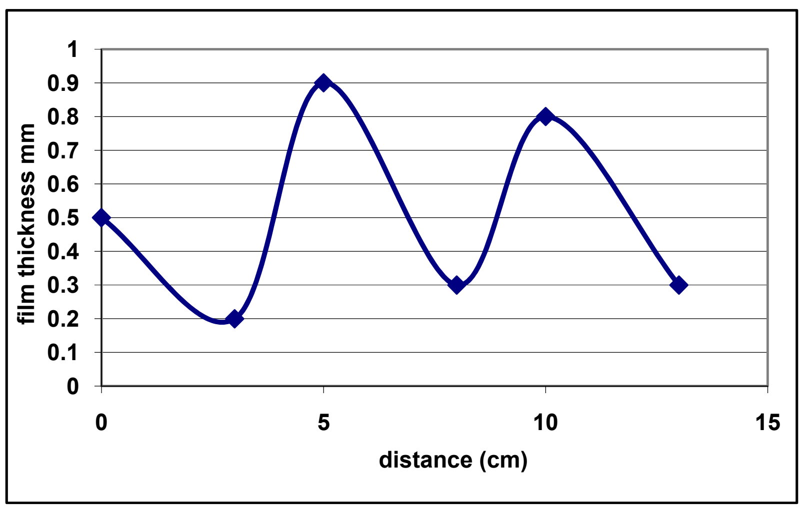

Figure (4). Water film thickness on a vertical plan of packing

REFERENCES

[1] M. Zivdar, R. Rahimi, M. Nasr and M. Haghshenas "Effect of Geometric Characteristics on Dry Pressure Drop of Packed Columns Using CFD Analysis" 32nd International Conference of SSCHE", Slovak society of Chem. Eng., May 23 - 27, (2005)

[2] Olujic Z., etal, "Predicting the efficiency of corrugated sheet structured packings with large specific surface area", Chem. Biochem. Eng. Q. 18(2), pp.89-96 (2004).