Optimization of Heat and Mass Exchange

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1. Introduction

The needs of society are often a driving force for engineering research. We live in an era in which global warming and atmospheric pollution are of great concern to the extent that they are stimulating research on energy efficiency and means to reduce pollution processes. This is a significant challenge that, if addressed wisely, will have far-reaching effects on sustainable life on our planet. To meet these dual challenges, consideration needs to be given to energy efficiency and pollution reduction through the development of new ideas, processes, and practices that can minimize the limitations imposed by the second law of thermodynamics and of optimisation processes that can extract the largest useful return for energy utilisation.

Heat and mass transfer together with fluid dynamics are three related topics that frequently occur simultaneously in many situations. In fact, the occurrence of only one of these phenomena alone is the exception rather than the rule. The basic equations that describe these phenomena are closely related, and the mathematical techniques for understanding them are very similar. It is therefore sensible to consider these topics together as a unitary subject. This is the approach we have adopted for this Special Issue.

In this Special Issue on “Optimization of Heat and Mass Exchange”, we have accepted and published 10 high-quality and original articles. These research papers cover theoretical, numerical, or experimental approaches on heat and mass transport phenomena. The Special Issue operates a rigorous peer-review process with a single-blind assessment and at least two independent reviewers, hence our final acceptance of these published high-quality papers.

2. Papers Presented in the Special Issue

The first paper presented by Sun et al. [1] offers an insight into the compression absorption cascade refrigeration system. The operating conditions are found to have a significant effect on the coefficient of performance, and these parameters are optimized simultaneously in their study. The results show significant quantity of waste heat is recovered to produce a cooling effect required by the system.

Martinez et al. [2] present the application of a mathematical model to temperature and viscosity in a mixture during the crystallization process in a scraped surface heat exchanger. The results are a coupled model based on these parameters of the heat exchanger that allow online estimation with errors below 10% for crystallized system.

Quan et al. [3] performed an analysis on the flow field of port plate pair of an axial piston pump for different piston speeds and inlet fluid velocities with the use of CFD software. It was found that the scale and strength of vortex reduced with an increase in the piston speed. Hence, the energy loss was also reduced and the efficiency was improved.
Su et al. [4] develop a two-dimensional two-channel model to simulate the process of heat transfer during phase change in an unsteady flow passage. The relative parameters of the heat flow inlet section of the corrugated passage are found to reach stability before those of the cold flow inlet section. The simulation reflects the heat transfer mechanism well during phase change in a corrugated flow passage of a plate heat exchanger.

Wang et al. [5] present synergy analysis that reveals the enhancement of heat transfer from the fluid circulation is the most significant at the center of the vortices and at the boundary between them. The work is a numerical investigation of natural convection in a circular enclosure with an internal flat plate with various orientations and aspect ratios. The numerical results show that the width of the plate has almost no effect on the horizontally placed plate.

Faraz et al. [6] apply the similarity transformation technique to a nonlinear partial differential system into a system of order differential equation. The objective is to investigate therm-diffusion effect and multislip effect on an asymmetric casson flow in the presence of chemical reaction. A strong numerical correlation is found from the results with published work in skin-friction-factor and Nusselt number.

Lee et al. [7] investigate forced convection on a plate-fin heat sink in an experimental study. The heat transfer performance and the effect spatial characteristics rate are investigated. They report that the 1-D numerical model with empirical coefficients provide good predicted trends in temperature profiles, thermal resistances and optimal heating length. The characteristics of optimal heating position for both laminar and turbulent flow are investigated in this study.

Alic et al. [8] introduce the computational intelligence methods to estimate heat flux at pool boiling processes in the isolated bubble regime. The performance of computational intelligence methods is determined according to the results of error analysis. The support vector machine regression method is found to perform better than the other methods used for pool boiling heat flux estimation.

Zhou et al. [9] provide an experimental and numerical study in an ice storage tank with finned tubes. The objective is to enhance the performance of the solidification process with the application of axially arranged fins and tubes. The results indicate a remarkable improvement in the performance. Benefits are observed with decreasing initial temperature in refrigerant and water as well.

Lu et al. [10] present a mathematical model and simulation of thermal fields of a large canned induction motor by different calculation methods in the effect of water friction loss. The results are compared with the measurements, obtained from the total losses using the loss separation method. The peak temperature and the temperature distribution of windings are not affected by the water friction loss. This paper will be of special interest to those involved in electrical machines cooling design.

3. Conclusions

We believe that the papers in this Special Issue reveal an exciting area that can be expected to continue to grow in near future, namely, the optimization of mass and heat exchange. The pursuit of work in this area requires expertise in thermal and fluid dynamics, system design, and numerical analysis. We hope that this Issue helps to bring the research community into closer contact with each other. Finally, we would like to thank our authors, reviewers, and editorial staff who have contributed to this Special Issue. I am sure all readers of this Special Issue of Processes will find these scientific manuscripts interesting and beneficial to their research work in the coming years.

Author Contributions: All authors contribute equally in this manuscript. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

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