2019 年度研究活動報告
Research activities in 2019

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ジャーナル論文，Publications

・Mark Anthony Redo, Jongsoo Jeong, Niccolo Giannetti, Koji Enoki, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Characterization of two-phase flow distribution in microchannel heat exchanger header for air-conditioning system, Experimental Thermal and Fluid Science, 2019.9, Vol.106, P.183-193.

・Prediction of Two-Phase Flow Distribution in Microchannel Heat Exchangers Using Artificial Neural Network」Niccolo Giannetti,Mark A Redo, Sholahudin Sholahudin, Jongsoo Jeong, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, International Journal of Refrigeration, 2020.3, Vol.111, P.53-62.

学会発表論文，Conference papers & Seminars

・Jongsoo Jeong(Invited speech), Mark A Redo, Niccolo Giannetti, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Two-phase flow distribution characterization and improvement in microchannel heat exchanger header, 2019.6, International Workshop on Environmental Engineering 2019, IE402.

・Mark Anthony Redo, Jongsoo Jeong, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Two-phase flow distribution in dual-compartment microchannel heat exchanger header, 2019.9, The 25th IIR International congress of refrigeration,TS-109.3

・N. Giannetti, M.A. Redo, Jongsoo Jeong, S. Yamaguchi, K. Saito, H. Kim, Theoretical Formulation of Two-phase Flow Distribution in Microchannel Heat Exchangers using Electric Circuit Analogy, 2019.6, International Workshop on Environmental Engineering 2019, E403.

・Jongsoo Jeong, Mark Anthony Redo, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Two-phase flow distribution at wide flow range in the vertical header of microchannel Evaporator, 2019.3, The 6th International Conference of Saving Energy in Refrigeration and Air-Conditioning, ICSERA2019-019.

・市川 暁広, 鄭 宗秀, 宮岡 洋一,山口 誠一, 齋藤 潔, 産業用ヒートポンプシステムの統合シミュレーション技術の構築 第 1 報:シミュレーションのコンセプトとシステム性能評価解析ロジック, 2019. 9, 日本冷凍空調学会年次大会講演論文集, C121.

Research Summary
I have mainly focused on the enhancement of the working fluid distribution performance and also clarified the characteristics of flow phenomena in microchannel heat exchanger header. One of the indispensable elements produced from the development of microfluidic technologies is the microchannel heat exchanger (MCHX), which its compactness gives the advantage of saving materials and production cost, saving space, as well as of reduction in refrigerant charge. The on-going challenge with this state-of-the-art technology is the flow maldistribution occurring inside the header, which consequently degrades the heat exchange performance.

In 2019, we suggested an alternative method in formulating the correlation from the analogy to electric circuits and Prigogine's theorem of minimum dissipation. In this manner, being derived from a physical representation, a higher degree of accuracy and, possibly, broader applicability were achieved.

Furthermore, Due to the intrinsic complexity of two-phase flow distribution and the limited mathematical flexibility of conventional formulations of the phenomenon, previous attempts generally fall short in the accuracy and applicability of their prediction. To address these issues, we noticed Artificial Neural Network (ANN) method with higher mathematical flexibility. The analysis of the network optimization for different shares of data used for the network testing, showed higher training and testing accuracy as the number of training data increases, along with no apparent overfitting.

And, we established the basic simulation technology for system optimization with the aim of achieving the development goals of the high-temperature heat pump.

In particular, we have built a highly versatile industrial heat pump simulator by enhancing the GUI so that it can flexibly respond to changes in refrigerants, systems, and operating conditions. Simulations were conducted for several model cases to which this high-temperature heat pump was applied, and the effects of introduction were examined.

Besides, we investigated noise issue generated from high pressure hydrogen gas flow inside the Hydrogen Tank Solenoid System (HTS). Both computational model and experimental measurement were conducted to investigate flow-induced noise caused by hydrogen flow characteristics inside HTS, particularly the one generated in solenoid valve during charging and using.