2019 年度研究活動報告

Research activities in 2019

機械科学・航空学科　齋藤　潔

Kiyoshi Saito, Dept. of Applied Mechanics and Aerospace Engineering,

論文，Published papers

- Niccolo Giannetti, Mark Anthony Redo, Sholahudin, Jongsoo Jeong, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Prediction of two-phase flow distribution in microchannel heat exchangers using artificial neural network International Journal of Refrigeration, Volume 111, 2020,Pages 53-62.

- MarkAnthonyRedo, KeisukeOhno, NiccoloGiannett, SeiichiYamaguchi, KiyoshiSaito, Seasonal performance evaluation of CO2 open refrigerated display cabinets, Applied Thermal Engineering, Volume 163, 2019, Article 114354.

- Nasruddin, Sholahudin, Pujo Satrio, Teuku Meurah Indra Mahlia, Niccolo Giannetti, Kiyoshi Saito, Optimization of HVAC system energy consumption in a building using artificial neural network and multi-objective genetic algorithm Sustainable Energy Technologies and Assessments,Volume 35, 2019, Pages 48-57.

- 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, Volume 106, 2019, Pages 183-193.

- Niccolo Giannetti, Piyatida Trinuruk, Seiichi Yamaguchi, Kiyoshi Saito, Film rupture and partial wetting over flat surfaces with variable distributor width, Science and Technology for the Built Environment, Volume 25, Issue 1, Accepted author version posted online: 31 Jul 2019, Published online: 09 Sep 2019, Pages 1313-1324.

- Sholahudin, Keisuke Ohno, Niccolo Giannetti, Seiichi Yamaguchi, Kiyoshi Saito, Dynamic modeling of room temperature and thermodynamic efficiency for direct expansion air conditioning systems using Bayesian neural network, Applied Thermal Engineering, Volume 158, 2019, Article 113809.

学会発表，Presentations in conferences

- Kiyoshi Saito, Keynote speech, History and latest trends of domestic hot water heat pump technologies, Workshop, The 25th IIR International congress of refrigeration, Aug. 2019, Montreal, Canada.

- Kiyoshi Saito, Latest Trend of Heat Pump and Dehumidification Technologies, ICSERA 2019, Mar. 2019, KINTEX, KOREA.

- 齋藤 潔, Plenary speech, 次世代冷媒の性能シミュレーション, 2019 年度近畿地区シンポジウム, Nov. 2019, 神戸大学.

- 齋藤 潔, Plenary speech, 環境エネルギー分野での産学官連携について, 神戸地域連携環境エネルギーシンポジューム, Jul. 2019, 神戸市.

- Yujin OHASHI, Ryosuke MORIWAKI, Seiichi YAMAGUCHI, Kiyoshi SAITO, Numerical Simulation of Falling-Film Absorbers at High Temperature International Workshop on Environmental Engineering 2019, June 2019,Okinawa,Japan.

- Kosuke BIZEN, Seiichi YAMAGUCHI, Kiyoshi SAITO, Thermal load characteristics of refrigerated display cabinet air curtain by thermal fluid analysis International Workshop on Environmental Engineering 2019, June 2019, Okinawa,Japan.

- 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 International Workshop on Environmental Engineering 2019 June 2019, Okinawa,Japan.

- SHOLAHUDIN, Keisuke OHNO, Seiichi YAMAGUCHI, Kiyoshi SAITO, Identification of vapour compression air conditioning system behaviour using Bayesian regularization neural network ICR 2019, Aug. 2019, Montreal, Canada.

- Richard Jayson VARELA, Niccolo GIANNETTI, Hifni ARIYADI, Seiichi YAMAGUCHI, Kiyoshi SAITO, Xin-Ming WANG, Hiroshi NAKAYAMA, A practical heat and mass transfer model between air and ionic liquid solution in an internally cooled dehumidifier with partial wetting ICR 2019, Aug. 2019, Montreal, Canada.

- M. A. Redo, J. Jeong, S. Yamaguchi, K. Saito, H. Kim, Two-Phase Flow Distribution in Dual-Compartment Microchannel Heat Exchanger Header ICR 2019, Aug. 2019, Montreal, Canada.

- Hifni M. ARIYADI, Niccolò GIANNETTI, Seiichi YAMAGUCHI, Kiyoshi SAITO, Comparative analysis of ionic liquids as sorptive media for absorption cooling systems, ICR 2019,Aug.2019, Montreal, Canada.

- N. Giannetti, R.J. Varela, H.Ariyadi, S. Yamaguchi, K. Saito, X.M. Wang, H. Nakayama, Semi-Theroretical Model of the Wetting Characteristics of Aqueous Ionic Liquid on an Aluminium Finned-Tube Desiccant Contractor ICR 2019, Aug. 2019, Montreal, Canada.

- Koki Furuta, Ryoma Teraishi, Yohei Kayukawa, Seiichi Yamaguchi, Kiyoshi Saito, M2 PVT property measurements for low-temperature natural refrigerant nitrous oxide, The 12th Asian Thermophysical Properties Conference, Oct.2019, Xi'an, China.

- JCS Garcia, N Giannetti, H Ariyadi, DA Varela, S Yamaguchi, K Saito, Numerical Simulation of Finned-Tube Heat Exchangers with Arbitrary Connectivity and Flexible Set of Input Conditions, IMPRES2019, Oct.2019, Kanazawa Chamber of Commerce and Industry.

- Takumi Ogiwara, Richard Jayson Varela, Seiichi Yamaguchi, Kiyoshi Saito, Hiroshi Nakayama, Xinming Wang, Heat and mass transfer characteristics of a fintube-type

regenerator for liquid desiccant systems with ionic liquid, ISTP 30th, Nov. 2019, Vinpearl Halong Bay Resort, USA.

- Mark Anthony Redo, Mark Anthony Redo, Jongsoo Jeong, Seiichi Yamaguchi, Kiyoshi Saito, Hyunyoung Kim, Two-phase Flow Distribution at Wide Flow Range in the Vertical Header of Microchannel Evaporator, ICSERA 2019, Mar. 2019, KINTEX, KOREA.

- M I Alhamid, Nasruddin, Arnas Lubis, Kiyoshi Saito, Hajime Yabase, Nyayu Aisyah, Energy Analysis for Solar Thermal Absorption System in Universitas Indonesia, ICSERA 2019, Mar. 2019, KINTEX, KOREA.

- 平沢 優好, 齋藤 潔, 山口 誠一, 井上 修行, 吸収冷凍機における不凝縮ガスが吸収現象に与える影響の解明, 第 53 回空気調和・冷凍連合講演会, 2019/4, 東京海洋大学.

- 福井 遼太, 山口 誠一, 齋藤 潔, 高温度域における濡れ特性を考慮した流下液膜の数値解析, 2019 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

- 寺﨑 佑隆, 山口 誠一,齋藤 潔, 三吉 直也,立石 浩毅, 長谷川 泰士, 数値シミュレーションによるターボ冷凍機の非定常特性解析, 2019 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

- 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 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

- 金子 琢哉, ジェイソン ヴァレラ リチャード,山口 誠一, 齋藤 潔, 中山 浩, 王 新明, イオン液体を吸収材として用いた中間冷却型気液接触器の熱・物質移動特性, 2019 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

- 吉田 知広, 大野 慶祐, 山口 誠一, 齋藤 潔, 二渡 直樹, 宇田川 陽介, ガスインジェクションサイクルの制御検討に向けた体系的特性把握, 2019 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

宮岡 洋一, 鈴木 隆起, 山口 誠一, 齋藤 潔 低 GWP 冷媒を採用した次世代冷凍空調技術の実用化評価に関する研究開発 第 1 報：次世代低 GWP 冷媒のサイクル性能評価研究の概要と 2018 年度の取り組み, 2019 年度 日本冷凍空調学会年次大会, 2019/9, 東京海洋大学.

研究成果

ヒートポンプシステムの高性能化を大きな指針として，2019 年には，低 GWP 冷媒を導入した中小型規模の冷凍空調機器の性能を高精度に数理解析するために，機器を構成する各種デバイスの数理モデル，数値解析手法を確立し，多様な冷媒の解析も可能とする熱交換器，圧縮機，膨張弁の数理モデルを構築した．モデリングが困難と判断された物理現象については，深層学習を含む機械学習及び進化計算等の人工知能関連技術（AI）も活用しながら高精度なモデリングを試みた．

また，イオン液体を吸収材として用いた中間冷却型気液接触器の熱・物質移動特性を解明し様々な熱負荷で潜熱分離型リキッドデシカントシステムと圧縮式ヒートポンプシステムの性能比較を行った．

そして，吸収式システムを対象として吸収器の高温域における濡れ特性を考慮した流下液膜の数値解析を行い，定常状態における熱物質伝達率の傾向を考察した．

これらの成果は，ヒートポンプシステムのさらなる高性能化に期待できると言える．

Research achievements

In 2019, we established mathematical models and numerical analysis methods to simulate precisely the performance of small and medium refrigeration and air-conditioning equipment with low GWP refrigerant, and constructed applicable mathematical theory on the simulation of heat exchanger, compressor, and expansion valve with various refrigerants. For Physical phenomena to have difficult modeling, Artificial Intelligence(AI) of machine learning including deep learning and evolutionary computation was attempted and utilized.

And, we clarified heat and mass transfer characteristics of a precooler and gas - liquid contactor using ion liquid as absorbent in liquid desiccant air-conditioning system, and evaluated and compared compression type heat pump system with latent heat separated liquid desiccant system with various heat loads.

Moreover, we performed numerical analysis of the falling film considering surface wettability at condition of the range of high temperature in absorber of absorption system and investigated the trend of heat and mass transfer coefficient on steady state.

From these achievements, we were able to extract very important guidelines for improving the performance of heat pumps.