Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

Numerical Analysis of Indirect Heat Recovery from Molten CuCl in Thermochemical Cycle for Hydrogen Generation

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ABSTRACT

Hydrogen as a clean fuel is deemed as an appealing solution to the looming threat of global warming by superseding fossil fuels. Furthermore, hydrogen could be the answer to the power storage problem of renewable energy technologies. Among current thermochemical hydrogen generation methods, copper-chlorine (Cu-Cl) cycle is of high interest owing to lower temperature requirements. However, this method faces various challenges such as scaling up. Therefore, it is crucial to improve the performance of the cycle in terms of designing more efficient heat exchangers in order to overcome these difficulties. In the present study, a double-pipe heat exchanger is numerically modeled using commercially available finite element software, COMSOL Multiphysics. Dissipated heat from molten salt is recovered via the counter-current air flow passing through the annular space between the two pipes. Various geometrical and operational conditions of the heat exchanger are investigated to provide insights for designing better indirect heat recovery systems within the thermochemical Cu-Cl cycle. A three-dimensional steady state model has been deployed and solidification of CuCl molten salt is also taken into account. Velocity fields and temperature fields of air flow and molten salt are solved simultaneously and effects of parameters such as air flow rate and molten salt inlet temperature are examined. Results indicate that the average temperature of air flow for a 15 cm tube is about 97 °C at the outlet.