Contribution ID: **477** Type: **Poster**

C2Po1D-05: Enhancing Flow and Heat Transfer in Continuous Conversion Heat Exchangers with Honeycomb-Structured Catalysts

Tuesday 20 May 2025 09:15 (1h 45m)

The continuous conversion heat exchanger is a critical component for scaling up hydrogen liquefaction plants while reducing energy consumption. However, existing continuous conversion heat exchangers utilize randomly packed catalyst structures, which suffer from uneven flow and heat transfer, leading to significant challenges such as high pressure drops and low heat transfer and conversion effectiveness. In this context, this paper proposes a novel continuous conversion heat exchanger featuring structured catalysts, where a honeycomb-matrix structure is integrated into the hot-side channels of the cryogenic heat exchanger. A multi-zone computational fluid dynamics model is developed by embedding a user-defined function for thin-layer heat and mass sources, capturing the interactions of flow, heat, and mass transfer across the refrigerant, hot hydrogen, metal walls, and catalysts. The effects of fluid inlet states and honeycomb matrix structural parameters are numerical analyzed. As a result, the optimal operating conditions and structural parameters are determined for various potential catalysts. Based on the ortho-para hydrogen conversion test platform, the novel structural catalytic unit demonstrates effective reductions in pressure drop and improvements in heat transfer and conversion effectiveness, compared to existing randomly packed structures. This work offers a new perspective for structural improvements in continuous conversion heat exchangers, contributing to the development of low-energy-consumption large-scale hydrogen liquefaction plants in the future.

Authors: Dr FANG, Song (Institute of Refrigeration and Cryogenics, Zhejiang University); Prof. WANG, Kai (Institute of Refrigeration and Cryogenics, Zhejiang University); Mr LIU, Wenrui (Institute of Refrigeration and Cryogenics, Zhejiang University); ZHENG, Jinming (Institute of Refrigeration and Cryogenics, Zhejiang University); Mr ZHANG, Hanwei (Institute of Refrigeration and Cryogenics, Zhejiang University); Dr ZHU, Shaolong (Institute of Refrigeration and Cryogenics, Zhejiang University); Prof. QIU, Limin (Institute of Refrigeration and Cryogenics, Zhejiang University)

Presenters: Dr FANG, Song (Institute of Refrigeration and Cryogenics, Zhejiang University); Prof. WANG, Kai (Institute of Refrigeration and Cryogenics, Zhejiang University)

Session Classification: C2Po1D - Ortho-Parahydrogen Conversion