Contribution ID: **320** Type: **Poster**

C2Po1F-04: Numerical study of liquid medium based packed bed cold storage in liquid air energy storage system

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

Liquid air energy storage (LAES) is a promising large-scale energy storage technology that supports renewable electricity integration and reduces carbon emissions. The cold energy storage unit plays a critical role in determining the efficiency of the LAES system. Currently, solid-phase packed beds are commonly used as cold energy storage units in LAES due to their safety and ease of arrangement. However, the thermocline effect within packed beds significantly reduces cold energy storage efficiency. To address this issue, this study introduces an innovative cold storage device employing a liquid heat transfer fluid in a packed bed. This paper presents a numerical analysis based on the porous media model to compare and evaluate the effects of various parameters, such as particle diameter, bed length-to-diameter ratio, and operating temperature range, on the thermocline effect within the packed bed. The findings of this study enhance the development of packed-bed cold storage technology, thereby advancing the large-scale application of LAES systems.

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Session Classification: C2Po1F - Large Scale Cryogenic Systems IV: Operation & Design IV