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A thermodynamic analysis of a coupled LAES system for recycling liquid ethylene cold energy

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Liquid air energy storage (LAES) is an emerging energy storage technology with significant potential for development, owing to its geographical flexibility and superior ability to integrate external energy sources. However, the efficiency of conventional LAES systems is hindered by the shortage of internal cold energy, necessitating the incorporation of external cold energy to improve system performance. Given the substantial amount of unutilized cold energy in the liquid ethylene (LE) regasification process, effective methods for recovering LE cold energy are required. This study proposes an innovative LAES-LE coupled system for the recycling of LE cold energy, using an intermediate cold-storage medium. The regasification cold energy of LE is employed in the low-temperature compression of air and subsequent cooling processes. In addition, Additionally, waste heat of approximately 245℃ is introduced to provide the heat for air expansion. This study establishes a composite thermodynamic model of the LAES-LE system and examines the impact of LE pressure, the temperature in low-temperature compression, and the number of low-temperature compression stages on system performance.

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