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Cryo-Compressed Hydrogen Economic Analysis

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Hydrogen energy holds significant potential as a novel and clean alternative energy source. Due to its low density under ambient conditions, hydrogen faces challenges in storage and transportation. Consequently, various high-density hydrogen storage and transportation methods have emerged in recent years, including compressed gaseous hydrogen, liquid hydrogen, and cryo-compressed hydrogen.
Nevertheless, the cost comparison among the three methods remains unclear. This has resulted in an unclear delineation of application scenarios for cryo-compressed hydrogen storage, impeding the practical implementation of this technology.
Therefore, this paper compares and analyzes distinct production processes among the three hydrogen storage and transportation methods, followed by an economic analysis of these diverse transportation approaches. A cost calculation model was developed, including the establishment of economic calculation boundaries, identification of factors influencing costs, formulation of calculation assumptions, and results analysis. Analyzed factors influencing the cost, including initial equipment investment, operational energy consumption, and transportation labor costs.
The primary influencing factor for compressed gaseous hydrogen storage and transportation is the labor cost of transportation. For liquid hydrogen storage and transportation, the main influencing factors are initial equipment investment and operational energy consumption. The various influencing factors for the cost of cryo-compressed hydrogen are relatively balanced. With the increase in transportation distance, the costs of all three methods also increase. Compressed gaseous hydrogen, liquid hydrogen, and cryo-compressed hydrogen have respective advantages in the ranges of less than 100 km, greater than 1000 km, and 100-1000 km. At 800 km, the cost of low-temperature and high-pressure hydrogen is 92% of that of liquid hydrogen.
This provides a reference for the applicable range of the cryo-compressed hydrogen storage and transportation mode.

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