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C1Or3C-02: Research on the matching supply of power and cold energy of liquid hydrogen cold chain logistics vehicles

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Liquid hydrogen cold-chain logistics vehicle (LHCCLV) is a special vehicle using liquid hydrogen (LH2) as the source of both power and cold energy. For the high energy consumption in the hydrogen liquefaction process has been regarded as a major weakness of LH2, the utilization of cold energy in LHCCLV can improve the economic performance and competitiveness of LH2. Because of the high energy storage density of LH2 and the relatively high efficiency of fuel cells, we find the cold energy can not meet the demand of LHCCLV. Therefore, we consider enlarging the cold energy by promoting the para-ortho hydrogen conversion (POC), whose reverse reaction consumes even exceeds 20% energy in the hydrogen liquefaction process. POC can not be carried out quickly without a catalyst, so we can control the 'valve' of the POC cold energy by reasonable process design, which is different from latent heat and sensible heat. In this paper, numerical models of releasing hydrogen from the LH2 and supercritical hydrogen tank are established in MATLAB, and the influence of POC on the supply of cold energy is analyzed. The changes in instantaneous and total cold energy supply under different working conditions are analyzed, and the important influence of POC is confirmed. At the same time, the influence of POC on the operation status of the storage tank is analyzed. The beneficial effect of POC is quantified in the paper, especially for the cold energy supply. This paper provides an important reference for the research and development of LHCCLV and also provides guidance for the comprehensive utilization of cold energy in other situations, so as to promote the improvement of the economy of hydrogen energy utilization routes in the form of LH2.

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