Thermodynamic analysis of simple Linde-Hampson hydrogen liquefaction systems with G-M cryocoolers

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The Linde-Hampson cycle is a classic method with J-T expansion. The cycle with LN2 pre-cooling might be suitable for simple hydrogen liquefaction systems because of low construction cost and no moving parts in the cold side, however the operating pressure is too high. To overcome the demerits three G-M cryocoolers of one KDE400SX (CSIC) and two AL325s (CRYOMECH) were applied to the cycle. The first cycle consists of the KDE400SX before J-T expansion and the two AL325s connected parallel after the expansion. And the second does three cryocoolers of KDE400SX followed by two AL325 for parallel connection after the expansion. The methods of applying three cyrocoolers suggested in the study were investigated by comparing the several parameters such as an operating pressure, liquefaction amount, LN2 consumption, effectiveness of heat exchangers and so on. It was found that the Linde-Hampson cycle utilizing cryocoolers could be adopted in a reasonable way to a small hydrogen liquefaction system. ASPEN HYSYS V11 and NIST REFPROP 10.0 of physical properties was used to analyze the cycles.