Optimal Design of a Cryogenic Distillation Column with Equilibrators for Hydrogen Isotope Separation

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In this study, we present an optimal design of a cryogenic distillation column for hydrogen Isotope Separation System (ISS) with two equilibrators. The distillation column was modeled as a packed column which is operated at a cryogenic temperature to separate hydrogen isotopes. Equilibrators are operated at room temperature so that HD, HT and DT can be exchanged with H_2, D_2 and T_2 by equilibrium reactions. Virial equation of state model was employed to allow for convergence in dynamic simulation while attaining the accuracy. The number of hypothetical trays, the locations of equilibrator attached stages, and the feed stage were set as the optimization variables. The bottom product must satisfy the lower bound of 90% tritium. The objective of the optimization is to minimize the tritium holdup in the column. For optimization, Pyomo, an open-source optimization modeling language, was used.