A superstructure-based approach for integrating work-heat within hydrogen allocation network

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Abstract

The use of hydrogen gases has expanded significantly in chemical industry due to its contribution to the decarbonization. The temperatures and pressures of hydrogen gases should be managed to satisfy the different hydrogen consumers that leads to considerable energy consumption. Such a serious challenge highlights the importance of work-heat integration for energy savings of hydrogen networks. Towards this end, a superstructure-based method is proposed for the work-heat integration specific to hydrogen allocation network, wherein the complex thermophysical properties of hydrogen are represented via an accurate surrogate model derived from the data of process simulation. To perform the optimal design of the system, a mixed integer nonlinear programming model is formulated to reflect all considered work-heat interactive relationship and constraints in hydrogen networks. Two examples are studied. 10.8% reduction in the net power consumption and 44.3% decrease in the total annual cost have shown the superiority of the proposed method.

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