Application of artificial neural networks to optimization of complex chemical processes: Hydrogen liquefaction process

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A well-done optimization is a very important task in traditional process design. However, difficulties arise due to the characteristic that the more complex the process, the more decision variables for optimization. Since many decision variables and target variables have a non-linear and high-dimensional relationship in a complex process, there will be hurdles to directly optimizing them.

In this study, we tried to overcome the hurdles encountered in the optimization stage due to complexity and non-linearity in the optimization of the hydrogen liquefaction process, which has been spotlighted in recent years, with ANN. First, the results of direct optimization of the base model were limited to the pre-cooling step and the optimization results of the model approximated by machine learning using the ANN model and the elapsed time were measured and analyzed for comparison. PSO was selected as the optimization algorithm, the base model was designed with Aspen HYSYS, and the ANN and optimization of the trained model were performed with MATLAB code. Interestingly, the results of optimizing the approximated model with ANN showed much less time and even better prediction results.