C3MR LNG PROCESS OPTIMIZATION: AN ENVIRO-ECONOMIC STUDY

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Since the global energy requirements are expected to rise and the world-wide energy demand is still supplied mostly by fossil fuels, a search for a suitable transition fuel is a high priority. The natural gas is considered the cleanest fossil fuel and is commonly recognized as the best option. However, because the natural gas is usually extracted at remote locations, suitable means of transport are vital in the gas industry. Liquefied natural gas (LNG) is suitable for long-distance transport and is already one of the pillars of secure energy supply in many countries. In this work, a 3.5 MTPA propane-precooled mixed-refrigerant (C3MR) LNG plant is modeled in Aspen Plus and subjected to a robust dual-objective optimization using the genetic algorithm (GA/NSGA-II) and a novel Aspen Plus – Matlab interface. For the optimization study, 18 process variables were chosen and varied in a ±75% interval. Thanks to the novel optimization interface, up to 1000 optimization individuals and 500 generations could be used. To choose the most suitable individual from the 1000 individuals in the final Pareto front, four decision making methods: Euclidean distance, fuzzy non-dimensionalized distance, and two statistical methods have been used and the results have been compared and discussed. The optimization results document approx. 76 mil. USD/year decrease in the total annual processing costs and an over 76 KTPA decrease in the carbon dioxide emissions. Furthermore, the in-optimization behavior of parameters was studied: only 6 out of 18 parameters underwent significant changes throughout the process while the others converged to optimum in the first iterations. Finally, the results of the dual-objective optimization were confronted with the single-optimization ones. The conclusion is that dual-objective optimization should be generally favored as the single-objective optimization yields only marginal decrease in the respective objective function while significantly increasing the other one.

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