Development, modelling and evaluation of a small-scale gas liquefaction plant

A small-scale gas liquefaction plant was developed and analysed based on process simulation tools and pilot tests. It will be installed in harbours, easing the penetration of liquefied natural gas (LNG) as a maritime fuel, in a sector facing more stringent environmental regulations. The proposed plant uses a multi-component refrigerant together with a propane precooling cycle and plate heat exchangers, to achieve a higher performance. This LNG production concept was modelled based on the Danish natural gas composition. Firstly, the total power consumption and heat transfer conductance were minimised by optimising the operating conditions and the refrigerant composition. The effects of varying feed and refrigerant compositions were analysed. Secondly, the system layouts were evaluated by conducting an exergetic assessment. Finally, the most promising layouts were validated by pilot plant measurements, for a feed processing rate of 2160 kg/h. The results indicate that the specific power consumption can be reduced to the 1400-1800 kJ/kg range, for an exergetic efficiency of 25-30%. A good agreement between the simulation and experimental results was found, which justifies the use of the property database of the Groupe Européen de Recherches Gazières for system analyses.

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