Exergy Analysis of Single Mixed Refrigerant Process Used in LNG Plant

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Abstract :

This paper provides an exergy analysis for Single Mixed Refrigerant process used in LNG plants. The equation of exergy destruction and exergetic efficiency for the main system components such as heat exchanger, compressors and expansion valve are developed. The relations for total exergy destruction in the system and the system overall exergetic efficiency are obtained. Also, combine pinch and exergy analysis based method; has been used to improve the overall exegetic efficiency of the refrigeration system through decreasing the temperature difference between the process and refrigerant streams in heat exchanger. It can help to determine which part of the process has the most lost work. Hence, it will be easily to identify which sources of system should be optimized. The results show that the minimum work depends only on the properties of incoming and outgoing process streams cooled or heated with refrigeration system and ambient temperature.

1. Introduction

Increasing global demand for natural gas is supporting the rapid growth of worldwide liquefied natural gas (LNG) production capacity. The liquefaction reduces its volume 600-times and thus makes long distance transportation convenient, which has a final temperature of about -162 ◦C approximately atmospheric pressure. The process of cooling and condensing the natural gas requires large amounts of energy, therefore it is necessary to optimize the process and find a suitable way to implement the optimal operation at steady state. There are several processes for liquefying natural gas based on the different refrigerant cycles used, capacity and ambient conditions.

This paper introduces an enhanced SMR process suitable for medium-scale (0.5-1.5 mtpa) and offshore natural gas liquefaction. The cycle fully utilizes two-phase expansion to achieve reasonable process efficiency with a single-cycle process.

LNG plant is interesting for pinch and exergy analysis since spends exergy (fuel, electricity) to remove energy (heat) from the substances. Exergy analysis is a powerful tool for designing, optimizing, and performance evaluation of energy systems. Moreover, pinch analysis relies on a process grand