Thermodynamic analysis for novel vapor compression/absorption cascade refrigeration system for LNG liquefaction processes in EgypT

Abstract

This research demonstrates a novel vapour compression/absorption cascade refrigeration system for LNG liquefaction process to replace the air-cooled condenser equipped in Propane precooling refrigeration circuit, via either seawater or cooling towers to remove the heat rejected from precooling cycle of propane. The current investigation focuses on the novel configuration consists of ConocoPhillips optimised cascade cycle using three vapour compression refrigeration circuits which are Propane, Ethylene and Methane, besides one vapour absorption refrigeration cycle. The first aim of this paper is to perform thermodynamic analysis of LNG plant produces 50 kg/s of LNG. The second aim is to present a comparative parametric study for different number of stages which are 6, 7, 8 and 9 stages to evaluate and enhance the coefficients of performance of these design configurations. The results of design configurations for LNG plant conclude that number of stages has significant effects on both Coefficients of performance and the liquefaction efficiency. The Coefficients of performance is strengthened by using the design configurations consist of nine and eight compression stages. The coefficient of performance for vapour compression/absorption cascade for LNG plant can be slightly reduced rather than tradition vapour compression cascade cycles in LNG production from 0.741 to 0.704 for nine stages and from 0.838 to 0.709 for eight stages. The specific power consumptions in (kWhr/kgLNG) can be optimized and adopted from 0.1875 to 0.225 kWhr/kgLNG, for the highly recommended design

configurations consist of nine and eight stages. The novelty of this study introduces economical and energy-analysis comparative studies to assess and optimize the performance of several design configurations for LNG plant regarding both economics and thermal performance. The conclusions can support the practical application.