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APPLICATION OF NEW EXTERNAL COOLING CYCLES IN TECHNOLOGICAL SCHEME OF HELIUM EXTRACTION AND NATURAL GAS LIQUEFACTION

M. Mehrpooya[1], A. V. Zaitsev[2], A. O. Lisovtsov[2]

[1]Faculty of New Sciences and Technologies, University of Tehran,
Iran, Tehran, North Kargar St.
[2]ITMO University,
Russia, Saint Petersburg, Kronverkskiy Ave., 49, 197101

The paper presents the results of studying a combination of new technological solutions in the processes of natural gas liquefaction and helium extraction. The most common and effective way to ensure cooling capacity in the natural gas liquefaction process is to use a cascade cycle on mixed refrigerant (MFC) as external cooling. The influence of introducing an absorption refrigeration unit on the technological process has been studied. To extract helium, the combined separation and rectification method is used. The purity of helium obtained is 50% (in moles). The running conditions of operation and the corresponding technical characteristics of the devices are presented and described. The curves of the resulting characteristics of heat exchangers indicate the correctness of the thermohydraulic calculations performed. The relative value of energy costs for obtaining 1 kg of liquefied natural gas in a technological process using MFC is 0,265 kWh/kg of LNG introducing an absorption refrigeration unit into the cycle reduces the ratio presented to 0,1849 kWh/kg of LNG. In the process of extracting helium using an absorption refrigeration unit gives the result of 0,951 and 132,9 kW/kmol of helium respectively. When using an absorption refrigeration unit, the helium extraction rate and power consumption ratio are 0,951 and 132,9 kW/kmol of helium, respectively. Application of the exergic analysis methods to the processes under consideration shows that the greatest value of exergic losses relative to other devices is observed in compressors. A detailed economic analysis has been carried out. It shows that the cost of the product obtained in the normal MFC cycle and in the MFC cycle using an absorption refrigeration machine is $0,1939 and $0,2069 per kg of LNG, respectively. Finally, on the basis of such economic factors as the cost of electricity and the cost of the product, the efficiency of the new cycle was analyzed.

Keywords: helium recovery, liquefied natural gas, refrigeration cycle, thermal integration of processes, energy efficiency, exergy analysis.

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MEHRPOOYA Mehdi, PhD, Associate Professor of Renewable Energies and Environment Department, Faculty of New Sciences and Technologies, University of Tehran, Tehran, Iran.
AuthorID (SCOPUS): 15725690500
ResearcherID: AAH-1617-2019
ZAITSEV Andrew Viktorovich, Candidate of Technical Sciences, Associate Professor of Cryogenic Engineering Department, ITMO University, Saint Petersburg, Russia.
SPIN-code: 1652-6922
AuthorID (RSCI): 200047
ORCID: 0000-0003-0677-6320
ResearcherID: E-1700-2017
LISOVTSOV Andrey Olegovich, Graduate Student of Cryogenic Engineering Department, ITMO University, Saint Petersburg, Russia.

Address for correspondence: zai_@inbox.ru

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