Accepted Manuscript

Title: A novel approach for operational optimization of multi-stage refrigeration cycles in gas refineries

Author: Hossein Kalantar-Neyestanaki, Mostafa Mafi, Ali Ashrafizadeh

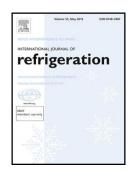
PII: S0140-7007(17)30185-8

DOI: http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.05.001

Reference: JIJR 3629

To appear in: International Journal of Refrigeration

Received date: 16-2-2017 Revised date: 26-4-2017 Accepted date: 1-5-2017



Please cite this article as: Hossein Kalantar-Neyestanaki, Mostafa Mafi, Ali Ashrafizadeh, A novel approach for operational optimization of multi-stage refrigeration cycles in gas refineries, *International Journal of Refrigeration* (2017), http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.05.001.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

A Novel Approach for Operational Optimization of Multi-Stage Refrigeration Cycles in Gas Refineries

Hossein Kalantar-Neyestanaki¹, Mostafa Mafi^{2*}, Ali Ashrafizadeh³

Highlights

- A novel approach for optimization of in-use refrigeration cycles is proposed.
- The performance limitations of components are considered in this approach.
- The independent variables of multi-stage refrigeration cycles are introduced.

Abstract

The efficient use of energy in refrigeration cycles of gas liquefaction plants is a contemporary topic of interest. The previous optimization studies on refrigeration cycles have not considered the components' operational limitations. By considering the fact that in operating plants, all constraints must be thoroughly taken into account, this paper presents a novel approach for operational optimization of in-use refrigeration cycles which takes into account the operational limitations of the components as well as the interaction between the refrigeration cycle and the core process. This novel approach exploits a combination of thermodynamic principles and pinch technology to express the multi-stage refrigeration cycles' power consumption as a function of several independent variables. To examine the applicability of the proposed approach, it is used to optimize a three-stage refrigeration cycle in a propane liquefaction plant. About 15.4% reduction in the specific power consumption is achieved.

Keywords:

Multi-stage refrigeration cycle, gas liquefaction plants, operational limitations of components, optimization, independent variables.

Nomenclature		MIX	mixer
η_{ex}	exergetic efficiency	AC	air condenser
$\eta_{\it C}$	Carnot factor	D	drum
η_s	isentropic efficiency	EV	expansion valve
$A_{ECC\ or\ EGCC}$	enclosed area in the ECC or EGCC (kW)	E	evaporator
T_0	ambient temperature (K)	Base case	denote the refrigeration cycle
T	temperature (K)		before optimization
Н	enthalpy (kJ)	Case A	denote the refrigeration cycle
h	specific enthalpy (kJ.kg ⁻¹)		after optimization by the CPEA
ΔT	temperature difference (K)	Case B	denote the refrigeration cycle
ΔT_{min}	minimum temperature difference approach (K)		after optimization by the
ṁ	mass flow rate (kg.h ⁻¹)		presented approach
$\eta_{s,comp}$	isentropic efficiency of compressor		
Ŵ	power consumption (kW)	Subscripts	
X	vapor quality	evp	evaporator
\dot{Q}_{evp}	cooling rate of evaporator (kW)	S	isentropic
h_{fg}	enthalpy of vaporization (kJ.kg ⁻¹)	cond	condenser
CRS	compressor rotational speed (rpm)	comp	compressor
PR	pressure ratio	U	upper stage
W W	specific power consumption (kJ.kg ⁻¹)	L	lower stage
VV	specific power consumption (k.j.kg)	max	maximum

¹MSc Graduate, Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran; hossein.kalantar@mail.kntu.ac.ir

^{2*}Assistant Professor, Department of Mechanical Engineering, Imam Khomeini International University, Qazvin, Iran; m.mafi@eng.ikiu.ac.ir; Tel: (+98)2833901122; Fax: (+98)2833780073

³Associate Professor, Faculty of Mechanical Engineering, K. N. Toosi University of Technology, Tehran, Iran; ashrafizadeh@kntu.ac.ir

Download English Version:

https://daneshyari.com/en/article/5017069

Download Persian Version:

https://daneshyari.com/article/5017069

<u>Daneshyari.com</u>