بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / سلوي محمود عقل

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات: لا يوجد

A SIMULATION STUDY OF MIXED REFRIGERANT ABSORPTION REFRIGERATION SYSTEM USING DIFFERENT ABSORBENTS

By

Noha Mahmoud Ahmed Mohamed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Chemical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

A SIMULATION STUDY OF MIXED REFRIGERANT ABSORPTION REFRIGERATION SYSTEM USING DIFFERENT ABSORBENTS.

Key Words:

Absorption Refrigeration; Hydrocarbons Refrigerants; Mixed Refrigerants; Simulation; Optimization.

Summary:

The performance of a mixed refrigerant absorption refrigeration cycle was studied to explore the feasibility to achieve an ultra-low range of chiller temperatures. The use of ethane-propene refrigerant mixtures with different compositions in combination with a wide range of hydrocarbon solvents were simulated using ASPEN HYSYS software. A parametric study was conducted for identifying the optimal operating conditions for each targeted evaporator temperature. The results revealed that the performance of the studied mixed refrigerant is generally enhanced at conditions of low absorption temperature and/or low condenser temperature. Chiller temperature in the range of -60 to -90 °C was revealed to be achievable using a cascade refrigeration system with a COP in the range of (0.18 to 0.32). The optimal absorbent for most of the studied mixture compositions, regarding maximal COP, and minimal (PP/Q_E), was found to be MCC5. However, commercial solvents in the same carbon atom range were proved to offer about the same performance at the optimal disclosed operating conditions. The proposed system was found to achieve electrical power savings in the range of 15-53% of that would be consumed by a VCRS for the same chiller duty and temperature as operating under the same conditions, depending on %ethane in the refrigerant mixture.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Noha Mahmoud Ahmed Mohamed   Date: / /2022

Signature:

Dedication

My humble effort I dedicate to my sweet and loving Father and Mother, whose affection, love, encouragement and prayers of day and night make me able to get such success and honor, along with all hard working and respected teachers.

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First, I would like to thank my advisors, Dr. Ahmed Soliman and Dr. Ahmad Wafiq, for the patient guidance, encouragement and support they have provided. I have been extremely lucky to have advisors who cared so much about my work, and who responded to my questions and queries so promptly.

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Nomenclature

ΔT	Temperature Gradient
ANN	Artificial Neural Network
ARC	Absorption Refrigeration Cycle
ARS	Absorption Refrigeration System
CC	Cooling Capacity
CFCs	Chlorofluorocarbons
CMR	Cold Mixed Refrigerant
COP	Coefficient of Performance
CR	Circulation Ratio
CWHE	Coil Wounded Heat Exchanger
DMR	Dual Mixed Refrigerant
ECC5	Ethylcyclopentane
GWP	Global Warming Potential
HCFCs	Hydrochlorofluorocarbons
HCMR	Hydrocarbon Mixed Refrigerant
HCs	Hydrocarbons
HFCs	Hydrofluorocarbons
HG	High Generator
HPA	High Pressure Absorber
HPG	High Pressure Generator
HPMR	High Pressure Mixed Refrigerant
HTG	High Temperature Generator
HX	Heat Exchanger
J-T valve	Joule-Thomson Valve
LG	Low Generator
LHP	Loop Heat Pipe
LNG	Liquefied Natural Gas
LPA	Low Pressure Absorber
LPG	Low Pressure Generator
LPMR	Low Pressure Mixed Refrigerant
LTG	Low Temperature Generator
MCC5	Methylcyclopentane
MR	Mixed Refrigerant
MRC	Mixed Refrigerant Cycle
MMR	Main Mixed Refrigerant
MTG	Medium Temperature Generator
M.wt.	Molecular Weight
NBP	Normal Boiling Point
NG	Natural Gas
NGL	Natural Gas Liquefaction
ODP	Ozone Depletion Potential
Patm	Atmospheric Pressure
PMR	Pre-cooling Mixed Refrigerant
PP	Pump Power
PPMR	Propane Precooled Mixed Refrigerant
PP/Q_E	Pump Power/ Chiller Duty

PRV	Pressure Reducing Valve
Q_A	Absorber Duty
Qc	Condenser Duty
Q_E	Evaporator Duty
Q_G	Regenerator Duty
R-170	Ethane
R-1270	Propylene
R-11	Trichlorodifluoromethane
R-12	Dichlorodifluoromethane
R-134a	1,1,1,2-Tetrafluoroethane
R22	Chlorodifluoromethane
R600	Butane
R600a	Iso-butane
R-290	Propane
RR	Reflux Ratio
SDR	Solution Distribution Ratio
SMR	Single Mixed Refrigerant
SS	Strong Solution
Tb	Absorber Temperature
Tc	Condenser Temperature
Te	Evaporator Temperature
Tg	Regenerator Temperature
VCRC	Vapor Compression Refrigeration Cycle
VCRS	Vapor Compression Refrigeration System
WFs	Working Fluids
WMR	Warm Mixed Refrigerant
WS	Weak Solution