Ain Shams University
Faculty of Engineering
Mechanical Power Engineering Department

PERFORMANCE OF REFRIGERATION SYSTEM USING ENVIRONMENTALLY FRIENDLY REFRIGERANT

A Thesis Submitted in Partial Fulfillment for the Requirements of the Degree of Master of Science in Mechanical Engineering

By

Tamer Mahmoud Aly Hassan
Bachelor of Science in Mechanical Engineering

Supervised by

Prof. Dr. Nabil Abdel-Aziz Mahmoud

Mechanical Engineering Department

Faculty of Engineering

Ain Shams University

Dr. Mohamed Saad El-Din El-Morsi

Department of Mechanical Engineering

School of Sciences and Engineering

The American University in Cairo (AUC)

Dr. Mohamed Hamdy Salama

Miraco Carrier - Misr Refrigeration & Air Condition

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CERTIFICATION STATEMENT

This thesis is submitted in partial fulfillment for the degree of Master of Science in Mechanical Power Engineering to the Faculty of Engineering, Ain Shams University.

The work included in this thesis was carried out by the author, primarily at the laboratories of the Mechanical Engineering Department, Faculty of Engineering, Ain Shams University.

No part of this thesis has been submitted for degree or qualifications at any other universities.

Signature

……………………….………..

Tamer Mahmoud Aly Hassan

RESEARCHER DATA

Name	**:**	Tamer Mahmoud Aly Hassan
Date of birth	**:**	14/10/1979
Place of birth	**:**	CAIRO-EGYPT
Academic degree	**:**	Bachelor degree in mechanical power and energy
Field of specialization	**:**	Electromechanical projects-army engineering authority
University issued the degree:		Military technical college.
Date of issued degree	**:**	2001
Current job	**:**	Officer in the engineering authority for army forces

BOARD OF SUPERVISORS

The undersigned certify that they have read and recommended to the Faculty of Engineering, Ain Shams University, for acceptance a thesis entitled **"Performance of Refrigeration System Using Environmentally Friendly Refrigerant"**, submitted by **Tamer Mahmoud Aly Hassan**, in Partial Fulfillment for the Requirements of the Degree of Master of Science in Mechanical Engineering.

1. **Prof. Dr. Nabil Abdel-Aziz Mahmoud**

    Mechanical Power Engineering Department
    Faculty of Engineering
    Ain Shams University

2. **Dr. Mohamed Saad Eldin El-Morsi**

    Department of Mechanical Engineering
    School of Sciences and Engineering
    The American University in Cairo (AUC)

3. **Dr. Mohamed Hamdy Salama**

    Miraco Carrier - Misr Refrigeration & Air Condition
    Egypt

Date: / /2019

EXAMINERS COMMITTEE

The undersigned certify that they have read and recommended to the Faculty of Engineering, Ain Shams University, for acceptance a thesis entitled "**Performance of Refrigeration System Using Environmentally Friendly Refrigerant**", submitted by **Tamer Mahmoud Aly Hassan**, in Partial Fulfillment for the Requirements of the Degree of Master of Science in Mechanical Power Engineering.

Signature

1. **Prof. Dr. Salah Mahmoud El-Haggar** **………...**
   Department of Mechanical Engineering
   School of Sciences and Engineering
   The American University in Cairo (AUC)

2. **Prof. Dr. Mahmoud Abdel Rasheed Nosseir** **...……...**
   Mechanical Power Engineering Department
   Faculty of Engineering
   Ain Shams University

3. **Prof. Dr. Nabil Abdel-Aziz Mahmoud** **……….**
   Mechanical Power Engineering Department
   Faculty of Engineering
   Ain Shams University

4. **Dr. Mohamed Saad el Din El Morsi** **………...**
   Department of Mechanical Engineering
   School of Sciences and Engineering
   The American University in Cairo (AUC)

Date: / /2019

ABSTRACT

The aim of this study is to experimentally investigate the usage of liquefied petroleum gas (LPG) as a substitute refrigerant for R134a in a household refrigerator and identify the most suitable charge and capillary tube length. The gravimetric composition of the locally available LPG by weight is (R290- 25.98%, R600-41.17%, R00a-9.99%, R601a-0.64%, R170-0.11%, R744-0.01%, butene-22.10%), Appendix D.

Five different charges at which LPG and R134a are charged and tested. The charges are 40 g and 50 g for LPG and 130 g, 150 g and 170 g for R134a. Four capillary tubes of 0.7 mm inner diameter, 1.9 mm outer diameter and 1.5 m, 2 m, 2.5 m and 3 m length each are used during experimentation at different thermostat positions (1, 2, and 3).

REFPROP-6.0 software is used to determine the thermodynamic properties of LPG and R134a.

The results indicate that maximum COP and minimum irreversibility for R134a is attained at a charge of 130g, capillary tube length 1.5m and consequently the maximum exergy efficiency. On the other hand, the best performance for LPG is attained at a charge of 50 g and capillary tube length 1.5m. Relative to R134a, LPG has a COP and exergy efficiency that are lower by an average of 24% and 49%, respectively, within the range studied. However, LPG consumes less power and has more on time ratio compared to R134a. Also, LPG is cheap, available in great amounts and has a very low GWP and zero ODP.

Key words: Refrigerant, Hydrocarbon, R134a, LPG, Energy and Domestic refrigerator

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