PERFORMANCE ANALYSIS OF AN AIR CONDITIONING SYSTEM USING ROTARY COMPRESSOR

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To my beloved wife,

Zue

To my baby,

Afiq

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First of all, all praise and thanks goes to Allah s.w.t who was gave the strength and blessings for author to make it possible to complete the thesis title **Performance Analysis of an Air Conditioning System Using Rotary Compressor**.

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ABSTRACT

The most air-conditioned vehicle is the automobile including car, busses, trains, trucks, recreational vehicles, air craft and ships. The major contributions to the cooling load in the transport are the heat from solar radiation and the heat from human especially in of public transport. The performance of car air conditioning system is driven by the rotation of RPM engine. The changes of rotation at high and low speed will give significant effect to the system. This project presents mathematical modeling and analysis computer simulation of car air conditioning systems with the four basic components consisting of compressor, condenser, evaporator and expansion valve. This air conditioning system will be using a rotary compressor with five sliding vanes. A computer simulation model has been developed and the effects of system performance are indicated by compressor speed, pressure ratios have been evaluated. The main objective of this work is to identify the performance of car air conditioning system using a rotary compressor .A FORTRAN programming was applied for the system modeling with R134a as the test refrigerant properties. For the validation of the perform a comparison study of this work with the previous experimental data to determine the accuracy of program as well to evaluate of the simulation results.The expectations of this project is to have an agreement between the simulation result and theory and these will be a fundamental to the future research from the aspect of the design compressor and the development of an air condition system.

ABSTRAK

Penyaman udara merupakan suatu sistem yang terdapat pada kebanyakan kenderaan seperti kereta, bas ,keretapi, pikap, kenderaan reaksi, kapal terbang dan kapal. Tujuan utama pengunaan sistem penyaman udara ini adalah untuk menyingkirkan haba yang terhasil daripada pancaran dan sinaran matahari. memandangkan penyaman udara pada kenderaan mengunakan kuasa putaran roda kuasa aci,jesteru itu, perubahan halaju putaran enjin akan mempengaruhi keupayaan kuasa dan prestasi sistem ini. Projek ini adalah untuk mengkaji permasalahan yang timbul melalui permodelan analisis matematik dan juga membuat suatu program komputer yang mengandungi komponen asas penyaman udara kereta seperti pemampat, pemeluwap, injap pengembangan dan juga penyejat. Sistem ini juga akan menggunakan pemampat berputar silinder oval yang mempunyai lima bilah. Tujuan utama projek ini adalah untuk mengenalpasti keupayaan prestasi sistem penyaman udara yang menggunakan pemampat berputar. Sistem simulasi ini mengunakan FORTRAN sebagai aturcara program dan R134a sebagai bahan penyejuk. Bagi tujuan penentusahkan keupayaan program, perbandingan telah dibuat dengan menggunakan data eksperimen. Maka dengan terhasilnya program simulasi penyaman udara ini, ia boleh digunakan sebagai rujukan dalam penyelidikan dan pembangunan pemampat dan juga sistem penyaman udara.

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NOMENCLATURE

A	Area, m^2
COP	Coefficient of performance, dimensionless
Cp	Specific heat, $kJ\ kg^{-1}$
h	specific enthalpy, $kJ\ kg^{-1}$
mr	refrigerant mass flow rate $kg\ s^{-1}$
N	compressor speed, *RPM*
n	polytrophic index, dimensionless
p	pressure, *bar*
Qc	heat rate rejection at condenser, *kW*
Qe	Refrigerant Capacity, *kW*
R	gas constant, $kJ\ kg^{-1}\ k^{-1}$
T	temperature, *K*
t	temperature ,^0C
AU	overall heat transfer coefficient, $kW\ k^{-1}$
WC	Compression work, *kW*
P	Compressor Power,*kW*
RPM	revolutions per minute

Greek letters

γ	Specific heat ratio *(cp=cv)*
η	Efficiency
ρ	Density $(kg\ m^{-3})$

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CHAPTER 1

INRODUCTION

1.1 Introduction

The largest application of refrigeration, which is the process of cooling, is in air conditioning. In the tropics an air conditioning system is widely used in vehicles such as cars, buses, trains, trucks, recreational vehicles, air craft and ships. Its main purpose is for comfort cooling as these vehicles are directly exposed to solar radiation and also receive heat from other source such as human being, engine and environment at higher temperature. The major contributions to the cooling load in the transport are the heat from solar radiation and the heat from human especially in of public transport. The performance of car air conditioning system is driven by the rotation of RPM engine. The changes of rotation at high and low speed will give significant effect to the system. According to the phenomenon, this project presents mathematical modeling and analysis computer simulation of car air conditioning systems with the four basic components consisting of compressor, condenser, evaporator and expansion valve. This air conditioning system will be using a rotary compressor with five sliding vanes because the capacity and the performance of compressor is better compare with other compressor. Computer simulation model has been developed and the effects of system performance are indicated by compressor speed, pressure ratios have been evaluated.

This thesis presents the computer simulation of car air conditioning systems. The class of equipment here studied is shown in figure 1.1. The system consists of the four basic components, namely the compressor, evaporator, expansion valve and condenser. This air conditioning system will using rotary compressor with five sliding vane manufactured by Patco Malaysia Berhad (table A.2).Many research endeavors have been pursued in the past few years aiming the numerical simulation of such systems. For the reason, the obtaining of general and flexible design methods is very important in the applications and the optimization of air conditioning system in order to take into account different aspects such as the Coefficient of the performance (COP), the characteristic of the rotary compressor and other components.

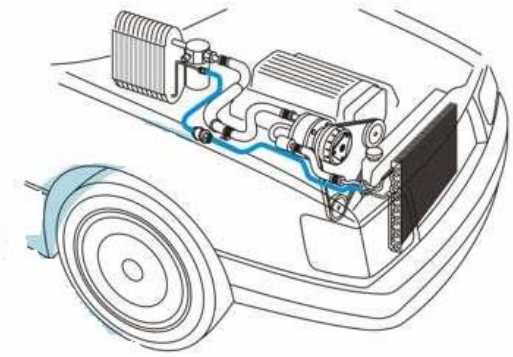

Figure 1.1: Car air conditioning system

1.2 Objective

The main objectives of this project are to determine and compare the performance of air conditioning system using rotary compressor. Car air conditioning is performed with compact compressor operating over large domain of rotation speed. On other hand, the mass flow rate and refrigerant capacity my have to be taken into account for low and higher speeds speed compressor. The compressor model is analysis with the mathematical models and simulated with a computer program. The simulation program will generate result to compare with previous experiment data and validate the accuracy and reliability program of air conditioning system being developed.