EFFECT OF VALVE FLOW COEFFICIENT (Cv) TO THE PROPULSION SYSTEM OF HYDRO-PNEUMATIC HYBRID DRIVELINE

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This report is submitted
in fulfillment of the requirements for the degree of
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2020

DECLARATION

I declare that this project report entitled "Effect of Valve Flow Coefficient To The Propulsion System of Hydropneumatic Hybrid Driveline" is a result of my own work accept as cited in the reference.

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering

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Date : 26 August 2020

DEDICATION

To my beloved family for the endless support that they had gave, especially to my beloved father and mother, Abdullah bin Othman and Zaliffa binti Mohamed.

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ABSTRACT

Hydropneumatic hybrid is one of the types of hybrid vehicles. It is the combination of two or more propulsion subsystem forms that operate in the vehicles. This is a fusion of an internal combustion engine (ICE) and a power hydraulic system, and an energy source of pneumatic system. The system's aim is to make comparison between performance of different value of valve coefficient. This research was previously performed using a low valve flow coefficient. But then the result was that it produced a system with high pressure losses. This project will be comparing the results of 1 and 0.5 of the valve flow coefficient in the hydraulic system. The performance is then will be recorded. The result is 1 valve flow coefficient gives better power and low pressure losses. This project will involve design and simulation. This project is using a simulation approach, the outcomes can be best seen by validating with the actual experiment. For future work, it would be good to run the experiment on the real test rig as it would produce more reliable data compared with the simulation.

ABSTRAK

Hybrid pneumatik adalah salah satu jenis kenderaan hibrid. Ini adalah gabungan dua atau lebih bentuk subsistem penggerak yang beroperasi di dalam kenderaan. Ini adalah gabungan enjin pembakaran dalaman (ICE) dan sistem hidraulik kuasa, dan sumber tenaga sistem pneumatik. Tujuan sistem ini adalah untuk membuat perbandingan antara prestasi nilai pekali injap yang berbeza Penyelidikan ini sebelumnya dilakukan dengan menggunakan pekali aliran injap rendah. Tetapi hasilnya adalah bahawa ia menghasilkan sistem dengan kehilangan tekanan tinggi. Projek ini akan membandingkan hasil 1 dan 0.5 pekali aliran injap dalam sistem hidraulik. Keputusan datanya kemudian akan direkod. Hasilnya adalah 1 pekali aliran injap memberikan daya yang lebih baik dan kehilangan tekanan rendah. Data akan digunakan untuk menganalisis prestasi nilai pekali aliran injap yang berbeza. Projek ini akan melibatkan reka bentuk dan simulasi. Projek ini menggunakan pendekatan simulasi, hasilnya dapat dilihat dengan mengesahkan dengan eksperimen sebenar. Untuk kerja pada masa hadapan, lebih baik melakukan ujian sebenar pada rig ujian kerana akan menghasilkan data yang lebih dipercayai berbanding dengan simulasi.

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LIST OF ABBREVIATIONS

ICE	Internal Combustion Engine
HEV	Hybrid Electric Vehicle
HHV	Hybrid Hydraulic Vehicle
FCV	Flow Control Valve
PCV	Pressure Control Valve
DCV	Directional Control Valve
RPM	Revolution per minute
Cv	Valve Flow Coefficient

LIST OF SYMBOLS

p	Pressure (bar)
Q_{avg}	Average flow rate
Δp	Pressure difference
$Pout$	Power output at hydraulic motor
N	Speed in RPM
T	Torque
Pin, sys	Input power at the system
p_{sys}	System pressure

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CHAPTER 1

INTRODUCTION

1.1 Background

Recently, hybrid car usage has been highly requested by the target users and hit the market. Hybrid cars are becoming affordable for everyone to own because of the lower production cost despite a new technology being developed. Hybrid cars using both a conventional engine and an addition propulsion system. Unlike conventional cars that only use gasoline or diesel to power the internal combustion of the engine. As well as the conventional cars, hybrids also used an internal combustion engine and fueled like other standard cars.

Buying a hybrid car will give an alternative way to overcome the increasing of fuel market price. One of the best features of hybrid cars is that it saves gas. Hybrid cars achieve sufficiently better fuel efficiency compared to the non-hybrid counterparts because it is using both a conventional engine and an electric motor. Other than that, hybrid cars is environmentally friendly. This is because it emits less toxic emissions compared to conventional cars. So, less carbon dioxide released into the atmosphere.

Hydro-pneumatic hybrid is one of the hybrid vehicle types. It is the combination of two or more types of propulsion subsystems work in vehicles. It is a combination of an internal combustion engine (ICE) and a hydraulic system for the propulsion and pneumatic system for the energy source. The conversion of energy losses in the braking system into useful energy is

the main concept of this system. Secondary propulsion of the hydro-pneumatic system usually applied to heavy vehicles (Wasbari *et al.*, 2018). The hydro-pneumatic driveline consists of five subsystems which are propulsion unit, a regenerative system, storage, transmission, and control system. Hydro-pneumatic driveline uses a propulsion mechanism to move the vehicle. The regenerative system converts heat losses into compression energy. Then, the hydro-pneumatic accumulator is used to store potential energy. The second propulsion unit then will demand energy stored if it is required. Lastly, the control system will manage the hybrid system (Wasbari, Anas and Abu Bakar, 2016).

This project is focusing on the hydro-pneumatic driveline. The effect of system pressure and RPM on the power output and torque of the system will be investigated. Then, the hydraulic motor efficiency will be calculated.

1.2 Problem Statement

The hydro-pneumatic driveline sub-system is one of the drive systems. The system delivers energy from the energy storage to the actuator, the energy is then stored in the accumulator. The aim of the system is to apply a dual hydro-pneumatic hybrid driveline to a hydraulic hybrid passenger car. Previously, this project was carried out by using a low valve flow coefficient. But then the result was it produced high pressure losses to the system. This project will be comparing the results of 1 and 0.5 of the valve flow coefficient in the hydraulic system. The performance is then will be recorded. The data will be used to analyse the performance of the different value of valve flow coefficient. This project will involve design and simulation.