EFFECT OF FILTER UNIT BACK PRESSURE TO THE WATER HYDRAULIC SYSTEM PUMP PERFORMANCE

HO BEE KIM

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Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

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"I hereby declared that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and qualify for the award of the Degree of Bachelor Mechanical Engineering (Thermal Fluids)".

Signature : .....

Name of Supervisor : FAIZIL BIN WAGBARI

Date : 25/6/2012

"I hereby declared that this is my own work except the ideas and summaries which I have clarified their sources"

Signature : .....

Author : HO BEE KIM

Date : 25/6/2012

Special dedicate to

My lovely

family, supervisor, friends, and all that help me to finish my thesis.

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ABSTRACT

This thesis presents a study of the effect of back pressure of filter unit in the water hydraulic system. The main purpose of this project is to study the difference of performance of a water hydraulic system with filter and without filter unit installation. The other purpose of the project is to study about the effects of flow rate to the back pressure of filter unit in the water hydraulic system. An application system which is an automatic operated door in water hydraulic system has designed to test the performance of the system with the existence of back pressure. The designed application system was simulated by using fluid simulation software to simulate the motion of the system. The hydraulic circuit will then help in set up of the experiment. Comparison experiment with filter and without filter was tested to examine the effect of back pressure in the performance of water hydraulic system. Another experiment will be carrying out to test the effects of different flow rate to the back pressure in water hydraulic pump system. As a result, the formation of back pressure was detected with the installation of filter cartridge in the system. With the increased of flow rate, the back pressure showed increment in the system. A few recommendations were suggested to improve the performance of water hydraulic pump system.

ABSTRAK

Tesis ini membentangkan kajian yang berkaitan tentang kesan tekanan balik unit penapis di dalam sistem hidraulik berasaskan air. Tujuan utama projek ini adalah untuk mengkaji tentang perbezaan prestasi sistem air hidraulik dengan penapis dan tanpa pemasangan unit penapis. Selain daripada itu, projek ini juga mengkaji tentang kesan kadar aliran kepada tekanan balik unit penapis di dalam sistem air hidraulik. Aplikasi yang merupakan pintu automatik yang dikendalikan dalam sistem hidraulik berasaskan air telah direka untuk mengkaji prestasi sistem dengan kewujudan tekanan balik. Sistem apikasi yang direka telah disimulasi dengan menggunakan perisian simulasi bendalir untuk mensimulasikan pergerakan sistem. Litar hidraulik akan membantu dalam ujikaji. Ujikaji perbandingan dengan penapis dan tanpa penapis akan diuji untuk mengkaji kesan tekanan balik dalam prestasi sistem air hidraulik. Satu lagi kajian akan dijalankan untuk menguji kesan kadar aliran yang berbeza kepada tekanan balik dalam sistem pam hidraulik air. Hasilnya, pembentukan tekanan balik dikesan dengan pemasangan unit kartrij penapis dalam sistem. Dengan peningkatan kadar aliran, tekanan balik menunjukkan peningkatan dalam sistem. Beberapa penambahbaikan telah dicadangkan untuk memperbaikikan prestasi sistem hidraulik berasaskan air.

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A	Cross Sectional Area
D	Diameter of cylinder
F	Force
N	Angular Speed
P	Pressure
Power	Power that generated
Q	Flow Rate
S	Distance moved by piston
t	Time
V	Volume
v	Velocity
W	Work

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CHAPTER 1

INTRODUCTION

1.1 Overview

Water hydraulic system pump is a system in which water is drawn from tank to a system by using a pump. The pump is driven by a motor so that it can be turned. A filter is added before water flow from the tank into the pump to avoid any unnecessary dirt particles flowing in the system.

A water hydraulic system pump depends on the pressure of water. The pressure of water is best in interpreting the performance of water. However, the existing of filter in the water hydraulic system may influence the pressure of water, especially the back-pressure of the filter. Pressure gauge is installed in the system to measure the difference of pressure change with and without the existence of filter. Besides, the variation of pressure in the system also will be observed in the project by manipulate the different pump flow rate.

1.2 Objectives

This project is about investigating the effect of filter unit back-pressure to the water hydraulic system performance pump. The objectives are as follow:-

i. To find the pressure comparison between without filter and with filter unit.
ii. To find back-pressure profile with different pump flow rate.

1.3 Scopes

The scopes of the project are as follow:-

i. Setup a water hydraulic system pump.
ii. Run the pressure comparison experiment between without filter and with filter unit.
iii. Collect data of back-pressure profile with different pump flow rate.
iv. Propose improvement of filter unit in the performance of water hydraulic system pump in case of necessary.

1.4 Problem Statements

The advantages that bring by filter in the hydraulic system are undeniable such as the ability to prevent dirt particles, reduce the frequencies in maintenance of the pump system and so on prolong the life span of the whole hydraulic system. However, the back-pressure that bring by filter has badly influenced the performance of the pump system. The problems include generating of excessive case pressure, seal failure and also the mechanical damage that bring to the system. Besides, the high back pressure will lead to leakage of the pump suddenly which is then caused injuries. More research and experiment are required to study the problem.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this section, the effect of the back-pressure of filter unit to the water hydraulic system will be review through trustable journals and books which has published. This part of discussion helps in more understanding about the approach of the project. It is a summary and synopsis of the study in the field of the project.

2.2 Definition of Back Pressure

"A condition in which the owners system pressure is greater than the suppliers' system pressure." Environment Protection Agency (2003). "Cross-connection Control Manual." United States: (EPA 816-R-03-002) Back pressure will be generated when fluid is pump through an obstructions or tight bends by a confinement vessel. The obstruction here is point to the filter unit while the confinement vessel is mean to be the water pump. Backflow is the undesirable reversal of flow of non-portable water or other substances through a cross-connection and into the piping of a water system. Back pressure is created when an undesirable backflow exists in a water system. A good quality of filter may create higher back pressure compared to a less quality of filter. A good quality of filter has finer structure so higher back pressure will be created. As back pressure increases, the

water flow rate will become smaller. In case filter gets clogged, then more force is needed to pump water through the filter.

2.3 Water Hydraulic System and Components

Water hydraulic system is a system which uses water as a pressurized medium in power transmission for machine apparatus, stuff handling devices, transport and etc. Water hydraulic system helps in reducing fire hazards, operating cost and contamination. It also contributes to the low volume applications and environmental friendly.

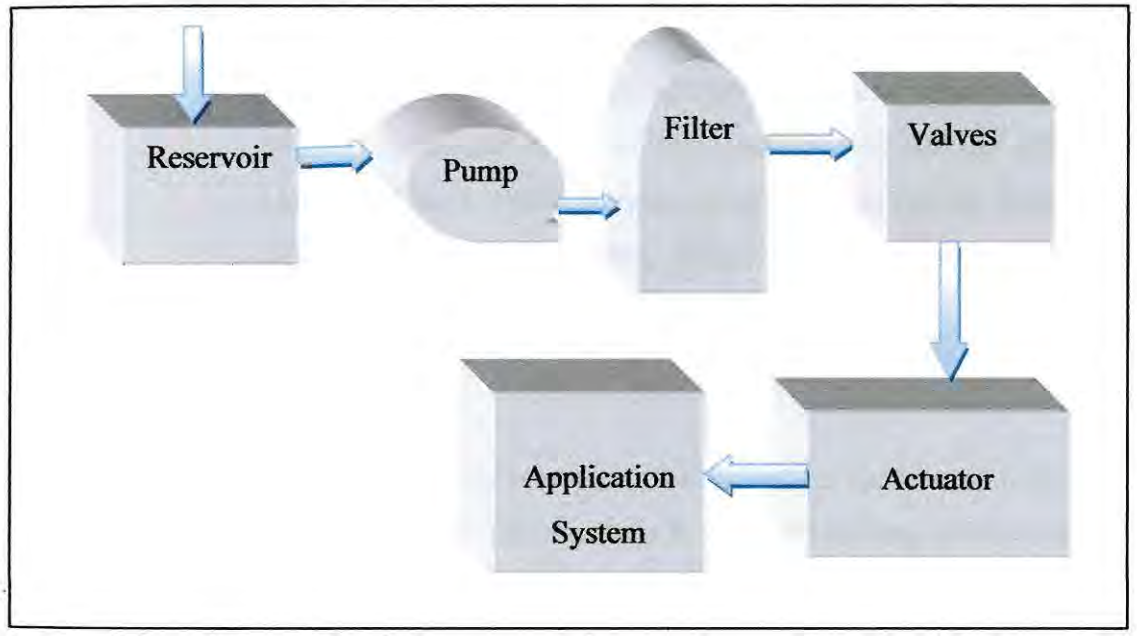

Figure 2.1: Schematic Diagram of Water

Due to the patent (Roger, 1971), Figure 2.1 shown the basic components of water hydraulic system are hydraulic fluids, reservoir, pump, filter, valve, actuator and etc. The descriptions of these components are shown below:

i. Hydraulic fluids

Water acts as a working fluid in the water hydraulic system, it is non compressible so that can transmit power easily from one end of the system to the other end of the system. It is also use to lubricate the

moving parts in the system to reduce friction loss and help to cool the components in the system. Besides, the working fluid should assist in removing contaminants to filter to avoid blockage. It also plays role as seal against leakage inside a hydraulic component of the system.

ii. Reservoir

The function of a reservoir in water hydraulic system is used to store the system's fluid which is water. Generally, the material of reservoirs is stainless steel or plastic or metal which coated with metal corrosion resistant material. The size of reservoir is larger than conventional hydraulic system.

iii. Pump

Pumps used to create flow in water hydraulic system. Fluid is drawn into the cavity of pump opening during the half cycle and then expels the fluid from the cavity of the pump closing for the other cycle. (Andrew, March 1999) Various types of pump can be used in water pump system such as piston pump, gear pump, vane pump, axial piston pump, radial pump and etc.

iv. Filter

This device use to keep clean for the system component from dirt and minute particles. This can help to prevent blocking in the components of the system and avoid from wear of those components. Filter can be installed between the components of the system and also install in the reservoir. The coarse type of filter install in the reservoir to remove large particle, while separate filter install between the components of the system to remove finer elements from entering the system.

v. Valves

There are three types of control valves can be used in water hydraulics system pump. Generally, the control valves include directional control valve, pressure valve and flow control valves. The function of directional control valves is used to control the water flow path by

changing the ports of the valve so that flow of fluid can be direct to the desire way. Pressure valves are divided into pressure relief valves, pressure reducing valves and sequence valve. Pressure relief valves are use to control the overloading of flow in the system. While pressure reducing valves and sequence valves are used to reduce the supply pressure and using pressure to manage the sequence of hydraulic circuits.

vi. Actuators

Actuators that used in the hydraulic system are cylinder and hydraulic motor. Cylinder which is also called as linear actuator is used to produce straight line motion for the hydraulic system pump. There are two types of cylinder which are single acting cylinder and double acting cylinder. The single acting cylinder has only one fluid chamber and produce force only in one direction. While the double acting cylinder can operated in two ways and power stroke can be produced in either way. Hydraulic motor also called as rotary actuators which can produce rotary motion for the hydraulic pump.

2.4 Types of Contamination

Generally, contamination divided into two types, externally contamination and internally contamination. External contaminant is generated from outside the system while internal contaminant is generated within the system. Both types of the contaminants are grouped as particulate contamination which is made of various materials of solid particles. External contaminant includes dirt, grimes and others. Internal contaminants exist when some of the components of the system wear. The contaminants may come from wear pump, actuator, seal and bearing. (Weibing D. & Larry S., 2004)

2.5 Causes of Contamination

According to Majumdar S.R. (2002), contaminants can be generated in a hydraulic system through:

- Insufficient cleaning of component parts which generated during manufacturing or assembly).
- The refill fluid may be polluted before entering the system.
- Wear particles are continually being generate by an operating system.
- Chemical breakdown of the hydraulic fluid.
- Occurring of cavitations.
- Ingest airborne contaminants through air breather and cylinder rod seals.
- Ingestion of contaminants during servicing or installation or replacement of components in the system.

2.6 Problems Caused By Contamination

A number of problems which caused by contaminant are stated in Majumdar S.R. (2002) as shown as below:

- Speed up the wear of components in the system, thus influence the system performance and service life.
- Slow down the operation of the system and cause the moving parts not operate smoothly.
- Score finely finished surfaces and lead to leakage by damage seal.
- Causing leakage and losing control during operation when contaminants stop valves from sealing properly.
- Act as a catalyst in assisting the oxidation of hydraulic and breakdown.