AUTOMATIC FOOD PROCESSING SYSTEM USING WATER HYDRAULIC TECHNOLOGY

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SUPERVISOR'S DECLARATION

I hereby declare that i have read this thesis 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 (Hons)

Signature : .....

Name : .....

Date : .....

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ARIFF SHAZAL BIN. MOHD. SALIM

A thesis submitted in fulfilment of the requirements for Bachelor of Mechanical Engineering (Hons)

Faculty of Mechanical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

DECLARATION

I declare that this project report entitled "Automatic Food Processing System Using Water Hydraulic Technology" is the result of my own work except as cited in the references

Signature : .....

Name : .....

Date : .....

DEDICATION

Special dedication to my beloved Abah and Umi,

Without them I am nothing.

ABSTRACT

This project main objective is basically to improve the food processing that uses water as the power transmission medium. Cleanliness is one of the focus of this project which water as the working fluid plays major role in this. Studies, journals and data from past researchers were used as reference to determine the methods used in this project. The methods that has been used in this project refer to the reconstruction of automation controller and testing the working fluid to ensure the food processing unit is fit to operate in a hygienical environments. PLC has been used as a controller for the system and two programs or diagrams has been design for the automation of the system. The used of PLC is much more reliable in terms of cost and troubleshooting. The results showed that the water pH is still within the limits but increasing on average 1.14% per week over time. Next the TDS readings of ppm shows scale formation inside the system. The experiments are also focused monitoring the working to determine the presence of impurities such as rust and scale. The expectation for this project is that the presence of scale and rust will be inside of the system and some equipment will be affected.

ABSTRAK

Objektif utama projek ini adalah untuk menambah baik mesin pemprosesan kuih semprit yang menggunakan air sebagai medium penghantaran kuasa. Kebersihan juga salah satu factor utama dimana air sebagai bendalir yang digunakan memainkan peranan penting untuk kebersihan. Kajian, jurnal dan juga data daripada penyelidik sebelum ini digunakan bagi menentukan kaedah yang digunakan oleh projek ini. Kaedah yang digunakan oleh projek ini adalah pembikinan semula pengawal automatik dan menguji air yang digunakan bagi memastikan sama ada mesin pemprosesan kuih semprit ini boleh digunakan ditempat yang mementikan kebersihan. PLC juga digunakan sebagai pengawal sistem ini dan dua program PLC sudah dicipta untuk mengautomasikan sistem ini. Penggunaan PLC memudahkan kerja penyelesaian masalah bagi pemasangan fizikal. Hasil kajian mendapati bahawa tahap pH air semakin lama semakin meningkat sebanyak 1.14% setiap minggu. Bacaan TDS juga menunjukan peningkatan nilai ppm dan juga karang. Experimen ini juga fokus kepada pengawasan air untuk menyiasat kehadiran benda asing di dalam sistem ini. Harapan projek ini adalah penemuan karat dan hasil mineral di dalam sistem ini dan beberapa peralatan akan mengalami masalah daripada ini.

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LIST OF ABBREVIATION

PLC	Programmable Logic Controller
pH	Power of Hydrogen
I/O	Input / Output
LED	Light Emitted Display
TDS	Total Dissolved Solid
(NO)	Normally Open
(NC)	Normally Closed
ppm	Parts per million
lpm	liter per minute
DCV	Directional control valve

CHAPTER 1

INTRODUCTION

1.1 Background of study

This project is basically a combination and continuation research from past researchers named Muhammad Syafiq (2013), Mohamad Haikal and Hafizi (2014), and Muhammad Zulfaqqar (2017). Previously, Hafizi had completed his research which related with the generation of water-based power unit while Muhammad Syafiq research was related to the design and manufacturing process for the food processing unit. Afterward, Mohamad Haikal proceeded it by improvising the machine component and installing programmable logic controller (PLC) into the system. Some way or another, Syafiq and Haikal just figured out how to conduct the food processing unit research by utilizing oil as a medium for the hydraulic system. However, Zulfaqqar did manage to utilize water as the working fluid for this food processing unit. This project is focused on the cleanliness of the system continuing Zulfaqqar research, repairing the electrohydrolic or timer-relay circuit that has been designed by Zulfaqqar and applying the said circuit to PLC for complete automation that previously Mohamad Haikal only manage to design the PLC for manually operated system.

Normally in food processing industries, they valued the cleanliness in their surroundings. In this manner, significant amount of the industries utilizing pneumatic system since it has a higher hygienic value in contrast with oil based hydraulic system. Despite the fact that water-based hydraulic system more prominent than of the pneumatic system, they

would incline toward pneumatic system because of the technological limitation of that time. Since limitation happened in the past easily overcome these days, water-based hydraulic system should re-develop again in this industry. Utilizing pneumatic system has low efficiency because the system requires a compressor. The function of compressor is compress the air and store it in a container for later use. However, it is impossible to accomplish uniform and constant piston speeds with compressed air.

Water based hydraulic system is already famous and being active back on 1980 in the western nation after it's declined in the early 1906 (Krutz and Chua, 2004). The development of water hydraulic can be visualized as a time graph shown in Figure 1. The deterioration and re-emergence of water hydraulic system was caused by several factors. First due to the limitation of water such as corrosion, freezing, low viscosity, higher bulk modulus, cavitation, formation of scale, and poor lubrication. Water hydraulic then reemerge back to society as increased of safety awareness, new environmental policy, health and safety of product consumers, long-term manufacturing cost, technological advancement, and advantages of water hydraulics against oil as working fluid.

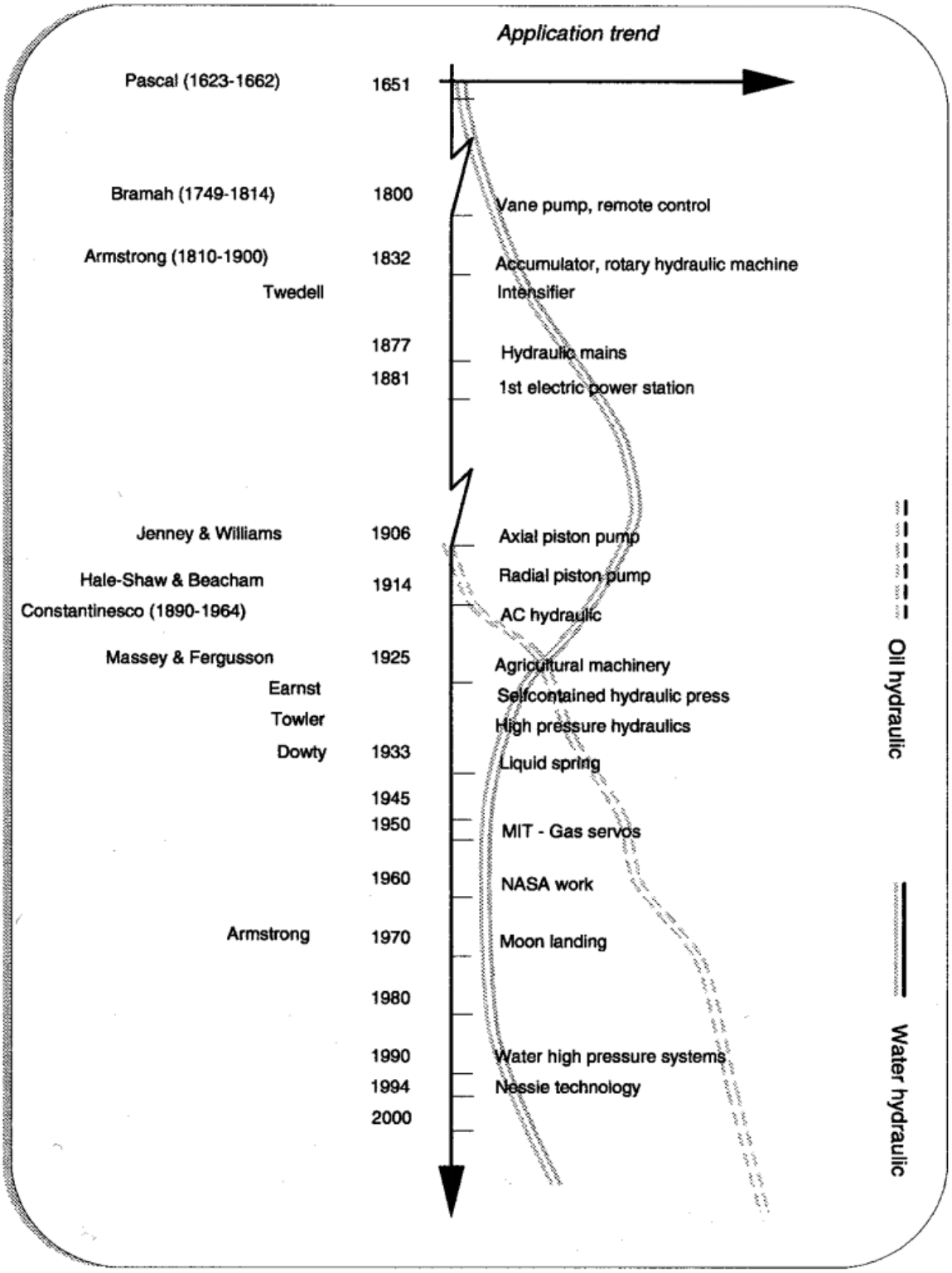

Figure 1.1: The Historical Development of Oil and Water Hydraulics

(Krutz & Chua, 2004)

1.2 Problem statement

Cleanliness and hygiene is the most imperative thing in the food industries. On modern day food industries use pneumatic system as it main system replacing older working fluid such as oil but with air the system engages many problems not only hygienically speaking but in terms of efficiency as well. Water hydraulic system however, fit all the criteria that pneumatic system also has and even several advantages against pneumatic system. Leakage problem for example, water hydraulic system will not harm its users because there is no dangerous gases or oil that will leaks out but only water. It also easier to detect where the leak is in the system. Water pose bigger threat than mineral oil which is rust, this will effect the overall performance and lifespan of the system. Besides that, safety is also the main reason to replace the system. Other than that, for processing unit that requires automation, installing a controller that met the safety requirement, easy to use, inexpensive and easy to maintain is a must.

1.3 Objectives

The objectives of this project are as follow:

1. To upgrade the system's controller and making it fully automated.
2. To investigate the working fluid's (water) pH and TDS level.
3. To investigate the effect of rust on the food processing unit parts by using visual inspection

1.4 Scope

The scope of this project are:

1. Upgrading the controller system from using a set of mechanical relays to the use of PLC with two sets of programs.

2. Monitoring the working fluids (water) by recording the pH and TDS readings every week for 12 weeks.

3. Installing conveyor belt to the system to move the product from the machine to another station

4. Checking and maintaining the DCV for rust and erosion damage by dissembling the parts from the system.

CHAPTER 2

LITERATURE REVIEW

2.1 History

Water hydraulics is not something new in the advancement of innovation. The world's first researcher, in The Greek Thales inspired further research on water when he announced water is a substance and not a blessing from the gods. After that Aristotle pronounced water a continuum which all of hydraulics depends on the law, what occurs at point A is transmitted to point B. After that, numerous gadgets in light of handy articulations of the water driven standards had been made by Ktesibios which originates from Alexandria and he is not from Greek province (Koskinen, 2011).

Around of the time, Archimedes was the primary individual to express that the presence of a pressure gradient was fundamental to flow. Archimedes additionally confirms that the impact of a disturbance in a closed framework at point A will be seen at point B. Another astonishing individual that takes out mathematical equation is Da Vinci. His equation is to compute volume flow and he is the first individual managing the stream of water past a mill wheel by applying closed-loop control. The first individual to make a

difference between ideal and viscose fluids is Simon Stevin. He also said the result of head and area as pressure independent with body of vessel (Koskinen, 2011).

Between the year of 1608 and 1647, Evangelista Torricelli runs barometric test and the relationship between outflow and head. Blaise Pascal is accountable for the affirmation that in a static fluid the pressure is the same anywhere and it is known as Pascal's Law until today. Blaise Pascal additionally inveterate relationship between the force area and the pressure. After that Robert Boyle set up the connection between volume, pressure and temperature known as Boyle's Law (Koskinen, 2011).

Additional contemplate is made and Sir Isaac Newton made his Second Law which permits calculating pressure required in a mass-based system and Daniel Bernouilli inveterate the relationship between flow velocity and local pressure. On 1703 until 1783, Leonhard Euler built a arrangement of mathematic in light of particles as opposed to points which had a colossal effect to those researching the specific nature of fluids (Koskinen, 2011).

Joseph Bramah an English inventor, has invented a hydraulic press that used water as its hydraulic fluid in 1976. This press also goes by the name of Bramah press. Bramah's press encapsulated the rule originally settled by Pascal in 1647, where by applying a force to a small area plunger in a closed cylinder can be utilized to act upon a bigger area plunger to deliver a correspondingly bigger force if the fluid spaces in the two plunger or piston cylinder is connected to each other (Gibson, 2009).

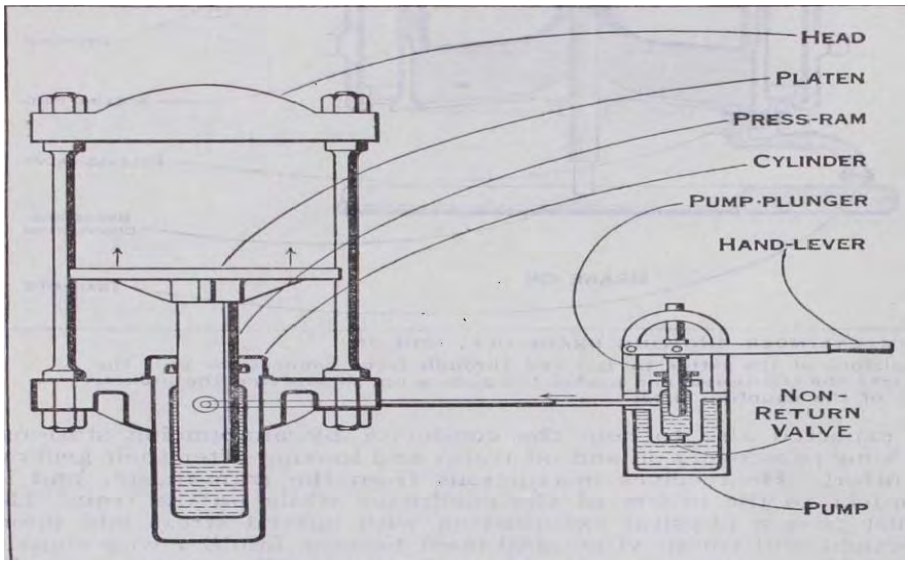

Figure 2.1: Bramah Press

This significantly improves hydraulics related invention as water produce no hazardous waste and much cheaper than oil. This became one of the greatest invention that's environmental friendly. After his creation, water was utilized as power transmitter in the fluid power system. After some time in 1900's, electrical innovation has associated with the fluid power system and water turns into the greatest restriction since water will go act as a conductor and possess a major health risk (Park, 2009).

2.2 Water

Essentially, water is a compound which mixture of one oxygen atom and two hydrogen atoms, bonded together by shared electrons. It is known as V-shaped polar molecule, which implies that the hydrogen atom is positive charged and pulls in to the negative charged oxygen atom. As a result of the polarity, water molecules are normally pulled in and adhere to each other, forming hydrogen bond. This hydrogen bond is the reason water have numerous unique properties, for example, the way that water is significantly denser in its fluid state contrast with its solid state.