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IMPROVEMENT OF THE REACTOR FEED PUMP PERFORMANCE BY IMPLYING SIX SIGMA METHOD USING THE DMAIC PHASES

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"I confess that this work is the result of my own investigations. All sections of the text and results, which have been obtained from other workers/sources, are fully referenced"

Signature :…….

Writer's name :…….

Date :…….

To my husband, son and family

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Assalamualaikum warahmatullahiwabarakatuh

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ABSTRACT

Six Sigma methods are used to determine solutions where it involves statistical analysis towards the problem statement. One of its important tools is DMAIC that consists of five different phases and each phase will determine results that are relatively connected to each other. In this case the performance of the pump is to be concerned. Using the DMAIC approach, which are define, measure, analyze, improve and control, the frequency of failure of the pump is to be studied and analyze. This study is conducted to help reduce the pump's failure frequency by suggesting a standardized system on the pump's maintenance schedule. Raw data are gathered from previous record of failure from the Technical Engineering Department, Pan Century Edible Oils Sdn Bhd. The data then are studied to determine the root cause and the reason that make it so significant. This study is managed to pull out the suitable solution by sorting a systematic study plan to minimize the failure frequency of the pump.

ABSTRAK

Six Sigma merupakan satu kaedah penyelesaian masalah di mana ia melibatkan analisis statistik bagi sesuatu pernyataan masalah. Salah satu daripada cabangnya adalah DMAIC yang terdiri daripada lima fasa yang berbeza iaitu menyatakan (define), mengukur (measure), menganalisa (analyze), memperbaik (improve) dan mengawal (control) serta setiap fasa akan menentukan keputusan yang saling berhubung kait antara satu sama lain. Dalam kes ini, prestasi pam di teliti sebagai bahan kajian. Dengan menggunakan pendekatan DMAIC, kekerapan kegagalan dikaji and dianalisa. Kajian ini dijalankan bagi mengurangkan kadar kegagalan pam dengan mencadangkan satu sistem piawai ke atas jadual penyelenggaraan pam. Pengambilan data mengenai kerosakan pam daripada rekod terdahulu diperolehi daripada Jabatan Kejuruteraan Teknikal, Pan Century Edible Oils Sdn Bhd. Data kemudiannnya dikaji untuk menentukan faktor utama yang menyumbang kepada berlakunya kegagalan dan kenapa ianya begitu ketara berbanding faktor-faktor yang lain. Kajian menunjukkan penyelesaian yang sesuai berjaya dicapai dengan menyusunatur pelan kajian sistematik bagi meminimakan kadar kegagalan pam.

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CHAPTER I

INTRODUCTION

Statistical analysis is to be done in this project. Using the DMAIC tools under the Six Sigma approach, the data will be studied and analyzed to determine the problem statement, scope of study and objectives of this study.

1.1 Problem statement

Reactor feed pump is one of the most important pump at the hydrogenation plant. It transfer feed from vessel to reactor for further processes. Once it stops functioning properly, the whole plant system will be interrupted. This will cause the plant to be shut down for a period of time, where technical team will attend to the problem caused by the pump. In a long term, the company will spend more on the corrective maintenance of the pump. This is because, the cost of the pump's spare parts are expensive. The total loss hour of production will decrease the company's profit as

hydrogenation plant contributes a large percentage from the company's net profits. Usually when the pump stops functioning properly, the plant will take minimum one day to perform the maintenance procedure.

Maintaining the pump's performance is very important to the whole plant's system. Of course the pump will not run smoothly hundred percent, but to prolong its operation hour will be a great deal. Not only it will save budget on corrective maintenance, it will also help the company to maintain or increase their net profits.

1.2 Scope

To conduct an analysis on the data, limitations will be set so that the objectives of this project can be achieved. Limitations are important because the analysis later will be focused on the problem statement only.

The scope of this project is to:

- To identify technical problems that causes the pump to mal-function.
- To set solutions that can help solve or minimize the problems and this solution must meet the industry's requirement.

Technical problems of the pump will be focused on this project as it seems to be the major failure to the pump. Procedure on operating the pump will not be included; however it will be used as reference to understand how the pump really works. The plant's overall process will also not be included as it also depends on the pump.

The solutions that will be gained after analyzing the data must meet the industry's requirement so that the company can choose whether to apply the solutions or not. The solutions means to help the plant to operate normally without holding their operation hour for too long. In the operation department perspective, consume to much

time on shut down will cost them trouble especially when dealing with customers on a high peak business term.

1.3 Objectives

The objectives of this project are:

- To ensure the product manufacturing (batch per day) is not interrupted by technical problems.
- To ensure a more systematic maintenance system.

By minimizing the pump's technical problems, the plant's operation will run more smoothly. This is a very important aspect of the plant's production schedule. Any delay or shutdown definitely will give negative effect on the plant's output. This matter will not only be concern to the technical team but also to the management team. Productivity of the plant will resemble the co-operation between respective team.

The most important for the technical team is a better maintenance system so that everyone can comply with it. A better maintenance system will ensure a better operating hour for all mechanical components in the plant but in this project, the only concern is the reactor feed pump.

1.4 Report summary

This report is consists of six chapters. Each chapter is different from one another however the content will be relevant starting from chapter one to chapter six.

1.4.1 Chapter One

Chapter one will explain about the problem statement, scope of project and objectives. A real problem will be studied and from the overall picture, the problem statement is extracted to make focus on stating the scope of project and objectives.

1.4.2 Chapter Two

Chapter two is more on reviewing data and information on aspects regarding the pump which are the company, hydrogenation plant, the pump's characteristic, quality and last but not least the method in overcoming the problem; Six Sigma and its tools DMAIC. There is no previous research regarding the problem statement given. All of the aspects mentioned in this chapter are relevant to one another to give a picture of how actually the pump's performance affects the whole situation.

1.4.3 Chapter Three

Methodology to conduct this project will be discussed in this chapter. As mentioned in the project title, the tool that is going to be used is DMAIC under the Six Sigma approach. DMAIC is actually consists of five different phases which are define, measure, analyze, improve and control. Under these five phases, there are several tools and for this project, only suitable tools are selected to analyze the data and gain results. This chapter also explains about STATISTICA software. STATISTICA is statistical software that helps to interpret data into an easier form to understand and analyze.

1.4.4 Chapter Four

The data were analyze and shown in this chapter. The results from each tools starting with the Define phase until the Control phase are continuously parallel which means the results from the Define phase will be used to be analyzed at the next phase. At the end, solutions for the problem statement will be gained. STATISTICA helps to transform data into graphical depiction for better understanding. It also helps to count automatically any necessary statistical characteristics.

1.4.5 Chapter Five

The results from chapter four will be discussed in chapter five. Chapter five will explain about the significant of the result and the fact of actually selecting the tools to analyze the data. Any abnormalities in the data will also be mentioned in this chapter.

1.4.6 Chapter Six

This chapter will summarized the whole project including methodology, results and a brief proposal of future project. Summarizing the whole project is different compare to abstract of the project. It is more on straining the results and it's significant to this project.

CHAPTER II

LITERATURE REVIEW

This chapter focuses on Pan Century Edible Oils Sdn. Bhd., Hydrogenation Plant and the reactor feed pump itself. From the reviewing of information later on will lead to detail analysis on what causes the problems and suitable method will be used to solve them.

2.1 Organization background

Pan Century commenced its operations in Malaysia in early 1978. Today, the company operates 13 plants at single location consisting of physical refining, fractionation, hydrogenation, splitter, soap noodle and glycerin manufacturing facilities with annual capacity of more than 1 million tonnes refined palm oil and related downstream specialty products. All the plants are high tech, world class plants equipped with modern instrumentation and process control.

The company added to its account, a number of awards including biggest throughput awards from Johor Port authorities, export achievements awards from Ministry of Trade and Industries Malaysia, Excellence Manufacturer Award from Federation of Malaysian Manufacturer, Global Quality Management Award United Kingdom, Energy Management Award from Malaysian Government and Environment Care Award. The Company is ISO 9002 accredited and is always striving to maintain a high standard of products and services to its customers.

The infrastructure available include Tank Farms of 80,000 tons capacity including stainless steel and epoxy coated mild steel tanks, 50 percent at Felda Johor Bulkers (FJB) with agitators for products uniformity. Factory tanks are linked to the most modern vegetable oil bulking facility in the world, FJB. A well organized dispatch bay is also available for dispatches via road tankers, ISO-tanks or for drummed products. For products sold in the free flowing flaked form, a comprehensive flaking and bagging plant complete with warehousing facilities has been provided. Products in bead form can also be supplied. A pilot plant for soap finishing is also available where soap formulation, stability is also available where soap formulation, stability and fragrance retention on finished soaps are studied to serve the customer better.

2.1.1 Organization management

Pan Century Edible Oils Sdn Bhd is currently managed by IOI Group, which is one of the most successful business groups in Malaysia. For almost a year of management which started on June 2007, Pan Century Edible Oils Sdn Bhd beginning to grew firm to be the most production refinery plant in Pasir Gudang. For 30 years, this plant was managed by Aditya

Birla Group from India. IOI bought Pan Century Group's plant and refinery in for RM423 million.

2.1.2 Departments in the Organization

There are nine departments that support this organization. Each department is related to one another and also has their own responsibilities.

Table 2.1 Departments with their specific responsibilities

DEPARTMENT	RESPONSIBILITIES
a. Human Resource	o Worker's welfare o Salary o Job advertisement o Worker's recruitment
b. Laboratory	o To maintain quality of product
c. Utilities	o Prepare tools, devices or component that will be used by maintenance department (mechanical, instrument and electrical)
d.Technical Engineering	o Maintenance and preventive maintenance on all mechanical equipment
e. Instrument	o In charge of electronic devices
f. Electrical	o Maintenance and preventive maintenance on all electrical equipment
g. Research and Developement	o Perform testing on product's potential o Research on latest technology to be used in the organization to enhance production

	o Develop current technology used o Modification on current technology for better performance
h. Operation	o Arrange product capacity for loading and unloading o Dealing with customer regarding products they want to purchase.
i. Purchase and Account	o Dealing with supplier o Arrange salary (account) o Prepare purchase order o Receive delivery order o Payment for bills

2.2 Hydrogenation plant

Hydrogenation plant is a batch process plant with loop reactor. The reactor is however functioned without stirrer or any other internals. Technology used in this plant is supplied by Buss Technology from Germany. The plant is commissioned in 1990 and the original batch size is 6.5 metric tons. Based upon type of feed and iodine value (IV) drop, the plant is capable of producing 15 to 20 batches or 100 to 130 metric tons per day. Hydrogenation is carried out at 19 to 20 bar of hydrogen pressure.

All equipment and piping are made of stainless steel (SS316). Reaction loop equipment is designed for 25 bar pressure and 230 degree Celcius maximum temperature. Plant control system is programmable logic control (PLC) based and semi automatic. Variable cost components of hydrogenation are hydrogen (48 percent), nickel catalyst (46 percent), power (5 percent) and balance is steam and water.

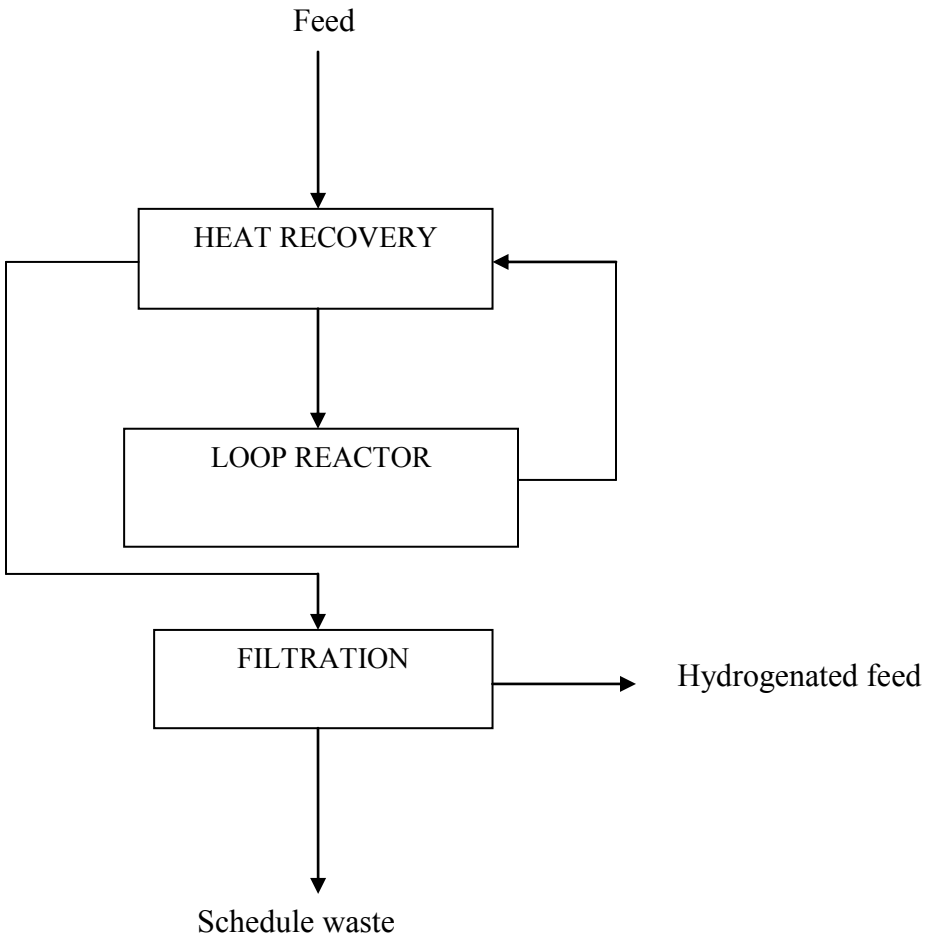

Figure 2.1 Hydrogenation Plant Process Flow Chart

2.3 Reactor feed pump

Reactor feed pump is a multi-staged pump where it is consists of more than one set of impeller and diffuser. It is also one type of centrifugal pumps and it has been installed at hydrogenation plant since 1990. This pump is very important to the plant's

operation due to its function which is conveying and distributing hydrogenated oil to the main reactor for further process.

The usage of this pump provides the following advantages:

- Excellent hydraulic pressure output and flow rate
- Minimum electricity consumption
- Extremely quiet operation

The pump also suitable to transfer non-aggressive and non-explosive liquids without solid particles or fibres and these criteria suits the medium the currently flows through. It is also non-self-priming, equipped with mechanical shaft seal and extended pump and motor shaft. The pumps have axial suction branch and radial discharge branch and are mounted on base plate. All movable parts in contact with the pumped liquid are made of stainless steel.

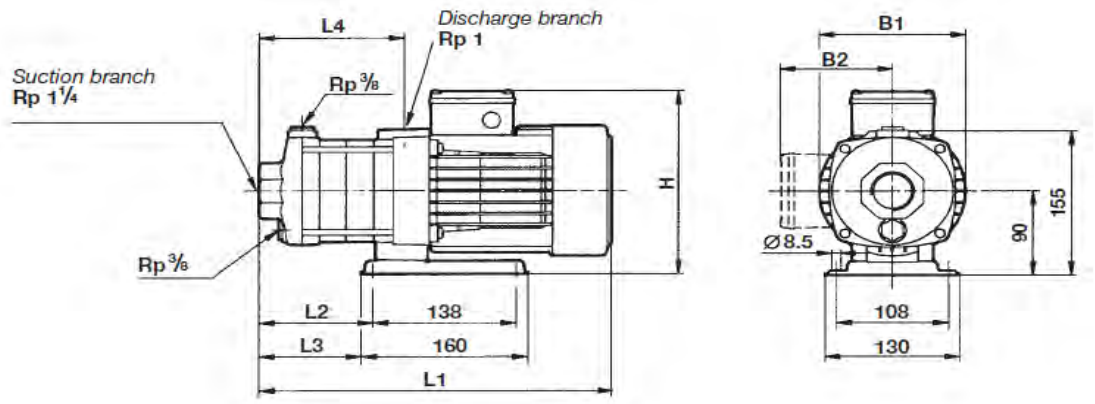

Figure 2.2 The pump dimensional drawing. All dimensions are in millimeter except for suction and discharge branch which are in inch.