



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **SEMI-AUTOMATED MACHINE TO MAKE SOAP FROM USED COOKING OIL**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design) with Honours

by

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FACULTY OF ENGINEERING TECHNOLOGY

2015

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Semi-Automated Machine to make Soap from Used Coking Oil**

SESI PENGAJIAN: **2015/16 Semester 1**

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I hereby, declared this report entitled “Semi Automated Machine to make Soap from Used Cooking Oil” is the results of my own research except as cited in references.

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## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

.....  
(NURUL AIN BINTI MAIDIN)

## **ABSTRAK**

Laporan ini menerangkan tentang produk yang dinamakan *Semi-Automated Machine to make Soap from Used Cooking Oil*. Pada peringkat awal laporan ini menjelaskan tentang pengenalan, latar belakang projek, pernyataan masalah, objektif, skop, organisasi projek, dan jangkaan hasil. Laporan ini juga menerangkan tentang kajian yang telah dilakukan dan kaedah yang digunakan dalam pengeluaran produk ini. Soal selidik telah dijalankan untuk mendapatkan kehendak pengguna. Melalui kajian ini, terdapat beberapa jenis konsep reka bentuk telah diwujudkan. Konsep yang terbaik telah dipilih untuk membangunkan produk ini. Perhatian khusus telah diberikan kepada proses merekabentuk dan proses pembuatan produk. Kesimpulannya, mesin ini telah dibangunkan dan ia berfungsi dengan baik. Tambahan pula, terdapat juga idea tambahan telah dicadangkan untuk projek masa depan.

## **ABSTRACT**

This report explains about the product named Semi-Automated Machine to make Soap from Used Cooking Oil. In the very beginning of the report has explained about the introduction, background of project, problem statements, objectives, scopes, organization of project, and expected result. This report also describes the studies that have been done on this project and the method used in the production of this product. Questionnaire survey was carried out to obtain customer needs. Through this survey, there are several types of design concept has been exist. The best concept has been chosen to develop this product. Special attention has been paid to the designing and the manufacturing process of the product. As a conclusion, the machine have been develop and it being function well. Furthermore, there is also additional idea has been proposed for the future.

## **DEDICATION**

I dedicate my dissertation work to my lovely late father, Abdul Rahman bin Badron for his hard work while he was still alive. Special thanks to my supportive mother, Hasnah binti Abu Bakar for her ongoing love and encouragement. There is no doubt in my mind that without her continued support and counsel I could not have completed this process. To my brother and sister, Mohd Aszuan bin Abdul Rahman and Siti Aszuani binti Rahmat who have never left my side and give help without complaining. Finally, not forgotten to my special friend, Muhammad Murtazdha bin Jaapar, through good times and bad, his kindness and extensive support has been present in this important time of my life, for which I am eternally grateful.

## **ACKNOWLEDGEMENT**

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. I wish to thank my project supervisor, Mdm. Nurul Ain binti Maidin. Her sage advice, insightful criticisms, and patient encouragement aided the writing of this thesis in innumerable ways.

I would like to thank my project panel, Mr. Abd Kahar bin Nordin and Mr Mohamad Ridzuan bin Mohamad Kamal for their encouragement and visionary comments which has opened my mind to think more creatively.

I would also like to acknowledge appreciation the crucial role of the staff of JTKP laboratory, who gave the permission to use the required machinery and the necessary material to complete this project.

Last but not least, I would like to thank my colleagues for sharing their ideas and opinions when I am needed.



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## **LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE**

°C	-	degree Celcius
2D	-	Two Dimensions
3D	-	Three Dimensions
5Rs	-	Rethink, Repair, Reuse, Recycle, and Reduce
BC	-	Before Century
CAD	-	Computer Aided Design
DNA	-	Deoxyribonucleic Acid
FTK	-	Fakulti Teknologi Kejuruteraan
H	-	Height
JTKP	-	Jabatan Teknologi Kejuruteraan Pembuatan
Kg	-	kilogram
L	-	Length
NaOH	-	Sodium Hydroxide
RM	-	Malaysian Ringgit
SWCorp	-	Solid Waste and Public Cleansing Management Corporation
UV	-	Ultra Violet
W	-	Width

# CHAPTER 1

## INTRODUCTION

Most Malaysians enjoy cooking fried foods. To fry, cooking oil should be used in specific quantities. Cooking oil made from oil extracted from oil palm and vegetables. There are also oils which made from seeds pressed process, which are sunflower seeds, peanut seeds, olive seeds, corn seeds and others. After frying foods, many Malaysians throw away used cooking oil into drains and rivers. The oil can harm the environment. Used cooking oil can produce soap. By mixing the used cooking oil with sodium hydroxide palette and water, soap can be produced. However, the resulting soap is for general use, for example washing floors and drains. The aim of this project is to produce a semi-automated machine for making soap by using used cooking oils. This tool is ideal to use in kitchens in every home and is able to simplify the process of making soap, thus can save environment.

### 1.1 Background of the Project

This project is to produce a semi-automated machine that can make soap from used cooking oil. The cooking oil can be converted to soap by using the mixture of used cooking oil, sodium hydroxide (NaOH) pellets, water and scented oil. By having this right machine, it will make it easier for users to carry out this converting used cooking oil to a soap process. They do not need to do this process manually. It can be use at a kitchen in every house. This machine will be design to raise the awareness of the importance of recycling the cooking oil rather than pouring it down into the sink.

## **1.2 Problem Statements**

Most people just throw away used cooking oil down the drain, it has led to many cases of pollution due to oil being dumped into the drain will flow into the river. In addition, there are people who throw away used oil into the sink. This causes their sink being clogged. However, there are a few people who have an awareness of this problem, and they have made this soap-making process manually without using any tools. It is also inconvenient because they had to use safety equipment such as face masks, goggles and gloves because this process involves chemicals.

## **1.3 Objectives**

This project will focus on meeting these objectives:

- (a) To create a machine to make soap from used cooking oil.
- (b) To find out the best design for this soap-making machine.
- (c) To compare the best method (by machine or manually) to make a soap.

## **1.4 Scopes**

Based on the objectives, the project work scopes are highlighted as follows:

- (a) Finding materials to make soap, which are NaOH pellets, used cooking oil, and scented oil.
- (b) Preparing tools to make a soap-making machine.
- (c) Providing some design of soap-making machine that are suitable for this project.
- (d) Comparing quality of soap and production time by using a machine and manual method.



## **1.5 Organization of the Project**

This report will be conducted in few chapters and each stated as below:

**(a) Chapter 1: Introduction**

This chapter will simply introduce about the project. This chapter contains introduction, problem statements, objectives, scope of project and expected results.

**(b) Chapter 2: Literature Reviews**

This chapter shows about the studies and research that relevant to the project.

**(c) Chapter 3: Methodology**

This part will show the canvas about the project methodology used in this project.

**(d) Chapter 4: Results**

This part will state out the result that be obtained.

**(e) Chapter 5: Discussions**

This chapter will talk about the discussion of the result of the project.

**(f) Chapter 6: Conclusion**

This chapter will discuss about the summarization of the project and the major conclusion of the project.

## 1.6 Expected Result

The expected result from this chapter stated as below:

- (a) The project will come out with a semi-automated machine to make soap from used cooking oil.
- (b) The best design will be choose for this soap-making machine.
- (c) Making soap by using machine will prove to be the best method compares to make soap manually.
- (d) Bring awareness to Malaysian people about the importance of recycling of cooking oil.
- (e) This machine will be commercialized in the market with the target that every home in Malaysia will have one of these machines.

## **CHAPTER 2**

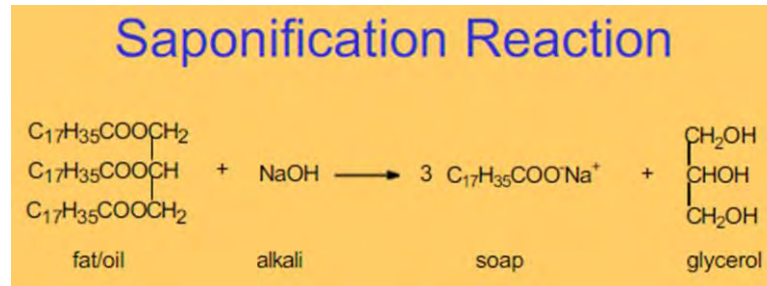
### **LITERATURE REVIEW**

In this chapter, the information, procedure, and all points the related to the research activities will be discussed. The information will be become additional source for the project in becoming more successful. To have a brief understanding of the researches related to the project, a few literature reviews had been done. The data collected from published literature, article, journal, and others which give attention on this project.

#### **2.1 Soap**

Word 'soap' comes from Latin *sapo*, which is origin from Latin *sebum*, *tallow*. Nuttall defined soap as "an alkaline or unctuous substance used in washing and cleaning" (Simmons, 2007). In chemistry, soap is a salt of a fatty acid. Soaps are mainly used as surfactants for washing, bathing, and also cleaning. It is clean by acting as a surface active agent, wetting agent and emulsifying agent. Soap is the result of mixing an alkaline solution with fat in specific amounts, with the correct temperature, usually around 40.5°C to 42°C. The two most important alkalis which usually use are sodium hydroxide (NaOH) and potassium hydroxide (KOH). When they are mixed well together under these specific circumstances, a chemical process changes the fat and alkali combination to a single substance, which is soap. This chemical process is called "saponification".

Saponification is a process of making soap. It is created by mixing rendered fat which from beef or mutton fat, with an alkaline solution. Within 24 hours 80% to 95% of the Saponification is complete, over the next several days to weeks it will continue this saponification process, becoming milder and milder (Desia, 2013).



*(Source: How Do Soap and Detergent Clean?, Kmerkgoe, 2013)*

**Figure 2.1 : Saponification Reaction**

Soap was probably discovered by Stone Age's woman who saw that the combined residues of ash and fat, which found in a fire after roasting a beast, made a useful cleaning compound. In 600 BC, the soap made by the Phoenicians from tallow and beech ashes was probably used as hair pomade, rather than for washing. The use of soap in personal hygiene is first recorded in the second century when the physician Galen mentions its use for body washing. Soap making in Europe was established by the end of the first millennium, with important centres at Marseille and Savona, where olive oil was used instead of tallow.

Hundred years ago, all soap was made from animal fats. This was happen when animals were butchered by families who reserve the lard for making the soap at home. Alkali solution was used too. Usually, lye was used as the alkali solution. Lye was created from the ashes of the fireplace.

In 1916, during World War I, the first detergent was made due to the shortage of supplies like tallow and fat. It was an excellent opportunity for women who wanted to free themselves from the exhausting chore of making soaps (Dana, 2015). By highlighting the relationship between cleanliness and health, the advertising campaigns in 1950s have increased soap popularity. However, in the current age,

everyone become more understands about the chemical process of soap making. Due to globalization, chance at gaining various beneficial oils from all over the world was getting better.

Nowadays, soap is a wonderful thing. Nevertheless, most soap users simply choosing a brand from supermarket shelf without think what is in it or how it is made. Soap is an object used for cleaning and made from vegetable or animal fats and oils, mixed with caustic alkali like sodium hydroxide or potassium hydroxide, which initiates a chemical reaction called saponification.

## **2.2 Used Cooking Oil**

Cooking oil is defined as vegetable oils that can be used in cooking. Vegetable oils include any group of liquid edible fats that are obtained from plants. For examples, olive oils, corn oils, palm oils, sunflower oils, canola oils, sesame oils and many more. Waste cooking oils, which are also known as used cooking oils, can be obtained from home, school canteen and restaurant kitchens.

After cooking, usually used cooking oil is thrown into the sinks, drained and rivers. In this way, many problems will arise such as water pollution, constrict the water flow due to the thick layers of oils, and clogged sink or pipe blockage. Contaminated water caused by used cooking oils will affect the life of underwater flora and fauna. Clogged sink or pipe blockage resulted higher expenses for maintenance process.



*(Source: Cooking Oil Recycling Program, 2015)*

**Figure 2.2 : Blockage Pipe due to Cooking Oil**

The use of cooking oil more than once can pose threats to the health of the community. Toxic compounds normally accumulate over time in some vegetable oils and this will react with amino acids, DNA and other biomolecules in the human body. This consumption can lead to diseases such as heart diseases, stroke, Parkinson's disease, Alzheimer's disease, liver and other diseases (Csallany, 2006). Hence people are advised to avoid using the same cooking oil when cooking at home. If eating out, avoid eating fried food. The improper disposal of used cooking oil includes disposing them down the sink and drain, onto the ground, and into the garbage. Liquefied fat, oil, or grease that is poured down the kitchen sink drain can cause serious problems. They can cling inside of pipes and the sewer system. Time by time, it can build up and eventually block pipes completely. If wastewater cannot move freely through pipes and out into the sewer system, it can come back to home and can cause unsanitary conditions and damages that can be costly to repair. When used cooking oil is poured down the house drains and sewers, logging problems will arise. This is because the soil will become sealed off from air and water, killing the earth worms and bacteria necessary for regeneration of plants (ENFO, 2006). The production of bacteria will arise due to the accumulation of the solid oil waste and it may cause terrible effects on birds, fish and plant life. This is because; all life forms need water to live. When used cooking oil is poured down the house drains, some of the drain systems will lead to the rivers, streams or ponds. This oil will be dumped

into it and causes a terrible effect on any kind of life forms in the rivers, streams or ponds such as killing fishes and water plants. Oil is poisonous to birds and can kill them. Oil can stick to their feathers and prevent them from flying and keeping their body warm. When used cooking oils are being dumped into rivers, streams or ponds, it is difficult to remove them. It is because that 1 litre of oil will contaminate 1 million litres of water (ENFO, 2006). More money has been spent in fixing property damage caused from sewage blocked, and causes expensive clean up and plumbing repairs. Clogged sewers can also lead to overflows, which can runoff into the street and straight into the storm drain system, and eventually into our creeks and streams without being treated. Again, more money is needed to mitigate this problem.

There are few proper ways to dispose the used cooking oils. The basic step is to put the used cooking oil in a sealed and non-recyclable container and discard it with regular garbage. Besides that, refrigerating the used cooking oil in container to harden is also makes the disposal process becomes easy.

Currently, there are no proper facilities for the disposal of waste cooking oil wastes in Malaysia. In addition to that, there is no enforcement on the use of the guidelines of proper waste disposal.

### **2.3 Sodium Hydroxide (NaOH)**

Sodium Hydroxide is a strongly alkaline used in many industrial processes. The chemical formula for Sodium Hydroxide is NaOH. NaOH has molar mass of 39.9971 g/mol. Its melting point is 318°C and its boiling point is 1388°C. The density in natural state is 2.13 g/cm<sup>3</sup>. This chemical is very soluble in water, alcohol, glycerin and methanol. It has an acidity of 13 and it can react with Carbon Dioxide (CO<sub>2</sub>) to form Sodium Carbonate (Na<sub>2</sub>CO<sub>3</sub>). Besides that, NaOH also reacts with other acids to form pure water and salts. The type of bond is ionic. The percentage composition by mass is Sodium 57.48%, Oxygen 40.00% and Hydrogen 2.52% (Anonymous, 2011).

Sodium Hydroxide (NaOH), or its common names are Caustic Soda or Lye, is a caustic metallic base. Pure NaOH is a white solid available in pellets, flakes and granules. It is solid substance which has a white colour and odourless. It dissolves easily in water and gives a high temperature while heating process. It is also can absorb  $\text{CO}_2$  from air. To avoid this absorption from happen, NaOH should be stored in an airtight container.

NaOH is used for many household and industrial purposes. The chemical forms a strong alkaline solution when mix it with water. It is not only used for household purposes in cleaning, but also used in many industries like paper and pulp, textiles, and used in the manufacturing of soaps, detergents and cleaners. It can also be used as a bleaching agent to bleach brown pulp. Since NaOH forms a strong alkaline solution when dissolved in water, it is commonly used in many laboratories for experimentation and testing. It is cheaply available, so that many educational institutions use it in student labs. In labs, NaOH is used to drive chemical reactions. It is a very good neutralizing agent, especially when used for neutralizing acids. It is used in oil refineries and oil drilling. This is because NaOH increases the viscosity and prevents heavy materials from settling. Since cheaper than other alkaline, anhydrous sodium hydroxide can be used as a catalyst for preparing biodiesel. In most households and industries, this is used to be a pH adjuster. One of the many uses of NaOH is that it can be used to extract alumina from its ore. Besides that, NaOH can be used for washing and chemical peeling of fruits and vegetables, chocolates, cocoa processing, and also soft drink processing.

NaOH is a known irritant and the ingredients can cause some effects due to the exposure of NaOH. Exposure to vapour, mist or liquid of NaOH can produce burns of the respiratory tract. While severe exposures could result in chemical pneumonia. If NaOH contact to the eyes, it can cause severe damage including burns and worse become blindness. The severity of the effects depends on concentration and how soon after exposure the eyes are washes. Skin may get corrosive, burns and the skin tissue destruction. Severe burns and complete tissue perforation of the mucous membranes of mouth, throat, and stomach. The target organs to receive the effect of exposure are eyes, skin, respiratory tract, and gastrointestinal tract.