



# **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

## **PSM TITLE: HOME COOKING OIL FILTER MECHANISM**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Product Design) (Hons.)

by

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**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

TAJUK: DESIGN AND DEVELOPMENT HOME COOKING OIL FILTER MECHANISM

SESI PENGAJIAN: 2016/17 SEMESTER 1

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## **DECLARATION**

I hereby, declared this report entitled Design and Development of Home Cooking Oil Filter Mechanism 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 fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

.....  
(MOHD KAMAL BIN MUSA)

## ABSTRAK

Projek Akhir Tahun iaitu *Design and Development of Home Cooking Oil Filter* merupakan salah satu alat penapis yang digunakan di rumah untuk menapis minyak masak yang telah digunakan di mana fokus projek ini hanya merangkumi isi rumah yang dikendalikan oleh suri rumah sahaja untuk memudahkan target sasaran menguruskan kehidupan seharian yang lebih teratur dan terjamin kebersihannya. Antara objektif yang diketengahkan dalam projek *Home Cooking Oil Filter* untuk menentukan kaedah penapisan yang digunakan di rumah, penapis minyak masak dirangka melalui kaedah penapisan yang digunakan dan membuat prototaip penapis minyak masak yang digunakan di rumah. *Home Cooking Oil Filter* merupakan satu produk baru yang akan diperkembangkan dalam Projek Akhir Tahun yang diberi fokus hanya untuk perkakas rumah sahaja. *Home Cooking Oil Filter* juga ialah satu produk yang boleh menapis dan menyimpan minyak yang telah ditapis dengan menggunakan penapis besi tahan karat sebagai mekanisma penapisan yang pertama, mekanisma penapisan yang kedua menggunakan *Nylon Mesh* dan juga karbon aktif sebagai mekanisma penapisan yang terakhir di mana ia menyerap bau minyak yang telah terpakai. *Home Cooking Oil Filter* akan menawarkan tawaran yang lumayan bersama pelanggan dengan memperbaiki ciri-ciri dan reka bentuk produk yang telah dipasarkan untuk memudahkan suri rumah menjaga kesihatan dan kebersihan makanan selain mampu mengurangkan kos perbelanjaan setiap bulan.

## **ABSTRACT**

This Final Year Project which Home Cooking Oil Filter is a device to filter used cooking oil that has been used in household where focused on the situation to ease the housewives manage and ease their everyday lifestyle to keep healthy on track. The objectives of this project are to determine the filter mechanism used in home, design the filter based on the mechanism used and produce a filter cooking oil prototype for household (home). The Home Cooking Oil Filter is a new product that will be developed in Final Year Project that focused on the household appliance. The Home Cooking Oil Filter is a product that can filter and store cooking oil using stainless steel strainer (1<sup>st</sup> filtration layer), nylon mesh filter (2<sup>nd</sup> filtration layer) and activated carbon (3<sup>rd</sup> filtration layer) as triple filtration mechanism. The Home Cooking Oil Filter has features that customer needs such as lightweight, easy to handle, washable and long-lasting. Home Cooking Oil Filter will offer a great deal with customer by improving the features and design compared to the current cooking oil filter to ease the housewives to keep health and hygiene of the food using used cooking oil and also able to reduce cost of the monthly expenses.

## **DEDICATION**

To my supervisor, Encik Kamal bin Musa dan my co-supervisor, Puan Umi Hayati binti Ahmad for their unlimited support in making this product design development project successful, to my family especially my parents, Encik Kemat bin Abu Hassan and Puan Nabiha binti Hj Kassim and my dearest eldest sister, Siti Zulaikha binti Kemat, for helping me mentally and physically to complete this project.

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## **LIST OF ABBREVIATION, SYMBOLS & NOMENCLATURE**

BOM	-	Bills of Materials
HCOF	-	Home Cooking Oil Filter
HDPE	-	High-density Polyethylene
LDPE	-	Low-density Polyethylene
PET	-	Polyethylene Terephthalate
PP	-	Polypropylene plastics
PS	-	Polystyrene
OTHER	-	Polycarbonate and Polylactide
V	-	Polyvinyl chloride
%	-	Percentage
°F	-	Degree Fahrenheit
°C	-	Degree Celsius

# CHAPTER 1

## INTRODUCTION

### 1.0 OVERVIEW

Home used cooking oil filter is a device to filter used cooking oil that has been used in household. Mostly, there are many of used cooking oil machine filter have been produced effectively in restaurant industry. The cost of the machine filter is quite higher compared to the manual filter because the system and technologies used to produce a productive machine filter but there are unsuitable home used cooking oil filter that can be used to filter out contaminants from used cooking oil. Therefore, in this project a home filter will be designed with a simple design by using an effective mechanism that can be simply design in Solid works software to improve design from previous filter. The filter will be designed is differ from the past and current cooking oil filter that have been made such as the design will be more simple and material use in the home used cooking oil filter. The mechanism of the filter must be effective and conducive to filter out the solid particles and if possible to avoid any sedimentation from occur after filtration. The mechanism concept that will be used is layer-by-layer concept (triple filtration mechanisms) where the stainless steel strainer, nylon mesh and activated carbon are used ,therefore the used cooking oil will be filtered as fine as possible. The material to filter out the contaminant from medium cooking oil should be heat resistance material to ensure the filter able to resist the heat.

## **1.1 PROBLEM STATEMENT**

Nowadays, the cooking oil prices are increased tremendously where the subsidies are eliminated due to economic crisis. Therefore, the cooking oil usage can be reduced by reused the cooking oil through appropriate mechanisms which can increase its lifetime. In this case, the housewives usually rarely recycled the used cooking oil without using the specific filter and container that can store cooking oil. The cost to produce the cooking oil is increased due to the industry market. The problems that focused in the project are there is inappropriate filter mechanism used by the housewives to filter the used cooking oil; there is inappropriate filter and equipment to filter the used cooking oil. Not just that, usually the kitchen surrounding will be messy, oily and dirty after frying foods and it cause the housewives become more miserable besides to prevent any incident occur from the situation.

## **1.2 OBJECTIVES**

The aim of this project is to design and develop a home used cooking oil filter mechanism. The objectives should be achieved in this project are:

- To determine the filter mechanism used in home.
- To study the filter based on the mechanism used.
- To produce a filter cooking oil mechanism for household (home).

## **1.3 SCOPE**

In this project, the scope will be limited to design and develop the home cooking oil filter based on the main scopes which are:

- To design a home cooking oil filter mechanism to filter out the particles inside the used cooking oil.

- The selections of material that will be designing the filter are stainless steel, nylon mesh and activated carbon.
- The type of material for container used to store the cooking oil with medium temperature.
- The fabrication of the cooking oil filter with functional prototype.



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 OVERVIEW**

Cooking oil consumption has increased over the last century as the world population has grown and more countries have become industrialized. Therefore, there is a great interest in recycling the used cooking oil besides turn it into biodiesel even though the crude oil has been major resources to meet the increased the energy demand to replace the fossil fuels. Home used cooking oil filter is a device to filter used cooking oil that has been used in household to reduce the living cost besides waste the oil that can be recycled through a specific mechanism by removing the solid particles that contains in the cooking oil. By throughout the research, a prototype will be produced according its design and development of home cooking oil filter from time to time.

#### **2.1 THE DEVELOPMENT OF USED COOKING OIL IN INDUSTRY**

In this era, the economic development have been increased rapidly especially in cooking oil consumption that caused shortage in resources. Therefore, in 2009, the concept of *cyclic economy* has been proposed to build a resource-saving and environmental-friendly society. Based on the concept that has been proposed, it increased the number of resources besides it can change the used edible oil (waste) into renewable resources (Qi 2009).

The term of used cooking oil and waste vegetable oil have been used in daily life where the oil is a waste that have been used or spent in cooking or frying collected from different areas in Malaysia. The used cooking oil usually used for

frying foods that contains animal fats while the waste vegetable oil free from the animal fats but it will be not considered as yellow grease. Yellow grease has been produced in United States or any countries that established Rendering Industries that contains low quality of animal fats. Oil can be class into economic resources because it can be recycled into another development where it is more sustainable and productive.

Even though the used cooking oil can be recycled through a certain process but recently it becomes a main topic on food quality problem. The negative feedback of this matter becomes more serious when symptoms such as indigestion, headache, dizziness, insomnia, fatigue and the discomfort of liver will caused (Lu 2012). It was because the used cooking oil not filtered and stored properly by using the correct equipment which the bacteria were growth due to the food particle left inside the used cooking oil. As the food particles left in the oil, they will turn into carbon that known as carcinogenic which is an item related to cancer development and also it can change the taste, colour and smoke point. This is also the reason the home used cooking oil filter will be develop through the problem arise to remove the food particles effectively and can reduce the disease that will occur.

Based on Paul William, Manager Director of KFE said that, “He believes it is a no brainer and that the decision is not whether to have it or not, but what level of filtration to go for”. Through separate pipes, they use standard filtration to triple filtration to extracts most of the debris before returning the oil back which the oil will be go through the Miroil filter bag, then to a super pad which to extract the tiny carbon particles too even though the customers more preferred into simple filtration system but to get an extra quality of oil, they may choose the triple filtration.

In Barcelona, they had been initiated with an effort to collect all used cooking oil annually by handing the Olipot to initiate the new recycling idea to reclaim as much of the used cooking oil as possible for providing ingredients for soap and biodiesel sector. Through the Green Points effort, 195,136 liters of used cooking oil had been collected which equal to 2.5% of oil used in annually in the Barcelona city. The campaign also held to encourage the users to support the objectives of Green Points by helping the council to collect the used cooking oil and at the same time will drop the oil at the Green Point place in the city to avoid them pour the used cooking

oil into the drainage that will cause effect on environment and health. The Olipot had been built to separate the lingering food and also able to keep hot cooking oil up to 180°C into a container to store the filter oil by using insulating skin to prevent the container from shrinking or warping the Olipot. The Olipot also is one of the portable filter products that can be used as benchmarking of home used cooking oil filter.



**Figure 2.1.1:** Olipot



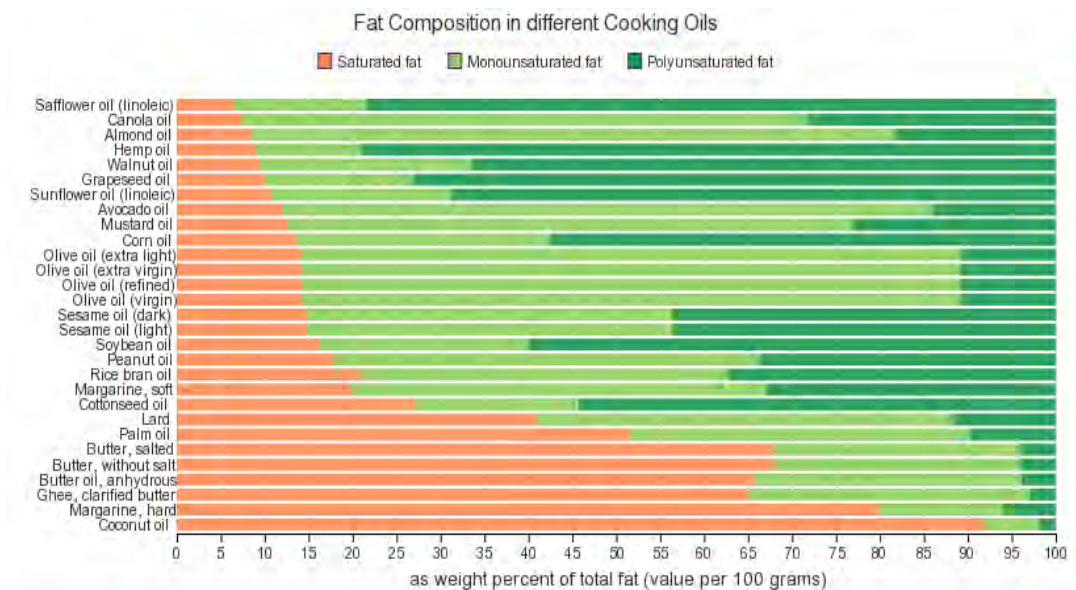
**Figure 2.1.2:** Olipot use



**Figure 2.1.3:** Green zone

## 2.2 THE COMPOSITION IN COOKING OIL

In term of oil, there are many types of cooking oil that can be used to fry foods especially Malaysians that use coconut oil as their main cooking oil besides olive oil. Based on the Figure 4, it shows the fat composition in different cooking oils.



**Figure 2.2.1 :** Composition of cooking oil

### 2.2.1 SATURATED AND UNSATURATED FATS

Even though in cooking oil has the highest saturated fats that derived from animals and plants-based sources which will turn in solid in room temperature. In context of good frying and good absorbability, the medium-chain saturated fat is the most preferable such as coconut oil and butter (vegetable oil) but there is still has long-chain unsaturated fats in oil even in small amount. If the saturated fat will be solid in room temperature, the unsaturated fats will be liquid in room temperature but it will be solidified at cold temperatures (Charts Bin statistics collector team, 2011).

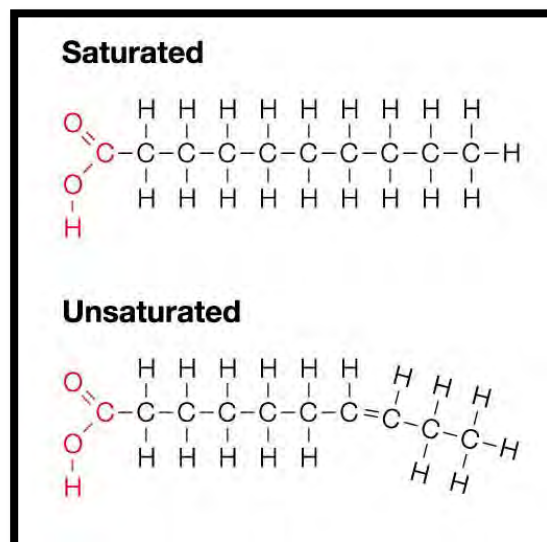


Figure 2.2.2: Saturated and unsaturated fats

### 2.2.2 FATTY ACIDS

The fatty acids present in the form of esters of glycerol which comprised of triacylglycerol. Each 95 grams of fatty acid will be equal to one hundred grams of fats or oil. In the fatty acid component, both physical and chemical characteristics that are positioned on glycerol molecule will be influenced to each other. The predominant fatty acids are saturated and unsaturated carbon chains with an even

number of carbon atoms and a single carboxyl group (Zambiasi et al. 2007).

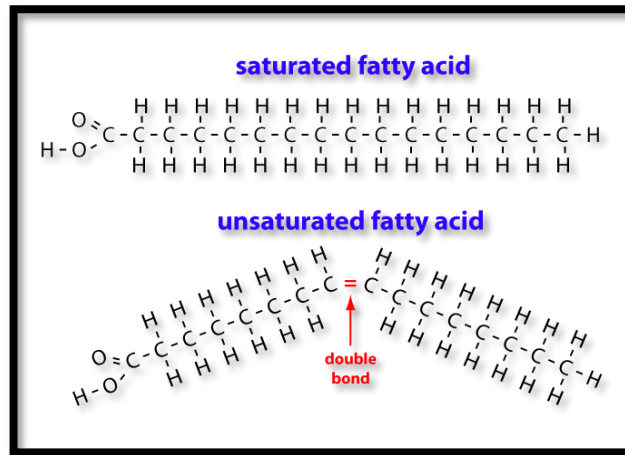


Figure 2.2.3: Saturated and unsaturated fatty acids

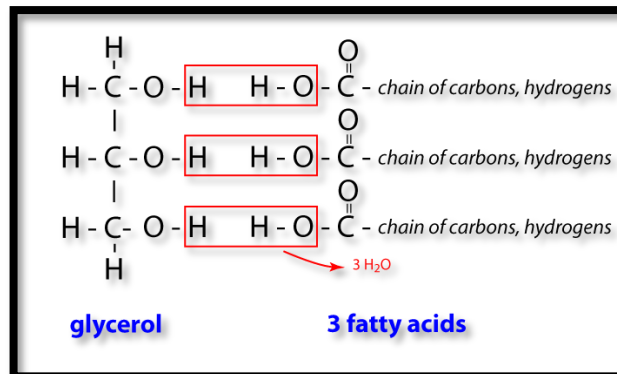


Figure 2.2.4: Glycerol and 3 Fatty acids

Vegetable Oils and Shortening	Polyunsaturated Fatty Acids*	Monounsaturated Fatty Acids*	Total Unsaturated Fatty Acids*	Saturated Fatty Acids*
Safflower Oil	75%	12%	86%	9%
Sunflower Oil	66%	20%	86%	10%
Corn Oil	59%	24%	83%	13%
Soybean Oil	58%	23%	81%	14%
Cottonseed Oil	52%	18%	70%	26%
Canola Oil	33%	55%	88%	7%
Olive Oil	8%	74%	82%	13%
Peanut Oil	32%	46%	78%	17%
Soft Tub Marg.***	31%	47%	78%	17%
Stick Margarine***	18%	59%	77%	19%
Veg. Shortening***	14%	51%	65%	31%
Palm Oil	9%	37%	46%	49%
Coconut Oil	2%	6%	8%	86%
Palm Kemal Oil	2%	11%	13%	81%
<b>Animal Fats</b>				
Tuna Fat****	37%	26%	63%	27%
Chicken Fat	21%	45%	66%	30%
Lard	11%	45%	56%	40%
Mutton Fat	8%	41%	49%	47%
Beef Fat	4%	42%	46%	50%
Butter Fat	4%	29%	33%	62%

Table 2.2.1: Polyunsaturated and Mono-unsaturated Fatty acids

### **2.2.3 ACIDITY**

Acidity is a degree of triacylglycerol breakdown due to the chemical reaction which are hydrolysis or lipolysis where the free fatty acids are formed. The free fatty acids are formed due to the lack of care during oil extraction from the poor quality oil source which caused the breakdown of triacylglycerol. The acidity of free fatty acids is a direct measure of oil quality that reflects to the consumption of oil.

### **2.2.4 SMOKE POINT**

The temperature under defined conditions where the volatile compounds are enough emerged when a bluish smoke becomes clearly visible from oil is known as smoke point. The degradation oxidation of products will be produced such as free fatty acid or in other words the smoke point is a limitation of temperature that cooking oil can be used. The higher the temperature of cooking oil, the higher the number of free fatty acids produces in the cooking oil. Based on the analyses that had been conducted by the expert, the intermittent frying oils that were used more than twice had been marked had a greater effect on oil deterioration than continuous frying.

Smoke Points of Fats and Oils	
Fat/Oil	°F
Flax Oil	225
<i>Canola Oil, unrefined</i>	225
<i>Safflower and Sunflower Oil, unrefined</i>	225
Corn Oil, unrefined	320
Peanut Oil, unrefined	320
Olive Oil, extra virgin	320
Butter	325 - 375
Coconut Oil, unrefined	350
Vegetable Shortening (e.g., Crisco)	360 - 370
Lard	360 - 400
Safflower and Sunflower Oil, refined	450
Corn Oil, refined	450
Peanut Oil, refined	450
<i>Canola Oil, refined</i>	425 - 475
Clarified Butter (Ghee)	400 - 500

**Table 2.2.2:** Smoke points and Fats and Oils

### 2.3 FILTRATION SYSTEM



Nowadays, there are many types of filtration system that have been developed due to the customer needs. Usually, the restaurants are the main customers that need most effective filter machine to make their business running smoothly. Therefore, they have their management team to make the decision on a matter regarding to the profit of their business and also due to the economic development that unstable nowadays. Many companies take these as their opportunity to develop their business especially in food businesses to introduce the best filter to filter out the food particles that left in the used cooking oil. The used cooking oil filters have been produced from the early 19<sup>th</sup> century where the deep frying oil can be recycled. Filter is a porous device for removing impurities or solid particles or unwanted substances from a liquid or gas passed through it.

After the green strategies for hotels are known, anything that can be exposed to risk the health and environment were handled, stored, collected and disposed (Zhu *et al.*, 2008). Green Economy era and green strategies was a great advantage to hotel

industry where it can recycle the waste produced from their hotel especially to reduce the greenhouse effect (Anon n.d., 2014) Based on the journal, we can motivate ourselves to reduce the used cooking oil consumption into green technologies where we can reuse the used cooking oil by filtering whether in hotels or household. This strategy can be implemented in household to reduce their monthly budget in cooking oil consumption.

From past to present, the filter have been produced through several types of filters that can filter out the used cooking oil into fine cooking oil even though the quality of the filter cooking oil will be reduced through several factors that might be influenced in it. Due to the some research, there several factors should be considered even though the users use a good oil filtration such as oxidization, high temperature and contamination from moisture and food. Therefore, there are several types of filter that can be used to improve the past used cooking oil filter.

### 2.3.1 TYPE OF FILTER BAG

Types of filter bag	Features	Micron rating
 <p data-bbox="387 1496 624 1529">Standard Felt bags</p>	<ul data-bbox="791 1245 1118 1469" style="list-style-type: none"> <li>• Full line of felt materials and micron rating.</li> <li>• Common bag rings.</li> <li>• Heavy duty and extended life designs.</li> </ul>	<p data-bbox="1153 1245 1390 1496">5, 10, 25, 50, 100, 200. *** able to withstand high temperature in range of 204 - 232°C.</p>
 <p data-bbox="354 1895 663 1928">Extended Life Felt bags</p>	<ul data-bbox="791 1570 1126 1827" style="list-style-type: none"> <li>• Excellent filtration on many contaminants at coarse inner layer, graded pore structure and greater depth.</li> <li>• Two times dirt-holding.</li> </ul>	<p data-bbox="1153 1570 1390 1783">5, 10, 25, 50, 100. *** maximum operating temperature in range of 93 - 104°C.</p>

**Table 2.3.1:** Type of filter bags