DESIGN AND DEVELOPMENT OF UFO (USED FRYING OIL) BIN PROTOTYPE

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY WITH HONOURS

2023

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Mechanical Engineering Technology with Honours

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology with Honours

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this Choose an item. entitled “Design And Development Of Smart UFO(Used Frying Oil) Bin Prototype” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree

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APPROVAL

I hereby declare that I have checked this thesis, and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering and Manufacturing Technology with Honours

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DEDICATION

Wholehearted dedication to my husband Mr. Arif Aiman and both of my parents, Mr. Ruzi Idris and Mrs. Aliza Mohd Anuar for their inspiration and who continually provide their moral support to me spiritually, emotionally, and financially throughout the semester while completing this final year project. I would like to thank you beloved siblings, friends and my lecturers who shared their words of advice and encouragement to finish this study.

Thank You for all prayers.

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ABSTRACT

This study's objective was to identify the current used frying oil (UFO) and to suggest an ecologically responsible method for used frying oil preservation to effectively manage waste used cooking oil. Then, a prototype of a container for collecting wasted frying oil was developed (UFO). The container was equipped with a lid, a handle, and a lid closing mechanism. The design was chosen using a conceptual design matrix and the Pugh approach. Then Initially, SOLIDWORK was used to develop the UFO Bin prototype. Several functionally diverse designs were considered. Utilizing the Pugh approach, the most effective design was chosen. As with the box, the prototype measures 34cm (length) by 27cm (width) by 20cm (height) when equipped with a handle. The container was constructed from polycarbonate (PC). The material was chosen because of its cheap price and durability. The prototype of the UFO bin is thus designed to help in the continuous and precise monitoring of the waste management system. It enables the treatment of used cooking oil waste in the future that is more environmentally friendly than the existing waste management system. Solidworks Simulation held a simulation. As an evaluation of the bin's durability, von Mises stress, strain, displacement, and drop test were conducted.

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ABSTRAK

Objektif kajian ini adalah untuk mengenal pasti minyak goreng terpakai (UFO) semasa dan mencadangkan kaedah yang bertanggungjawab secara ekologi untuk pemeliharaan minyak goreng terpakai untuk menguruskan sisa minyak masak terpakai dengan berkesan. Kemudian, prototaip bekas untuk mengumpul minyak goreng terbuang telah dibangunkan (UFO). Bekas itu dilengkapi dengan tudung, pemegang, dan mekanisme penutup tudung. Reka bentuk dipilih menggunakan matriks reka bentuk konsep dan pendekatan Pugh. Kemudian Pada mulanya, SOLIDWORK digunakan untuk membangunkan prototaip UFO Bin. Beberapa reka bentuk pelbagai fungsi telah dipertimbangkan. Menggunakan pendekatan Pugh, reka bentuk yang paling berkesan telah dipilih. Seperti kotak, prototaip mengukur 34cm (panjang) dengan 27cm (lebar) dengan 20cm (tinggi) apabila dilengkapi dengan pemegang. Bekas itu dibina daripada polikarbonat (PC). Material tersebut dipilih kerana harganya yang murah dan tahan lasak. Oleh itu, prototaip tong UFO direka untuk membantu dalam pemantauan berterusan dan tepat sistem pengurusan sisa. Ia membolehkan rawatan sisa minyak masak terpakai pada masa hadapan yang lebih mesra alam berbanding sistem pengurusan sisa sedia ada. Solidworks Simulation mengadakan simulasi. Sebagai penilaian terhadap ketahanan tong sampah, ujian tekanan, terikan, anjakan dan jatuh von Mises telah dijalankan.

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ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

First and foremost, I would like to thank and praise Allah the Almighty, my Creator, my Sustainer, for everything I received since the beginning of my life. I would like to extend my appreciation to the Universiti Teknikal Malaysia Melaka (UTeM) for providing the research platform. Thank you also to the Malaysian Ministry of Higher Education (MOHE) for the financial assistance.

My utmost appreciation goes to my main supervisor Mdm. Sushella Edayu Binti MatKamal for all his support, advice, and inspiration. Her constant patience for guiding and providing priceless insights will forever be remembered.

Finally, I want to express my heartfelt gratitude to my husband, Arif Aiman bin Rosli, who has been a pillar of support in all my attempts. I'd also like to thank my dear parents for their unending love, support, and prayers. Finally, I'd like to express my gratitude to everyone who helped, supported, and inspired me to begin my studies.

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LIST OF SYMBOLS AND ABBREVIATIONS

UFO	-	Used Frying Oil
HDPE	-	High-Density Polyethylene
LDPE	-	Low-Density Polyethylene
WCO	-	Waste Cooking Oil
UPM	-	University Putra Malaysia
UV	-	Ultraviolet
PTFE	-	Polytetrafluoroethylene
P. P	-	Polypropylene
UHMW	-	Ultrahigh Molecular Weight Polyethylene

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

For the past few years, if not decades, vegetable oil usage and demand have skyrocketed. Vegetable oil is useful for a variety of things. In today's market, there are many different types of vegetable oils. Palm oil, coconut oil, maize oil, sesame oil, sunflower oil, soybean oil, olive oil, canola oil, and a variety of other vegetable oils are all examples of vegetable oils. Nut oils, which are derived from nuts, are also available. Almond oil, hazelnut oil, and others are examples of nut oils. However, because of their nutty and distinct flavour, as well as the difficulty in extracting them, these nut-based oils are quite expensive. These vegetableoils are mostly used as a cooking oil, but it also used to make other items including soap, supplements, and health and beauty products.

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Palm oil, sunflower oil, and sesame seed oil are the most often used cooking oils in Malaysia. Above all, Malaysians prefer palm oil since it is suitable for frying food. Fried food and fast food are the most common foods in Malaysian cuisines. To fry these foods, you'll need a lot of oil. The frying oil, on the other hand, can only be reused three times. After that, it's time to get rid of the used oil. The issues come when there is no effective waste management in place to handle the old oil, particularly when the city council fails to collect it (*Palm Oil Is More Commonly Used than You May Know*, n.d.).

On the negative side, because vegetable oils are widely used for cooking, they create a lot of waste, particularly used frying oil (UFO) waste. Used frying oil (UFO) is one of the most vexing problems of contemporary civilisation and a substantial contributor to

environmental deterioration, particularly in metropolitan areas. However, this does not negate the fact that it has an impact on the rural environment. It is influenced, but the effects are more obvious in urban settings because they are more densely inhabited and host a large number of commercial outlets in the food and beverage (F&B) sector. The commercial use of cooking oil on a large scale by the snack manufacturing industry and F&B establishments such as hotels, restaurants, caterers, roadside eateries, dhabas, and even street vendors results in the production of hundreds of tonnes of UFO with no planned and scientific method of disposal.

When garbage is not handled properly, it adds to a variety of environmental challenges and other problems. Mishandling of these used frying oil (UFO) wastes causes blockages in wastewater plant infrastructure, which is one of the most prevalent difficulties. Continuous research and studies for improvement are still on, however wasted frying oil might possibly be utilised as a basic material for biodiesel synthesis. This is why research on waste management must be enhanced, as well as the participation of all people, in order to establish a sustainable city, country, and globe.

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1.2 Problem Statement

If used frying oil (UFO) is not collected and recycled properly, it may end up in our environment, damaging landfills and ground water. As a result, used frying oil (UFO) must be properly managed and kept. In the marketplace, there are still few products or properly used frying oil (UFO) collector equipment.

Though some used frying old (UFO) collector equipment has been commercialised in the markets, it does not appear to be practical for residential use. Some collector designs continue to rely on the manual collection approach. The traditional waste collector container

is not user-friendly or practical for everyday use in the home. The traditional garbage collector design also took up a lot of room while failing to provide a strong mobility feature.

Aside from that, the traditional used frying oil (UFO) waste collector is fairly expensive and out of reach for most people, as it will be used for home uses and other things. Due to its size and purpose, the traditional used frying oil (UFO) waste collector is similarly limited in mobility.

1.3 Objective

The main aim of this research is to design and develop a UFO (used frying oil) bin. Specifically, the objectives are as follows:

i. To identify the advantages and disadvantages on the design of the existing used frying oil (UFO).
ii. To design an economical and environmentally friendly solution for used frying oil storage based on customer survey results
iii. To analyse the stress, strain, and displacement on the design

1.4 Scope of Study

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The scope of this study are as follows:

i. The designing of the bin will carried out in SolidWorks application
ii. The analysis of stress and strain will use in SolidWorks simulation

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Used Frying Oil

The term "used oil" refers to any previously used petroleum-based or synthetic oil. Oil is what keeps our cars, lawnmowers, and other machines running properly. However, contaminants such as dirt, metal scrapings, water, or chemicals can become mixed up with the oil during normal use, causing it to operate well no longer. This used oil must finally be refilled with fresh or re-refined oil to complete the task effectively.

Most frying oils come from a single source. Antioxidants and antifoams are frequent additives to frying oils. In some circumstances, source oil blends are utilised to add a desirable flavour (peanut oil with soybean oil), boost stability (cottonseed oil with soybean oil), or change the texture and appearance (cottonseed oil and tallow). There are also chemically blended oils that are produced through interesterification (coconut oil with soybean oil). Oil can also be partially hydrogenated. Fatty acid composition studies using gas–liquid chromatography is utilised to determine the content of the blend (GLC). Melting point and IV are two more composition indicators. Oil's eating quality, functionality, and rate of deterioration vary substantially depending on its source, processing, or formulation. The combination of an ingredient specification and a comprehensive quality management viewpoint for the oil component guarantees the manufacture of high-quality frying oil and, therefore, fried food. The original quality of frying oil may have a major influence on the quality of fried food made with it. All the procedures involved in preparing the oil have an impact on the initial quality of the oil as well as its durability during frying. Filtration and degumming are standard oil processing procedures, as are alkaline or physical refining, bleaching, hydrogenation,

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winterization or fractionation, deodorization, and packing. The quality of oil is measured against norms or specifications (Orthoefer & List, 2007)

2.2 Impact of Waste Cooking Oil on Environmental

Waste cooking oil (WCO) is classified as a hazardous waste because inappropriate disposal can result in serious environmental concerns such as drain and sewer obstructions and water or soil pollution. The physical and chemical features of WCO are analysed in this review, as are its rules and policies in various nations to encourage WCO refined biofuels. Blended WCO can be used as an auxiliary fuel in municipal solid waste incinerators, with the heat generated capable of forming superheated steam and generating electricity via a combined heat and power system. WCO also has a high ratio of hydrogen atoms to carbon and oxygen atoms, allowing it to be catalytically cracked and converted into hydrogen gas (*Frying Oil - an Overview | ScienceDirect Topics*, n.d.).

WCO-based biodiesel has typically been created through transesterification to replace petroleum-based diesel, which is both non-degradable and non-renewable. As a result of its appealing psychochemical qualities as well as its economic feasibility, the potentials of hazardous WCO as a green alternative energy source for electricity generation, hydrogen gas, and biofuels production (biodiesel, biogas, biojet fuel) are critically explored. The challenges of using WCO as a source of energy are also discussed, as are its future potential.

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2.3 Waste Management for Cooking Oil

In comparison, there are few differences in how used cooking oil waste is handled in foreign developed countries and within Malaysia. An analysis study of cafeteria operators in proper waste cooking oil management has been conducted.

Palm oil is the most often used cooking oil in Malaysia. Malaysian Palm Oil is an ideal choice for many Malaysian households because to its extended shelf life, bland (neutral) flavour, less foamy, broader cuisine uses, ample supply, and low cost. Despite the many advantages of Malaysian Palm Oil, one aspect is typically forgotten by consumers: disposal. It is important to emphasise that safe cooking oil disposal applies to all types of cooking oils, not only palm oil. Pouring used cooking oil down the drain is terrible for the environment and bad for the government's budget. In 2016, Malaysia's Klang Municipal Council paid over RM6 million to remove clogged drains caused by solidified cooking oil, a necessary but costly mitigation effort to avoid floods that might have been easily avoided if everyone had properly disposed of old cooking oil (*How to Dispose of Used Cooking Oil: The Sustainable Way – MPOC*, n.d.).

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Waste cooking oil (WCO) may be an useful secondary raw resource if properly managed. In contrast, uncontrolled disposal has both environmental and economic effects. As a result, it is vital to improve WCO recovery rates through citizen participation and effective collection operations. In 2015, a social cooperative ran the collection programme, but after a change in local administration in 2016, the collection of WCO was outsourced to a commercial firm. In 2015, a systematic questionnaire was utilised to assess home involvement in the collecting programme. According to the data, 53% of respondents practised WCO collection. 76 percent of people who did not collect WCO disposed of it improperly at home (kitchen or toilet). They did not participate in the collection effort mostly

owing to misconceptions. As a result, it was advocated to support information and environmental education programmes in order to increase residents' environmental awareness. Unfortunately, the management change, combined with serious problems in municipal waste collection throughout the region as a result of the continuous closures of the mechanical and biological plants, resulted in a sharp drop in collection from 7730 kg in 2015 to an average of 3800 kg for the period 2016–2019, with a loss of more than 15,000 kg of WCO incorrectly disposed of, causing environmental and economic damage. As a result, although education and awareness activities are critical, the method in which the collection service is entrusted is also critical, especially in areas with long-standing waste management difficulties. (Giovanni De Feo, Aurelio Di Domenico, Carmen Ferrara, Salvatore Abate and Libero Sesti Osseo, 2020)

2.4 Waste Disposal Method Advantages and Disadvantages

Cooking oil may be recycled in a variety of ways, including the manufacture of soaps, candles, and renewable energy. Companies such as Pusat Teknologi Biomass UPM and Fat Hopes Energy in Malaysia transform used cooking oil into biodiesel. Soaps made from used cooking oil are commonly referred to as eco soap or green soap. These handmade soaps are popular nowadays and might be profitable. Such soaps are made by Green Yards and Soap Opera Kuala Lumpur, for example. The Malaysian Palm Oil Industry urges customers to make more sustainable choices by recycling excess palm oil (*Waste Disposal Methods*, n.d.).

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Table 2.1 Waste Disposal Method Advantages and Disadvantages (Waste Disposal Methods, n.d.)

Advantages	Method	Disadvantages
- - Convenient - Low-cost - Source of nourishment, shelter, and breeding	Ocean dumping	- Ocean warming - Food source depletion - Desalination
- With a small increase in the number of persons, the volume can grow. - Land that has been filled in can be repurposed for other community uses.	Sanitary landfill	- - The completed landfill area can settle and requires care. - Proper planning, design, and operation are required.
- - Requires little land - Can function in any weather - Produces stable, odour-free residue - Reduces waste volume by half - Is inexpensive- Requires little land	Incineration	- Expensive to develop and run - Requires a lot of energy - Requires skilled people and ongoing upkeep - Odour, trash, and vermin - Pollution-related damage

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