UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled “Tensile Properties Of HDPE Exposed To Biodiesel” 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.

Signature : 

Name : SASIDHARAN A/L ARUMUGAM

Date : 18 JANUARY 2022

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 Technology (Automotive Technology) with Honours.

Signature : 

Supervisor Name : EN. HAIRUL BIN BAKRI.

Date : 18/1/2022

DEDICATION

My dissertation is dedicated to my family and many friends. A special thanks to my beloved parents, Arumugam and Lecthumy, whose words of support and persistence continue to echo in my ears. Kalaivani, Nethiyasri, and Devandran, my sisters and brother, have never left my side and are very precious to me. I shall be eternally thankful for everything they have done for me, particularly Pavithiran's help in developing my technological abilities, Eeswaran's many hours of proofreading, and Tan's assistance in mastering the leader dots. I dedicate this work to my dearest friends, and I thank them all for being there for me during the project. You've both been my biggest supporters. ACKNOWLEDGEMENTS I would want to express my gratitude to my committee members who went above and beyond the call of duty.

ABSTRACT

Biodiesel is an alternative diesel fuel made from plant oils and animal fats. It is made up of monoalkyl esters that are produced when triglycerides in oil or fat are stimulated to react with simple monohydric alcohol. Transesterification of oils with short-chain alcohols or esterification of fatty acids create biodiesel. HDPE (high-density polyethene) is a plastic resin produced by copolymerizing ethylene with a tiny quantity of another hydrocarbon. HDPE is widely utilized as a primary material in the film, pipe, and container sectors. In this study, HDPE storage tank is used for Biodiesel production. However, HDPE as a storage tank for Biodiesel production has a problem with degradation and a decrease in strength. From the hardness test, B10 under 50 °C shows the highest decrement value compared with other HDPE samples, and B30 under room temperature shows the lowest decrement value compared with other HDPE samples. From the tensile test, the young modulus of B10-RT is the highest compared with other HDPE samples in week 1, and the young modulus of B10-T50 is the highest compared with other HDPE samples in week 2. High young modulus changes its shapes only slightly.

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CHAPTER 1

INTRODUCTION

1.1 Background

HDPE is a thermoplastic substance made up of carbon and hydrogen atoms that are bonded together to produce high molecular weight products. The British employed it to insulate radar wires during World War II, which was its initial commercial application of HDPE. In 1953, Erhard Holzkamp and Karl Ziegler of the Kaiser Wilhelm Institute created high-density polyethylene (HDPE). Catalysts and low pressure were used in the process, which is the foundation for the creation of a wide range of polyethylene compounds. (Gibson, 1963). High Density Poly Ethylene is one of the most desirable materials for future storage tanks (HDPE). It's also a little tougher and opaque, and it can endure somewhat greater temperatures of 120 °C or 248 °F for less duration. Because of its flexibility, HDPE fuel tank can be used to store Biodiesel. This material is recognized for its excellent chemical resistance as well as its ability to decrease fuel penetration. (Nurul Komariah *et al.*, 2017) .According to a recent research by Christensen and L.McCormick (2014), biodiesel blends stored in polyethylene fuel tanks were stable for 380 days when kept at 23 °C, while formation of peroxides and acids was found after 56 days of storage at a higher temperature (80 °C). However, tests involving the storage of biodiesel blends in HDPE and other polymeric materials are currently ongoing. Besides this, the regarding of project towards Biodiesel is production of Biodiesel from waste cooking oil and storage of waste cooking oil for a maximum of two months for vehicle used at the university. The most common

storage tank for Biodiesel production is HDPE. A complete research is needed on the capability of HDPE as a storage tank that required for the construction of such reactors.

1.2 Problem Statement

HDPE as storage tank for Biodiesel production undergoes the process of degradation and decrease in strength. HDPE storage tank may be failure by external factors such as stress crack caused by heat and pressure but however HDPE storage tank that contain Biodiesel has low performances due to exposure of Biodiesel to HDPE. So, a detailed study is needed to see the effect of using HDPE as a storage tank.

1.3 Research Objective

There are some objectives that need to be achieved from this project, which are:

i) To determine the tensile and hardness properties of HDPE immersed in Palm Oil Biodiesel

ii) To investigate the effect of Biodiesel concentration on the performances of HDPE

1.4 Scope of Research

There are a few guidelines proposed to ensure that this project meet the objective requirement based on the work scope of the project. The scopes are:

I. Concentration of Palm Oil Biodiesel are B10 (10% pure biodiesel and 90% is FAME) and B30 (30% pure biodiesel and 70% are FAME)

II. Storage temperature under 27°c or room temperature and 50°C

III. Storage durations is up to 336 hours approximately 2 weeks

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Two organic chemists from the Imperial Chemical Industries Research Laboratory were evaluating several compounds on March 27, 1933. The white, waxy material R.O Gibson and E.W. Fawcett were testing would turn out to be a revolutionary chemical that would transform the world, much to their astonishment. Polyethylene became a reality. In an autoclave, the researchers started a reaction between ethylene and benzaldehyde. Their testing container appeared to have sprung a leak, allowing all of the pressure to escape. There was a white, waxy material that looked suspiciously like plastic. The scientists found that the pressure loss was caused in part by a leak, but that the major reason was the porosity, after carefully repeating and assessing the experiment. A year later, the material's first practical application as a film was discovered. HDPE was developed by Karl Ziegler of the Kaiser Wilhelm Institute and Erhard Holzkamp in 1953. HDPE was first manufactured as a pipe two years later, in 1955. It was originally employed as an undersea cable coating, then as a key insulating material for military applications such as radar insulation. This is because it was so light and thin that it allowed radar to be installed on airplanes, greatly decreasing the weight. The substance's identity was kept a closely guarded secret. Polyethylene became a huge popularity with customers after the war. . It was the first plastic to sell more than a billion pounds per year in the United States. It is now the world's most widely used plastic. Polyethylene currently possesses good moisture-vapor, chemical, and electrical resistance. It's used to make Containers for biodiesel, wire cable insulation, pipe, linings, coatings, and engineered films, among other things. It's used in a wide range of products, including power

transmission, consumer goods, packaging, electronics, and household items. Its main drawback is its lack of mechanical strength, unless it is aided with scrim reinforcement. As technology advances, its usefulness improves, produce it the high effective use of natural resources such as petroleum and natural gas. Nana Hinsley (2015). Polyethylene is the most widely manufactured polymer in the world, with approximately 90 million metric tons produced each year. Nowadays, HDPE is highly demand material that has been use as storage tank for Biodiesel production.

Figure 2.1 The raw material of HDPE

2.2 Biodiesel

Biodiesel is made from biomass, which is a renewable energy source. Transesterification of animal fat or oil can be used to make it. It's produced from soybean, cottonseed, canola, and corn oil, as well as recycled cooking greases like yellow grease and animal fats like cow tallow and pig lard, and various combinations of these components. Transesterification is the process of converting triglycerides into fatty acid alkyl ester in the presence of another alcohol and a catalyst with glycerol as a byproduct. It has also been proposed to carry out for supercritical temperatures, a chemical reaction occurs. without the need of a catalyst. Biodiesel is sustainable and biodegradable since it is manufactured completely from vegetable oil or animal fats. Biodiesel also has a low Sulphur content, as well as polycyclic aromatic hydrocarbons and metals. Diesel fuel generated from petroleum can contain up to 20% polycyclic aromatic hydrocarbons. Polycyclic aromatic hydrocarbons are up to three orders of magnitude more soluble in water than straight chain aliphatic hydrocarbons for an equal amount of carbon atoms. Biodiesel is a safe option for transit and storage since it does not contain polycyclic aromatic hydrocarbons. (Vasudevan and Briggs, 2008)

2.2.1 Type of Biodiesel

Biodiesel comes in a variety of concentrations and can be mixed. B5 (up to 5% biodiesel) and B20 (up to 20% biodiesel) are the most prevalent (6 percent to 20 percent biodiesel). B100 (pure biodiesel) is most commonly used as a blend stock for lesser blends and is seldom utilized as a transportation fuel. Biodiesel blends including B100 have been effectively utilized in underground mining equipment. Biodiesel's potential to minimize emissions and human exposure to this criterion pollutant has prompted the industry to use greater biodiesel mixes. B20 is a popular blend because it offers an excellent mix of economy, emissions,

cold-weather performance, compatibility of materials, and solvent capabilities. Although B20 with 20% biodiesel content has 1% to 2% less energy per gallon, it is reported that B20 apparent difference in performance or fuel efficiency. Biodiesel also offers certain emissions advantages, particularly for engines made with biodiesel.(Sarno and Iuliano, 2019).

2.2.2 Method of Biodiesel Production

Biodiesel manufacturing can take place on a batch or continuous basis. Most companies favour batch size production because it is simple, cost-effective, and requires less skilled employees. Transesterification can be accomplished in a variety of ways. The lab scale batch reactor is the most widely utilized among them.

2.2.2.1 Batch reactor technique on a lab scale

A reflux condenser, a magnetic stirrer, and a round bottom flask with three or two necks are used in the majority of these reactors. For the production of biodiesel, this sort of reactor is employed in labs. The three necked round bottom flask shown in Figure 2.2.2.1 is linked to the condenser, thermometer, and Erlenmeyer.

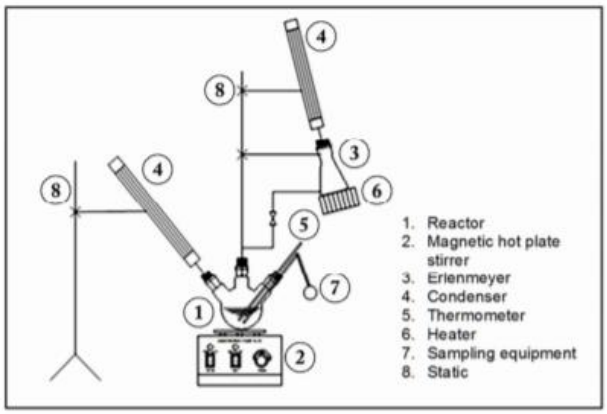

Figure 2.1 Batch reactor for transesterification

The catalyst is combined with alcohol after the titration that determines the amount of catalyst required for the reaction, after that, it's combined with oil in the reactor. continually stirred. When the reaction is finished, the result is a two-layer product that is separated using a separating funnel. Biodiesel is on top, while Glycerol is on the bottom. The generated biodiesel is then rinsed with water to eliminate any not react with alcohol or catalyst. By reacting with Na2SO4, the water in the product can be eliminated. When utilizing methanol as an alcohol, the reaction temperature is usually kept between 55 and 650 degrees Celsius. The ethanolysis of animal fat takes place at a temperature of 300°C. It was claimed that Using a 6:1 methanol to oil ratio, NaOH 1percent wt/wt as catalyst, and a 60 1 °C temperature for 1 to 3 hours while continually stirring at 300 rpm, 80 percent yield of Biodiesel could be generated from WCO in a lab scale batch reactor.