

# Design and Testing of Oil Distillation Performance Tools Become Alternative Fuel

Mochammad Fajar Pamungkas

Bogor Agricultural University, Indonesia

**Abstract:** Efforts to process waste into things that can be reused today are done so as not to pollute the environment. Automotive industry waste is currently disposed of in large quantities of used oil. Handling this waste that will be used as alternative fuels such as diesel. The use of tools in the processing of waste into alternative fuel one of them with distillation tools. Distillation is a means of separating substances contained in the main product by separating the substances to be separated as an additive in the oil. Used vehicle oil is a hazardous and toxic waste product from by-products on motor vehicles, cars and other vehicles. Oil is useful for reducing engine wear on the vehicle. Oil generally consists of 90% base oil and 10% additives. A distillation tool in the process of waste oil waste, which is separating base oil (oil) with used oil additives. The distillation designed in this research is distillation model with used oil product which will produce the final product of base oil in the manufacture of oil (base oil). The experiments performed by Virlya RA, Bagus KP, Winoto P (2014) stated that used oil has black physical properties with specific gravity of 0.8 ml / g, a viscosity of 120.45 g / cm sec, which would be distilled into oil base oil (base oil) clear yellow with viscosity of 5.14 g / cm sec, flammable at 85°C. Used distilled oil starts to exit the oil at the end of the distillation device at 180°C. The base oil (base oil) of distillation will be used as alternative fuel, that is diesel.

**Keywords:** Design, Testing, Distillation, Oil, Alternative Fuel

## 1. Introduction

### 1.1. Background

The current energy supply increases with the increasing number of existing transportation current use of fuel oil. The demand for fuel oil increases by approximately 0.7% annually. The provision of energy is an important factor in a country promoting infrastructure development, social as well as in other fields. Along with the needs of development, energy needs continue to increase then needed a technology in making energy needed.

The energy source used today is petroleum and coal in meeting energy needs within a country. The role of petroleum in the coming year will not be the same anymore at this time. This is due to petroleum resources and coal began to decrease. Major energy sources are used continuously so as to make energy sources in the future will be exhausted. In addition, the production of fuel oil through transformation technology in the country is not sufficient.

Energy utilization is currently done in reducing dependence on fuel oil (BBM), where one of them is ethanol. Ethanol is a volatile alcohol. Alcohol has a clear colorless color, distinctive aroma, liquid phase at room temperature, and combustible (Susilo S 2009). Ethanol is categorized into two groups: ethanol dihydrate (ethanol 95-96% v / v) and ethanol unhydrate (ethanol > 99.6% v / v). The second ethanol group is the ethanol used as a fuel and is called fuel grade ethanol (FGE) (Susilo S 2009). Ethanol with a concentration higher than 99.5% or commonly called fuel grade ethanol. This can not be achieved because of the difficulty of separating the hydrogen bonded in the chemical structure of alcohol by the usual distillation. Therefore, to obtain fuel grade ethanol is carried out further purification by means of azeotropic distillation (Nurdyastuti, 2008).

Development of an ethanol distillation apparatus is essential in the bioethanol industry. The product of fermented alcoholic bioethanol is low ie 8-10% alcohol. Therefore, to obtain high quality of bioethanol is needed further purification process by stratified distillation. The continuous distillation method with reflux (rectification) is one of the most efficient distillation methods applied on an industrial scale. This method uses a number of stages that are cascaded so that it will increase the separation process. Rectification method has several advantages that is 1). bigger operating capacity, 2) cheaper cost, 3). constant distillation rate, and 4). distillation results have a higher concentration level.

## 1.2. Research Purposes

The purpose of research is to design and test used oil distillation tools.

## 2. Research Methods

### 2.1. Time and Place of Study Implementation

This research was conducted at Lab Leuwikopo (TET) Department of Mechanical Engineering and Biosystem IPB. The time of the research is conducted from April to July 2017.

### 2.2. The Materials and Equipments

The materials used in this research are data of diesel properties determined by Pertamina, color data from oil using standard ASTM (American Standardization Testing Material), combustion axis, used oil, and diesel. Used oil materials needed for research come from Astra Daihatsu Motor (ADM) Sunter North Jakarta. The tool used in this research is the viscometer, thermometer, cup, stirrer, motor drive, bunsen container, foot three, kassa, stative as a retaining cable temperature gauge, stop contact, flow meter, and stopwatch.

### 2.3. The Research Procedure

The research procedure will assist research activities on design and performance testing of used oil distillation equipment. Some of the activities carried out in this study are seen in Figure 1.

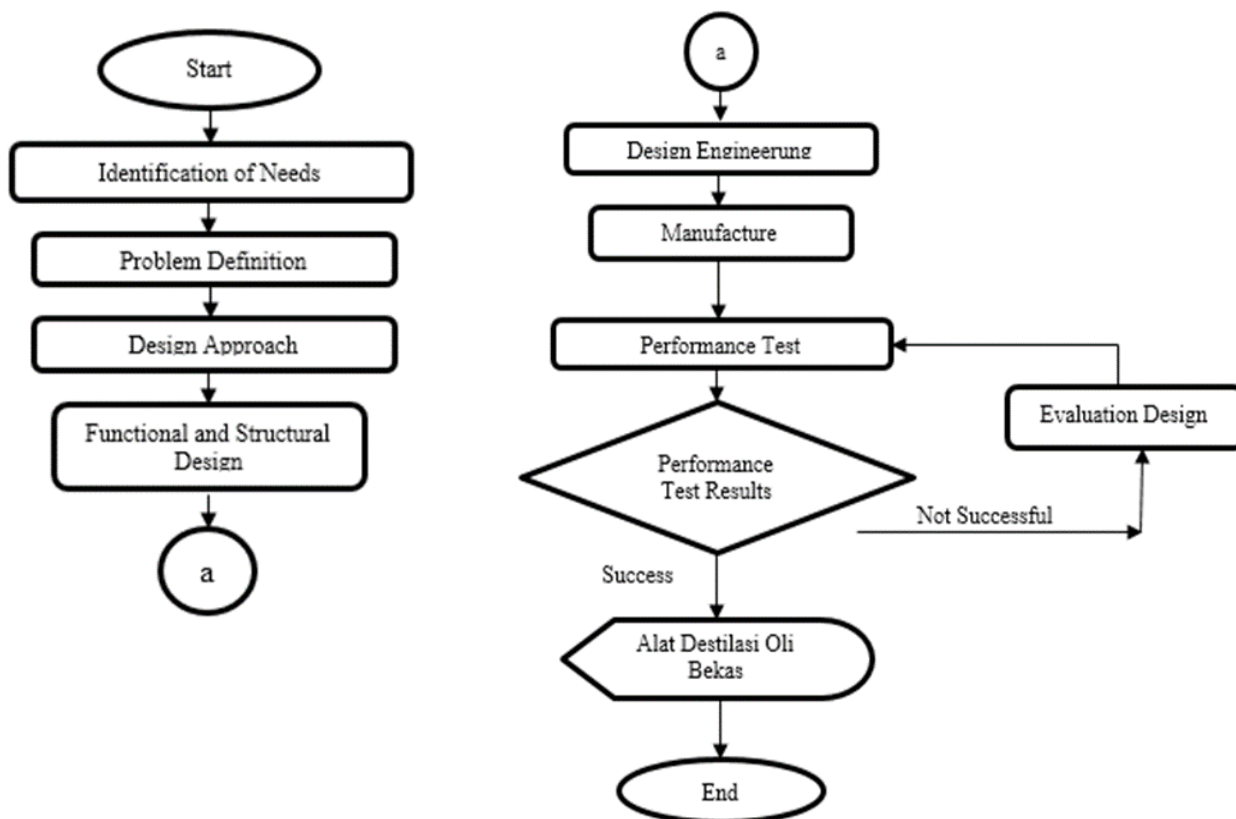


Fig 1. Flow Chart of Tool Design Stage

## 2.4. Research Approach

Generally used waste oil based on base oil (base oil). Waste that can be recovered into fuel that is used oil while other waste B3 waste handler only so as not to harm the environment. So encouraging in handling waste oil used to be useful things like base oil (base oil) can be fuel gasoline, diesel, jett oil, or lubricating oil with advanced process. The base oil produced from the waste oil treatment process using a distillation apparatus by its working principle is to separate the two compounds where the boiling point difference of the base oil compound with the additive of the lubricating oil. So as to produce a more clear oil or called PAO (Polyalphaolefin).

The design of this 4 liter distillation tool with a flow rate of 2 liters / hour based on the lubricant oil that has been used every month 4 liters of car per month. Temperatures achieved in heating used oil to separate two compounds at 180°C. The temperature makes the base oil (PAO) evaporate at a temperature of 170°C with an additive (C2F4) at its boiling point of 200°C. The difference in the boiling point makes the base oil separate from the additive. The distillation process is carried out for 2 hours to achieve optimum results. The process continues until the used oil source runs out within a certain period.

The distillation apparatus used by considering the material does not react or evaporate, is strong at high temperature, and is inexpensive in manufacturing ie stainless steel. Steel has a hard, strong nature, at high temperatures, easy to form, easy to manufacture. The distillation made using a tray so that the distillate vapor can be filtered with other foreign bodies. The fuel comes from LPG gas stoves where the temperature is 300-600°C with 12 hours of use per day. This fuel is based on direct test results in heat utilization compared to the heat from inadequate sunlight in the heat exchange ie at the highest temperature 340°C temperature that occurs. So the separation does not occur between the two compounds by using the heat of the sun or solar cell. This tool is designed to cost seven million in fabrication. This tool is manufactured outside the company. The result of distillation of used oil in the form of base oil (base oil) which will be used as fuel. This base oil will be used as substitute fuel for kerosene by testing the flame and heat produced in combustion and as a substitute for diesel in the initial flame of the boiler if every day the boiler is turned off.

## 2.5. Functional and Structural Design

This distillation apparatus comprises six essential components: heat source (gas stove), lower column, tray column, condenser, cooling pipe, and distillate reservoir tank. The capacity of this distillation apparatus is 4 liters of used oil from byproducts of oil use in cars. The components in the design of distillation include:

### 2.5.1 The Heat Source

The heat source serves to heat the oil to produce hot steam and then stream it into the lower column through a spiral pipe that serves as a heating coil. Heating source is an electric stove or gas stove placed under a steam tank. The temperature of the gas stove is 100-380 °C which is done by direct experiment.

### 2.5.2 The Bottom Column

Bottom column is made of stainless steel pipe with outer diameter of 15.24 cm, 0.5 cm thick, height 20 cm. The bottom column serves as a place to heat the oil to be distilled.

### 2.5.3 The Tray Column

Tray columns are made of stainless steel pipe with outer diameter 7.62 cm, 0.2 cm thick and 100 cm high. The tray column is equipped with a dish made of stainless steel plate with a thickness of 0.2 cm with small holes. Tray column serves as an oil purifier by using a tray system that is sieve tray.

### 2.5.4 Condenser

Condenser is made of stainless steel pipe with an outer diameter of 5 cm, 0.2 cm thick and 30 cm long. The condenser functions as a heat exchanger by absorbing heat from the oil vapor into water passing through the condenser as high as the condensation process occurs.

### 2.5.5 Distillate Container Tank

This tank serves to accommodate distilled oil material. In this tank is divided into two channels: reflux

channel and top product channel (top product). The oil flow divider in the distillate reservoir tank is by means of a valve. The result of distillate is designed with 99% base oil (PAO) distillate and additive (C2F4) 1%.

### 2.5.6 Models Design Distillation

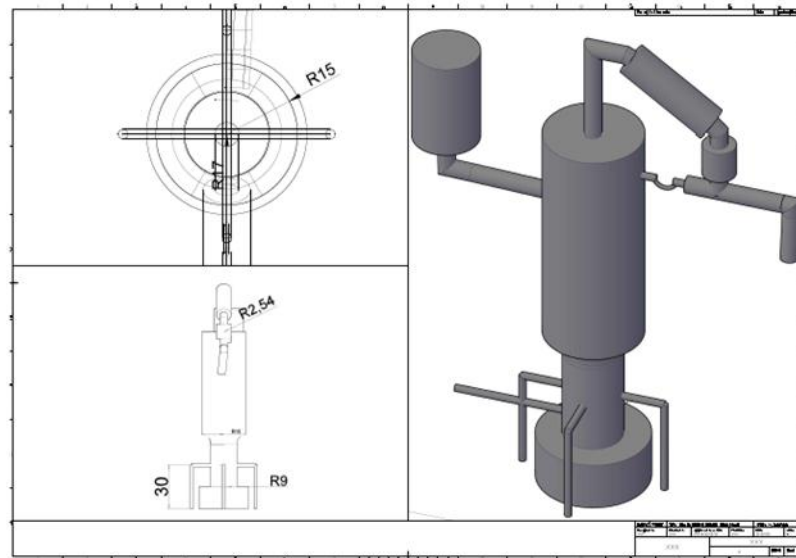


Fig 2 Model Design Distillation Lubricant

## 3. Results and Discussion

Figure 3 is the result of design of distillation of used oil. This distillation tool can be used various research materials. Testing of used oil distillation is done in lab leuwikopo Department of Mechanical Engineering and Biosystem Bogor Agricultural University. Distillation heater with two types of stove and fuel used gas. The test is carried out over a period of time where several stages are performed. The first stage of preparation of used materials is 10 liters of used oil and regulates fluid flow to the feed, bottom, and condenser. The second stage performs the measurement of the temperature reached by the stove when it is turned on. The third stage enters the used oil into the distillation and measures the vapor and temperature changes within and above the distillation. Temperatures achieved in the testing of used oil at the bottom of the distillation are 320oC and the temperature at the upper distillation 129oC. Temperature of gas stove 600oC where it is lit for 6 hours. The results obtained in this test is a mixture of liquid as much as 5 ml.



Fig 3 Design Distillation of Used Oil

The result of distillation research of used oil in the form of liquid mixture between oil and water. The mixture can be seen by not joining the two liquids. The physical aspect of the result is an unpleasant smell like

gasoline or fuel. It is not yet certain that the mixture is oil (fuel) or not oil. Material testing is not conducted to determine the oil mixture is fuel or gasoline. The result can be concluded that distillation of used oil can be done in such a method so as to produce two mixtures of liquid oil and water.

The distillation product has not been tested to be an alternative fuel. It cannot be proven that distillation results may not necessarily be an alternative fuel. This paper proves that used oil can be distilled into new products clearer and smell like fuel. The process of being fuel from the distillation product has not been up here need to proceed further into alternative fuel.

#### 4. Acknowledgements

Thanks God for the grace of God for all his gifts so that this scientific work is completed successfully. The title of the study was conducted from May 2017 until August 2017 Design And Testing Of Oil Distillation Performance Tools Become Alternative Fuel.

Thanks to the author of the authors who have provided support suport, prayer, and funding, Mr. Dr.Ir. Leopold O N, S.TP., M.Si. as mentors who have provided advice and direction in this research. In addition, the award of the author conveyed to Mr. of the Center for Materials and Engineering along with the staff who had assisted during the data collection. Hopefully this scientific work useful.

#### 5. References

- [1] ASTM D 2270-86. Standard Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100oC.
- [2] Budianto A. 2008. Determination Method of Coefficient of Viscosity of Liquid by Using Linear Regression of Stokes Law. [Thesis] National Seminar IV SDM Nuclear Technology Yogyakarta. High School of Nuclear Technology – BATAN
- [3] Coulson JM. 1983. Chemical Engineering. Singapore (SG): Mc. Graw Hill Dahlan MH, Setiawan A, Rosyada A. 2014. Separation of Used Oil Using Column Filtration and Membram Ceramics Made of Raw Zeolite and Clay. [Journal] Chemical Engineering No. 1, Vol. 20 things. 41
- [4] Darmanto S, Sigit IA. 2006. Biodiesel Analysis of Coconut Oil as Alternative Fuel of Diesel Oil. [Traction Journal] Vol. 4. No. 2
- [5] Hamid A, Effendie R A.K, Susila J. Designing Virtual Plant Distillation Methanol-Water Column Using Wonderware Intouch With Data Acquisition Process Using Microcontroller. [Proceeding Seminar on Final Duty] Department of Electrical Engineering, Faculty of Industrial Technology - Sepuluh Nopember Institute of Technology Surabaya
- [6] Henley EJ, JD seader. 1976. Equilibrium-Stage Separation Operations in Chemical Engineering. United States (US): Johnwiley & Sons.
- [7] Hudoyo R, Shanti MRS, Setiawan A. Testing Effect of Addition of Used Oil Filler Oil Saturated as Identification of Energy Content in Pure Oil [Proceedings]. Faculty of Science and Mathematics of Satya Wacana Christian University
- [8] Komariah NL, Ramdja AF, Leonard N. 2009. Theoretical Review of Distillation Column Design for IWijayandustri Scale Factory Prep. [Chemical Engineering Journal] 4, Vol. 16 Raharjo WP. 2007. Utilization of Tea (Three Ethyl Amine) In the Process Of Used Oil Purification For Fuel In Aluminum Smelting. [Journal of Science & Technology Research] Vol. 8, No. 2, p. 166 – 184
- [9] Stefan Raharjo Nugroho and Hasto Sunarno 2012. Physical Identification of Motor Vehicle Engine Viscosity on Temperature Function by Using Helium Neon Laser. Journal of Science and ArtI 1-5
- [10] Susilo S. 2009. Design and Performance Test of Ethanol Distillation Equipment with Rectification Method. [Thesis] Faculty of Agricultural Technology Bogor Agricultural University.
- [11] Wiratmaja IG. 2010. Testing of Biogasoline Physics Characteristics as Alternative Fuel Substitute Pure Gasoline. [Journal of Mechanical Engineering Sciences] Vol. 4 No.2 (145-154)