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Pilot Facility for the Use of Used Oil as an Alternative Fuel for Diesel

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ABSTRACT: Consumption of lubricating oil continues to increase, until 2018 it reaches 1.14 million kL (kiloliters), the increase in oil use per year increases by around 2.5% then in 2019 there will be at least 600,000 kL of used oil that has not been processed properly.

Oil consumption the main target is the establishment of a pilot facility to use used oil into alternative fuels. Alternative fuel (BBA) produced from the processing of used oil as fuel Type Solar Oil marketed domestically.

Distillation process with the help of NaOH as a catalyst to obtain a clear and maximum product (quality and quantity). The results that have been obtained during the experiments are at a NaOH concentration of 0.05 kg / 10 liters of used oil showing excellent product results. The waste generated by this process is in the form of sludge and dirty oil which is directly reused.

This used oil processing technology is expected to be able to be a breakthrough and the right solution to minimize the impact of used oil pollution and convert it into fuel that has high beneficial value and economic value as well as reduce fuel imports, reduce dependence on technology from outside, increase state foreign exchange, as well as encourage industrial competitiveness and increase the level of domestic content (TKDN).

KEYWORDS: Facilitation of alternative fuels, NaOH distillation, import substitution and carrying capacity of local industrial content.

INTRODUCTION

Crude oil production in Indonesia is increasingly limited, data from the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas) 2016 states that Indonesia's petroleum production is only 831,000 barrels per day while national needs reach 1.6 million barrels per day. To cover the deficit, Indonesia must import petroleum or its derivative products.

Currently, the government is aggressively dealing with the problem of hazardous and toxic waste. Waste oil is included in the category of B3 waste that must be overcome. One way to handle it is by processing this used oil into new lubricating oil or fuel. Basically, used oil can be used directly as fuel but this will cause pollution such as black smoke, air pollution that results in odors, toxins and ecosystem effects so that this is prohibited by both central and regional governments.

B3 Waste Management is an activity that includes reducing, storing, collecting, transporting, utilizing, treating, and/or stockpiling B3 Waste.

The B3 Waste management hierarchy is intended to be produced in each production unit as little as possible and strive for zero, by seeking reduction in sources by material processing, material substitution, regulation of activity operations, and the use of clean technology.

The new paradigm in B3 waste management is to make the most of B3 waste before it is destroyed or stockpiled. B3 waste is currently considered as a resource that must be used either as a raw material or alternative material or as an alternative fuel.

Based on studies and implementations carried out by several parties in the use of B3 waste that have received permits, waste B3 waste can be processed into alternative fuels to be further used as fuel equivalent to MFO, HSD or diesel. The processing process does not require complicated technology, it only requires special equipment to heat used oil so that fuel can be used immediately. Used oil B3 waste processor that uses technology that causes environmental pollution such as air pollution, water and new solid waste which is quite significant.

Goals and Objectives

The purpose of this activity is to carry out the construction of facilities for the use of used oil into alternative fuels equivalent to HSD or diesel, reduce waste B3 used oil and increase the Domestic Component Level (TKDN) by utilizing as many raw materials, materials and local resources as possible.

Pilot Facility for the Use of Used Oil as an Alternative Fuel for Diesel

Meanwhile, the target of the activity is the construction of a facility for the use of used oil into alternative fuels equivalent to HSD with an installed capacity of 10 kL BBA / month, based on a feasibility study and drawing engineering design that has been prepared in previous activities

Scope

The scope of work includes Civil work of factory, office and warehouse buildings, equipment fabrication, Equipment installation, Piping and Instrumentation, Installation of utility and security equipment, Mini laboratory facilities, and commissioning

Special Requirement

There are several special requirements that must be met in the implementation of this activity:

1. The technology used does not produce significant B3 Waste
2. Apply pollution control technology for both airwater and B3 waste to a minimum
3. Meet all environmental management standards, both air pollution emission quality standards, ambient and B3 waste management administration if the resulting process produces waste
4. The resulting product meets the standards of HSD or diesel equivalent fuel.

Location

The construction site for the used oil utilization facility as an alternative fuel will be at the Banjar Bakula Regional Landfill, Banjarbaru City, South Kalimantan Province

METHODOLOGY

Sustainability analysis with an emphasis on the sustainable development of alternative fuel facilities to replace diesel through the development of young-scale industries with batching technology installed with catalytic cracking technology to cooling water
Some of the calculation bases used in the design of the pilot plant for this used oil utilization facility include:

a) Manufacture of alternative fuels (BBA) with waste oil feedstock operating in batches. The installed capacity of the pilot plant is 10 kL BBA / month.
b) The process technology used is thermal cracking at a temperature of ~350oC by adding NaOH chemical liquid as a catalyst, so it can be called catalytic cracking technology. The gas formed is then condensed using cooling water and absorption using kwarsa sand.
c) The characteristic of the used oil used is the type of used oil obtained from the collector located in Prov. South Kalimantan.
d) The BBA production process is:

- Preparation of raw materials
- Mixing with caustics (1–2.5% NaOH solution).
- Condensation of products resulting from the distillation process by using a cooling pool.
- Two stages of separation between gas, dirty oil (mintor) and non-condensed NaOH residue in separator tank A and between gas and liquid in separator tank B.
- Color absorption of oil products from separation by adding NaOH.
- Dirty solar filtration results from color absorption with the help of kwarsa sand to produce ready-to-sell clean diesel.

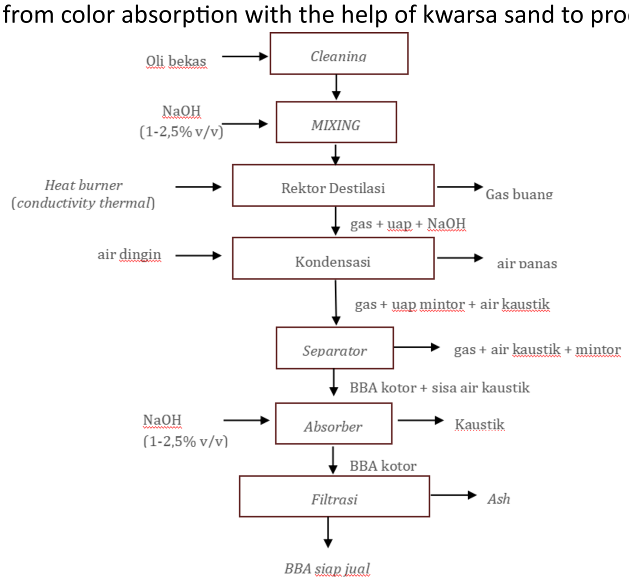

Figure 1: Block diagram of the construction process of the BBA Solar facility.

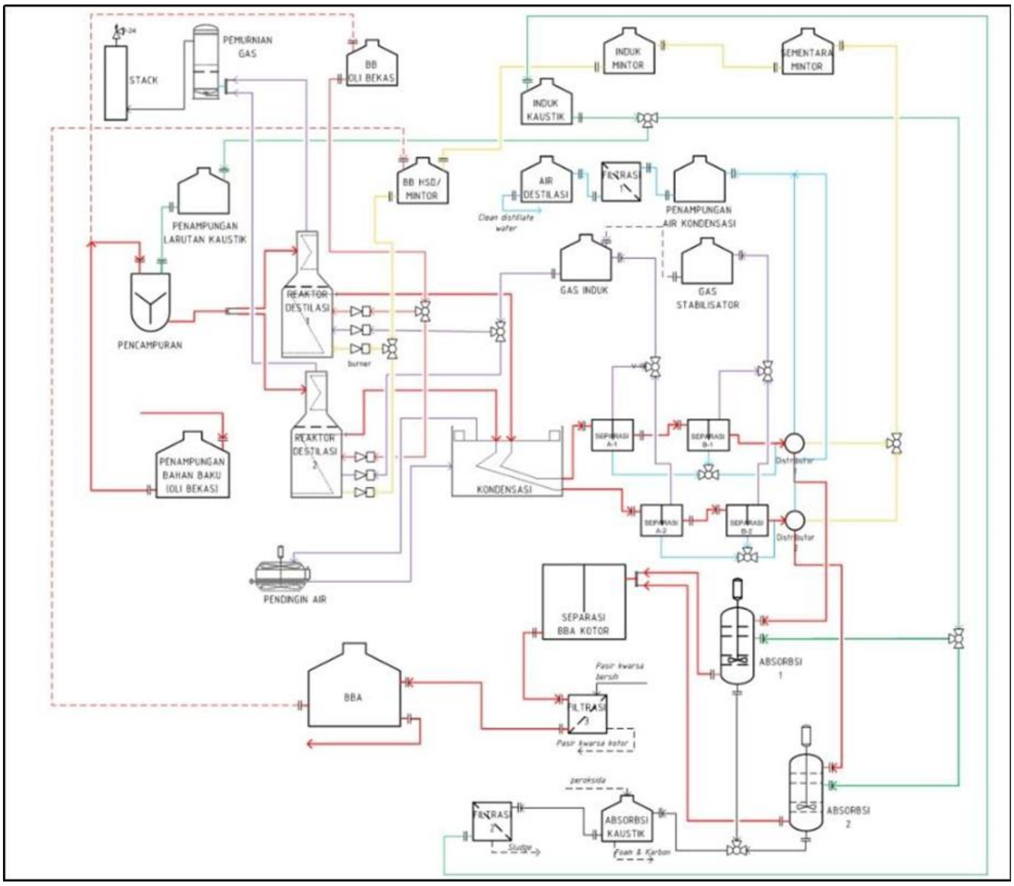

Figure 2: Flowsheet of BBA Solar Facility Installation

RESULTS AND DISCUSSION

Process Description

a. Material Preparation Stage

The main raw materials include:

- Used oil raw materials with water content below 10% are stored in TP-04 with the help of P-301 pumps at room temperature and atmospheric pressure. The installed volume of such raw material storage tanks has a capacity of 10 m3. The density value of the used oil used for the calculation is 0.885 kg/L.
- Caustic soda (NaOH) is stored on the TK-01 caustic master tank with an installed volume of 3 m3. At the initial stage storage is carried out manually, that is, entering NaOH solids and conditioned 1-2.5% v / v. However, after the production stage is running, caustic soda can also be produced from the by-products / residue of the absorption process in TA-01 and TA-02.
- Supporting Materials
- HSD for the BBA manufacturing process is only for the start-up of combustion TR-01 and TR-02 until gas and mintor are produced.
- Kwarsa sand as a filtration medium in TF-03 between the dirty product (BBA) and the residual sludge that is still contained in the product. Kwarsa sand is prepared manually on filtration tanks of 100-150 kg.
- Hydrogen Peroxide on TL-01 is for binding impurities such as residual carbon (sludge) that is included by caustic dirty soda. The process / reaction that occurs gives a buble effect, so that the remaining carbon is bound and rises upwards in the form of foam. Then it is flowed entirely into the filtration process in a row starting from caustic soda and until the last foam / sludge is flowed.

Figure 3: Temperature and time graph in a distillation reactor

b. Mixing Stage

Drain the used oil from TP-04 to the mixing tank (TM-01) with a volume of approximately 3300 liters or approximately 2940 kg, then drain caustic soda (NaOH) into the TM-01 tank so that it mixes and homogenizes with used oil at certain revolutions. The installed capacity of the mixing tank is 1.5 m3, this means that 3-4 times the repetition of the mixing process is carried out for 1 distillation reactor.

Checking the NaOH solution before entering the mixing tank needs to be done by titration periodically (min. 3 times).

c. Heating Stage

Drain a mixture of used oil and caustic soda into TR-01 or TR-02 using a P-102 gear pump. With the role of the mixer motor, it is hoped that the two fluids can be homogeneous.

BR-A1 or BR-B1 is activated to heat the reactor with diesel fuel as a start-up until the production of flue gas mixed with hot air vapor and carbon to the scrubber (SC-01) continuously until the cooling process. The flow of product gas is flowed to obtain a saturation (condensation) treatment in the cooling pool. The use of HSD fuel as a combustion start-up only reaches a temperature of 250oC and

then use used oil from TT-03 until it reaches a temperature of 350oC. In addition to using used oil, gas from separator products is also used to increase and maintain the temperature in the reactor tank.

Heating can last 2 to 3 days to the saturation point (no steam and dirty oil is produced). It is estimated that the gas and steam produced from the heating process is approximately 805 kg. Meanwhile, by-products such as residues and sludge (± 5% w/w) are reused as solid fuel in distillation reactors.

d. Condensation Stage

Condensation of steam, dirty oil and caustic dirty soda contained in the combustion gross BBA is saturated using HE-01. Water with a temperature of 30oC comes from cooling water circulated using a centrifugal pump P-202. The flow of combustion products in the distillation reactor is flowed using pipes dipped in the HE-01 pool.

The products resulting from this saturation process are expected to be 100% liquid and gaseous. 3180 liters of gas + oil vapor. As for the hot water, it is flowed back to the cooling water.

e. Separation Stage

The separation process of gas, dirty oil (mintor) and dirty alternative fuel is carried out on TS-A/B with installed capacities of 0.3m3 and 0.8 m3 respectively. Each distillation reactor has a separate path/flow, so the need for this separation tank (TS-A/B) is 4 units installed in series.

The first stage of separation in TS-A1/2 resulted in a by-product gas of about 5.5% of the input and a mintor of 21.76%. Then the rest is streamed to the second split stage in TS-B1/2. The gas and mintor mixture plus gross BBA products produced were 20.2% and 79.8% respectively which were then flowed to distributors 1 or 2.

There are 3 types of products resulting from this separation process, namely:

1) Dirty BBA, flowed to TA-01/2 to obtain absorption and purification treatment of the remaining sludge included.
2) Mintor, flowed into a temporary mintor tank (TT-02) to be subsequently accommodated in the mintor mother tank and used as fuel.
3) Caustic soda water is condensed, flowed into a temporary caustic tank (TT-01) for residual sludge filtration treatment and reused for the process.

f. Purification Stage

The purification process is the process of adding a 10% v/v caustic soda solution from the costic mother tank (TK-01). The purpose of this process is to purify and bind the remaining NaOH + sludge (carbon) solution to the separated gross BBA (TS-A/B). A stirring system is attached to the absorbtion tank with the aim of binding by-product residual NaOH + sludge solution and flowing to the bubble tank (TL-01).

The products produced in the purification process are flowed to the settling tank (TS-01) with the aim of separating the remaining carbon and sludge carried away after the purification process. It can be said to be a settling process

g. Screening Stage

This process is the end of a series of BBA production processes equivalent to HSD. TS-01 products are streamed to TF-03 with 100 mesh. However, before flowing into the filtration tank, 25 kg of kwarsa sand is put into the tank with the aim of helping to separate the remaining carbon from the dirty BBA and increasing the color level of the BBA itself.

The filtering process product is around 2216.28 kg with by-products such as carbon sludge and kwarsa sand which are included in 1.5 kg. BBA is filtered around 2500 liters which is an HSD-level alternative fuel.

By-product the remaining costic sludge solution produced during the absorption process in TA-01/2 is re-filtered using TF-02 so that the sludge is separated from the soda caustic solution. By using a chemical pump P-205 to PP-207 and then accommodated into the TK-01 soda caustic main tank as a raw material for supporting the process.

h. Storage Stage

Alternative fuels resulting from the filtration process (TF-03) are stored in TP-03 products and can subsequently be distributed/sold to the market.

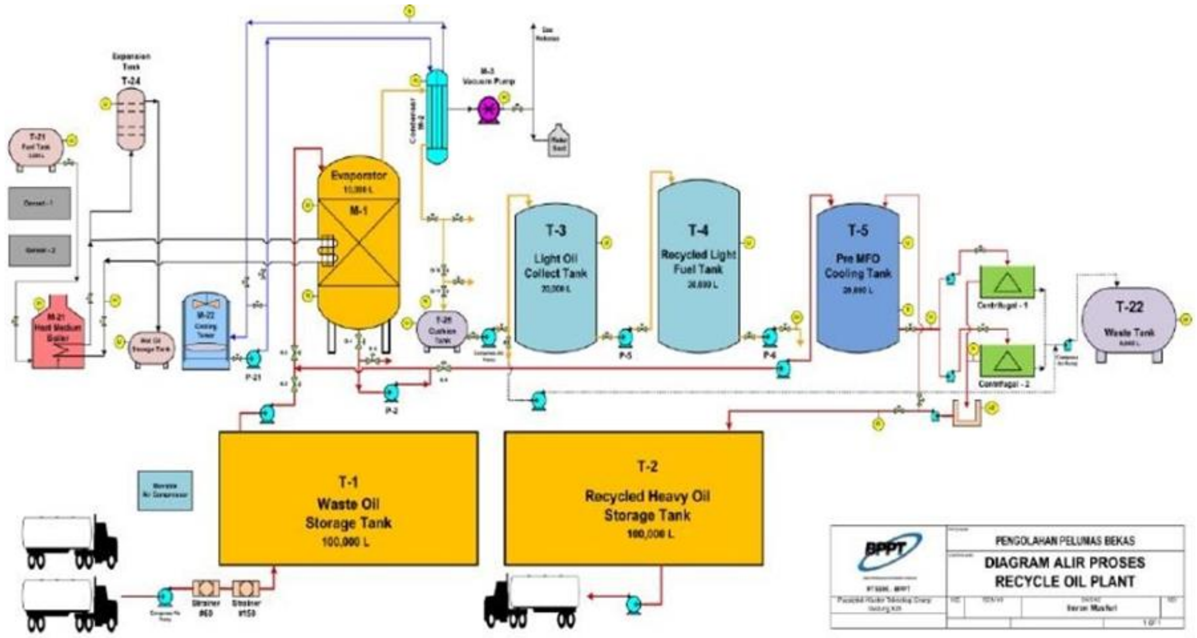

Figure 4. Flow Chart of Fuel Manufacturing Process from Used Lubricating Oil

i. Cooling Stage

The heat exchange process that occurs in cooling water aims to recycle condensed water (HE-01). Inlet temperature in cooling water ±60oC and cooling target up to 30oC.

Figure 5. Demo of used lubricating oil processing plant into MFO

The entire explanation of the process above uses 2 distillation reactors (TR-01/2), and if the two run simultaneously, the BBA product produced is approximately 5000 liters / batch. Time taken in one process (per-batch) and maintenance maximum 10 days (full-day)

Commissioning

The commissioning began on January 6, 2020 by heating the distillation reactor 2 (TR-02) which had been drained of 1.5 kilo liters of used oil. Meanwhile, a 20%wt (6 kg) caustic soda solution is flowed to TR-02, waiting for the start of the distillation process.

Before firing, it is prepared:

a) Condition the condenser (HE-01) as the cooling medium for the water fluid.
b) Enable connected scruber (SC-01)
c) Heat to be generated from the used oil burner (BR-B2)
d) Flow the used oil in TP-04 to the fuel tank of used oil + mintor (TT-03) using a pump (P-101).

Track Record

Until 2017, the Agency for the Assessment and Application of Technology has developed the production process of demo plants of used oil into fuel [products in the form of 90% marine fuel oil (MFO) equivalent fuel or fuel oil and 10% high speed diesel (HSD) equivalent fuel] with a capacity of 40 tpd. The production test process has been carried out until it reaches full operation continuously.

The flow chart of the process of making fuel oil from used lubricating oil can be seen in Figure 3. The photo demo plant can be seen in Figure 4. The technology used is vacuum distillation using an evaporator in a relatively low temperature so that energy use is more efficient and effective.

Marine Fuel Oil (MFO) products or Fuel Oil produced from the above process have a high level of viscosity compared to diesel oil. The use of this type of fuel is generally for direct combustion in large industries and is used as fuel for steam power stations and some uses that from an economic point of view are cheaper with the use of fuel oil. The price of fuel oil is cheaper than the price of diesel oil (HSD) and also its use is more limited.

Economic Outlook

The investment plan to establish a used lubricating oil processing plant into alternative fuels with a capacity of 10 kl per month is feasible both from the financial aspect and business profitability.

There are 2 options for development, including:

- The first option is the construction of a factory with a Grant Scenario. In this scenario, investment costs (equipment and permits) are entirely derived from grants. From the results of the projected profitability of the business, this scenario is most profitable to develop under conditions that match the assumptions used. It is estimated that the net profit obtained is about 30% of the total sales of HSD products.
- The second option is the construction of a used lubricant processing plant with an Investment Scenario (investment funding is obtained from own capital). With this scheme, the project is also feasible to develop. The lower the licensing costs incurred, the better the value of the feasibility indicators.

CONCLUSIONS

Commissioning and Production Test work has been carried out and achieved the target of 100% or 5.00% of the total work. This means that all work on the Used Oil Utilization Facility as an Alternative Energy Source has been COMPLETED.

The entire sapai development process with the implementation of the piping system and other installations went well.

The overall finishing process starting from the implementation of the sapai system simplification of waste production waste received facilitation as previously expected

The collection of alternative raw materials for diesel and the settlement of waste formed can be completed by coordinating with a special task force with stakeholders so that used lubricating oil can become an alternative fuel such as diesel and its waste can be used as paving blocks as well as possible.

The next effort is to encourage regulatory efforts that arouse domestic self-reliance efforts in achieving the level of local content of onvestors in promoting the independence of the domestic industry to be more beneficial to national development.

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