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PREFACE

Following the previous successful of SENTEN-ICoNETS 2015-2017, five research centers under the Deputy of Nuclear Energy Technology – National Nuclear Energy Agency of Indonesia (BATAN) in collaboration with Universitas Sriwijaya organize the First Symposium of Emerging Nuclear Technology and Engineering Novelty (SENTEN) with theme:"Discovering Science and Engineering Novelty for improving human life prosperity". SENTEN 2018 has been conducted in Horison Ultima Hotel, Palembang, South Sumatra, Indonesia, on 4-5 July 2018. This conference aims at summarizing recent research activities relevant to the nuclear, material, mechanical, electric, chemical, geology, architect and civil engineering, computer science and IT, food and agriculture, and also facilitate communication among relevant experts.

More than 150 people from Indonesia, Malaysia, India, Taiwan, and some other countries have participated in this conference. About 207 presentations including 6 keynote speeches and 1 plenary talk are presented. The presentations are grouped into 9 areas of particular interest: (1) Nuclear Science and Engineering, (2) Material Science and Engineering, (3) Mechanical and Industrial Engineering, (4) Electrical Science and Engineering, (5) Chemical Science and Engineering, (6) Geological Science and Mining Engineering, (7) Architecture and Civil Engineering, (8) Computer Science and Information Technology, and (9) Food and Agricultural Science, Natural Resource Science.

From about 190 full papers submitted, then peer-reviewed by relevant experts, eventually 169 papers were accepted for publication in this proceeding. We are indebted to all of authors for submitting their original papers.

We would like to thank all participants, and express our gratitude to all those who helped the success of this conference.

Syaiful Bakhri

SENTEN 2018 Chairman

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FOOD AND AGRICULTURAL SCIENCE, NATURAL RESOURCE SCIENCE

Figure 1. National Fuel Consumption from 2006 to 2017 [1]

Provision of energy sources that can support national energy security continues to be sought, especially new and renewable energy sources. According to the [1], by 2017 Indonesia has new and renewable energy potentials of more than 441 GW but only realized 8.89 GW. The Government of Indonesia is committed to targeting renewable energy contribution of 23% of overall national energy needs by 2025 and intensifying its energy savings program by reducing 17% of fossil fuel consumption.

A number of measures taken by the government to curb fossil fuel use include electricity savings in government buildings, restrictions on the use of official vehicles, the conversion of kerosene to LPG, the conversion of fuel from gasoline to gas, the development of nuclear technology, restrictions on the number of passengers for the vehicle (3 in 1), the use of solar cells for traffic regulators until the development of new and renewable energy such as the utilization of geothermal energy, wind energy, solar energy, water energy, sea tidal energy, energy from plants such as biomass and biodiesel. Biodiesel is increasingly ogled by the government and the private sector as Indonesia as one of the largest palm oil producers in the world has huge potential to develop this type of fuel. Pertamina as an agency authorized to produce and distribute fuel in Indonesia has been mass producing B5 type which means 5% fuel oil vegetable and 95% fossil fuel.

Tabel 1. Biodiesel National Standar [2]

No	Parameter	Unit	Value	Method
1	Densitas (40 °C)	Kg/m3	850-890	ASTM D 1298
2	Viscositas (40 °C)	Mm2/s (cSt)	2,3 – 6,0	ASTM D 445
3	Cetane Number		Min. 51	ASTM D 613
4	Flash Point (close cup)	°C		
5	Cloud Point	°C		
6	Copper Strip Corrosion (3 jam, 50 °C)		Max. No. 3	ASTM D 130
7	Carbon Residu - Sample - -10 dist. Residu	% mass	- Max 0,05 - Max 0,3	ASTM D 4530
8	Air dan sedimen	% vol	Max 0,05	ASTM D 2709 atau ASTM D1160
9	Temperatur Destilasi, 90% recovered	oC	Max 360	ASTM D1160
10	Sulfated Ash	% mass	Max 0,02	ASTM D 874
11	Sulfur	ppm (mg/kg)	Max 100	ASTM D 5453 atau ASTM D 1266
12	Phosphorous Content	ppm (mg/kg)	Max 10	AOCS Ca 12-55
13	Bilangan Asam (N_A)	Mg-KOH/g	Max 0,8	AOCS Cd 3-36 atau ASTM D 664
14	Free Gliserin	% mass	Max 0,02	AOCS Ca 14-56 atau ASTM D 6584
15	Total Gliserin (G_{ttl})	% mass	Max 0,24	AOCS Ca 14-56 atau ASTM D 6584
16	Kandungan Ester	% mass	Min 96,5	-
17	Bilangan Iod	% mass (gr I_2/100 gr)	Max 115	AOCS Cd 1-25
18	Halphen Test		Negative	AOCS Cd 1-25

Biodiesel is defined as monoalkyl ester of long chain fatty acids contained in vegetable or animal oils for use as diesel fuel engines. Generally in Southeast Asia such as Indonesia, Thailand, and Malaysia use palm oil as raw material for biodiesel production. However, the use of palm oil as a raw material for the manufacture of biodiesel collided with the interests of food for human basic needs. In this research used waste cooking oil to produce biodiesel by reacting with methanol and catalyst. The type of catalyst used is an alkali catalyst that is KOH because it is cheap and widely available [2] [3].

Tabel 2. Characterization of waste cooking oil [4]

Properties	Values
Density @ 15 (°C)	934 (kg/m^3)
Spesific gravity @ 15 (°C)	0.9232
Kinematic viscosity @ 49 (°C) in catalyst	24.9
Flash point (°C)	207
Acid value (mg KOH/gr oil)	1.8
Safonification value	192.3
Iodine value (mg KOH/gr oil)	69.7
Density	930 (kg/m^3)
Molecular weight	883 (gr/mol)

The ultrasonication increases the chemical reaction speed of the transesterification and also facilities the change of production method from batch processing to continuous flow processing. The principle of ultrasound action in biodiesel production is primarily based on the emulsification of the immiscible liquid reactants by microturbulence generated by radial motion of cavitation bubbles. It allows a short reaction time and high yield because of emulsification and cavitation of the liquid–liquid immiscible system [5]. The ultrasonic irradiation biodiesel process reduces the reaction time by 30 min or more as compared to the conventional method. The highest biodiesel yield and methyl ester content were observed at an ultrasonic power of more than 450 W [6].

Do Van Manh *et al*. [7] studied the effects of ultrasonic irradiation time (t) on the biodiesel yield (Y) of biodiesel produced from blended oil consisted of 20, 50 and 30% of tung, canola and palm oils, respectively and CH_3OH and KOH. Their results showed that biodiesel yield reaches high value of 87–91% for tung oil as t ≥ 5 min, while of about 92–94% for blended oil as t ≥ 1 min. The researchers suggested that the tung oil should be blended with other oils in order to produce biodiesel satisfying the biodiesel standards. Table 2 shows the optimum condition required for biodiesel production from various oils. The properties of biodiesel obtained by this method are in agreement with the standard biodiesel [8].

Table 3. Biodiesel Production using Ultrasonic Technology

Type of oil	Optimum Condition	Reference
Waste cooking oil	Molar ratio of alcohol to oil of 6:1, 1wt.% KOH, temperature of 45°C, ultrasound power of 200 W, irradiation time of 40 min	9
Coconut oil	Molar ratio oil to ethanol of 1:6, 0.75wt.% KOH, 7 min reaction time.	10
Canola oil	Methanol/oil molar ratio of 5:1, 0.7 wt.% KOH, reaction time of 50 min, ultrasonic irradiation of 20 kHz with an input capacity of 1 kW.	11
Coconut oil	Molar ratio oil to ethanol of 1:6, 0.75wt.% KOH of of oil, 7 min reaction time.	12
Jatropha Oil	Molar ratio oil to methanol of 1:4, catalyst of 5 wt.% of oil, reaction time 30 min, ultrasonic amplitude 50% (100 W/m^3) and cycle 0.7 s.	13
Crude Cottonseed Oil	Methanol/oil molar ratio of 6.2:1, 1 wt% NaOH, reaction time of 8 min.	14

Ultrasonic technology has been recognized as an effective method to enhance mass transfer rate between immiscible liquid-liquid phases within a heterogeneous system [15]. When a liquid is irradiated by a strong ultrasonic wave, large quantity of tiny gas bubbles appear and collapse violently, which is a phenomenon known as acoustic cavitation [16]. The tiny bubbles repeatedly expand and contract according to the pressure oscillation of ab ultrasonic wave [17].

The speed of the bubble collapse sometimes increases up to the sound velocity of the liquid and the temperature and the pressure inside a bubble increase dramatically because a strong collapse is nearly adiabatic [18,19]. As a result, ultrasonic in transesterification has proven to be an efficient activation energi to initiate the reaction [20]. Ultrasonic assisted transesterification does not only shorten reaction time but also minimize the molar ratio of alcohol to oil and reduce energy consumption compared to conventional mechanical stirring method.

2. Materials, Equipment and Experimental Procedure

2.1 Materials

Waste cooking oil was collected from residual usage of household. Methanol and KOH (Merck KGAa Germany) were purchased from Dira Sonita supplies, Palembang.

2.2 Equipment

Ultrasonic cleaner type GT Sonic P3 is used to perform transesterification reaction between methanol and waste cooking oil. The spesification GT Sonic P3 have 12 cm x 25 cm x 22 cm (W x L x H) with adjustable ultrasonic power from 30% to 100% (maksimum power 100 W and 40 KHz) and adjustable heater from 30 ^{o}C to 80 ^{o}C.

2.3 Experimental Procedure

The experiment was carried out by reacting the waste cooking oil with methanol with 6: 1 molar ratio and adding a catalyst of 1% of the waste cooking oil weight. The pellet of KOH was first added to methanol and make sure that the KOH dissolved completely in methanol. As soon as, this mixture was added to waste cooking oil and the time is set for 10 minutes. The produk consists of two layer, upper layer is biodiesel and lower layer is glicerol. This layer can separate by using separator funnel. The catalyst present in biodiesel is removed by mixing it with hot water at a ratio of 1: 1. This mixture also separate by using separator funnel. Biodiesel is boiled untill 100 ^{o}C to remove the water content and analyzed. This experiment was conducted by varying the time, ultrasonic power and temperature of the heater. Variation of time at 30, 35, 40, 45 and 50 minute, ultrasonic power were set to constant at 100% simultaneusly the heating temperatur is turn on at 50 ^{o}C.

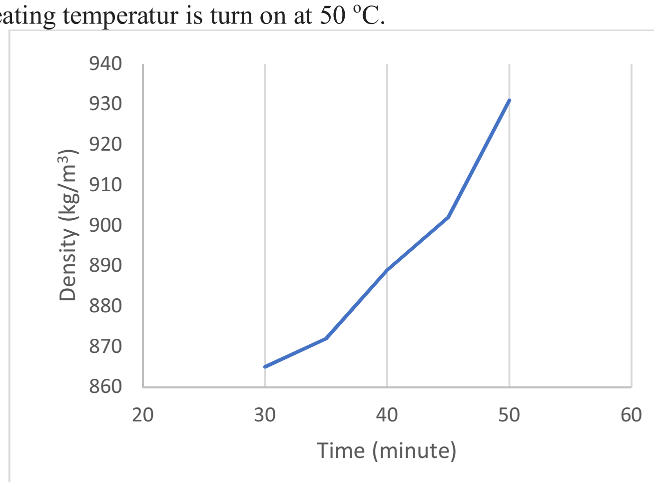

Figure 2. Effect of time reaction on density of biodiesel

3. Result and Discussion

The obtained biodiesel is then analyzed to refer to Indonesian National Standard Agency (INSA) 04-7182-2006. The results of biodiesel analysis can be seen in figure 2-5.

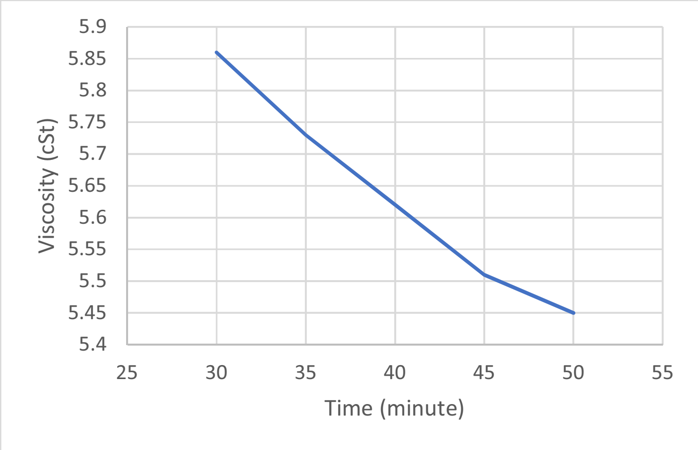

Figure 3. Effect of time reaction on viscosity of biodiesel

Based on figure 2 and 3, biodiesel characteristics (density and viscosity) are inversely proportional, maksimum density is obtained by 50 minute transesterification reaction time ie 931 kg/m^3, while for maksimum viscosity is obtained by 30 minute transesterification reaction time ie 5,86 cSt.

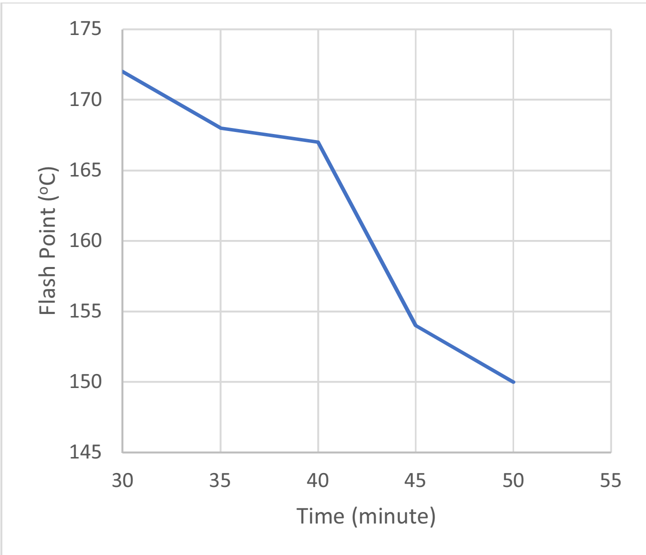

Figure 4. Effect of time reaction on flash point of biodiesel

Based on figure 4 and 5, when the transesterification reaction time got longer than before, the flash point and water content are decrease, maksimum flash point is obtained by 30 minute transesterification reaction time ie 172 °C, while for maksimum water content is obtained by 30 minute transesterification reaction time ie 0,0126 % volume.

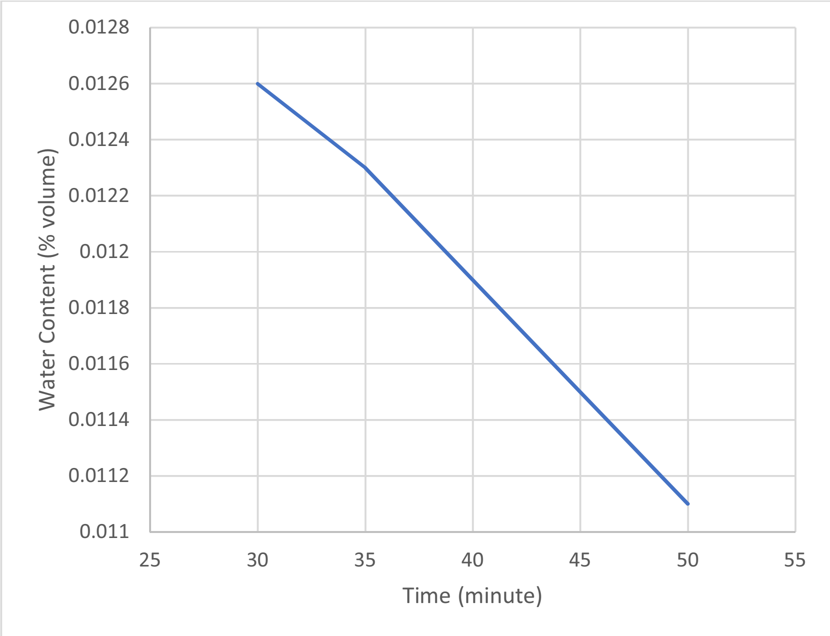

Figure 5. Effect of time reaction on water content of biodiesel

4. Conclusion

The research has explored the ultrasonic irradiation method to produce biodiesel from waste cooking oil. Transesterification product (biodiesel) has been analyzed at laboratory indicates that mets the requirement from Indonesian National Standar Agency (INSA) 04-7182-2006.

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