Preliminary Study of Purification Used Cooking Oil Using Bagasse Adsorbent

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Abstract

Adsorption is a process where a solid is used to removing a soluble substance. This research used natural adsorbents which are made by bagasse from the waste of sugarcane juice to recover the used cooking oil. Constituent structures of bagasse derive from carbon materials that make bagasse suitable to be used as adsorbent. The parameters used in measuring the quality of used cooking oil in this research are Free Fatty Acid (FFA) and color. Analysis Free Fatty Acid done by titration method (AOCS, 2009) while color analysis done with appearance which made by researcher. From the experiment conducted, it can be established that bagasse without activation can reduce FFA to 7.4 % when the bagasse with activation can reduce to 80 %. In color reduction, from the appearance, number of quality is 1 – 4 from the best to worse quality, used cooking oil which recover with bagasse without activation have the color quality at number 4, while bagasse with activation in number 3.

Key words: Adsorption, Bagasse, Purification, Used Cooking Oil, Free Fatty Acid, Color.

1. Introduction

Recycling used cooking oil using adsorbents, such as silica gel, magnesium oxide, aluminum hydroxide gel and activated clay, has been established before (Lin and Reynolds, 1998; Miyagi and Nakajima, 2003). In the sugar industry, bagasse is reuse as fuel; to generate steam, generate power, charcoal briquettes, and producer of gas, however bagasse generated from the squeezing process of extracting sugar cane juice, is not being utilized, at least as per the present time. (Pandey, G. N, Careney. G.C. 2008).

This research attempt to explore the use of natural adsorbent made up of bagasse from sugarcane juice waste to recover the used cooking oil. Structural component of bagasse made up from carbon material makes bagasse suitable as adsorbent.

The parameters used in measuring the quality of used cooking oil in this research are the Free Fatty Acid (FFA), amount of hydrolysis and the color darker is effect from oxidation. FFA which is known from several studies can cause some health problems, such as coronary heart disease, renal disease, liver disease and psychiatric disorders. Refined oils should not contain more than 0.1% FFA. (Gunstone. Frank D, 2008. Ching Kuang Chow. 2008). FFA analyses are the quality indicators that determine the amount of hydrolysis (Richard D. O'Brien, 2009).

Recycling of disposed oils into purified frying oil using bagasse being waste products from sugarcane juice as adsorbent are expected to reduce waste disposal problems. This has been consistently discussed and it also decreases the prospect of endangering the ecosystem.

2. Methodology

New and used cooking oils were obtained from a local processor at home. The weight of adsorbent to be used was 20 % from sample, which is 3 gram from 15 ml volume of sample with 60 minutes time of treatment.

2.1 Materials and equipment

The materials used are derived from waste from sugarcane juice (bagasse) usually obtain from stall selling sugarcane juice. The used cooking oil on the other hand is based on cooking oil that has been condition by the researcher. Activation of bagasse will be using NaOH solution. The instrument used is a Whatman filter paper # 41, Thermometer, Rotavapor R-210 BUCHI Switzerland, Spectrophotometer Thermo scientific Genesys 20, Chemical laboratory support equipment Such as mixers, electric stove, Erlenmeyer, pipettes drops, balance sheet measures, and weights

2.2 Design of Experiment

This experiment involves two main stages, adsorbent bagasse making process and used cooking oil refining using bagasse adsorbent. The success of bagasse as an adsorbent can be seen by comparing the value of FFA and color density of the new cooking oil, used cooking oil and cooking oil after treatment with the bagasse adsorbent.

The Flowchart below illustrates the stages of research:

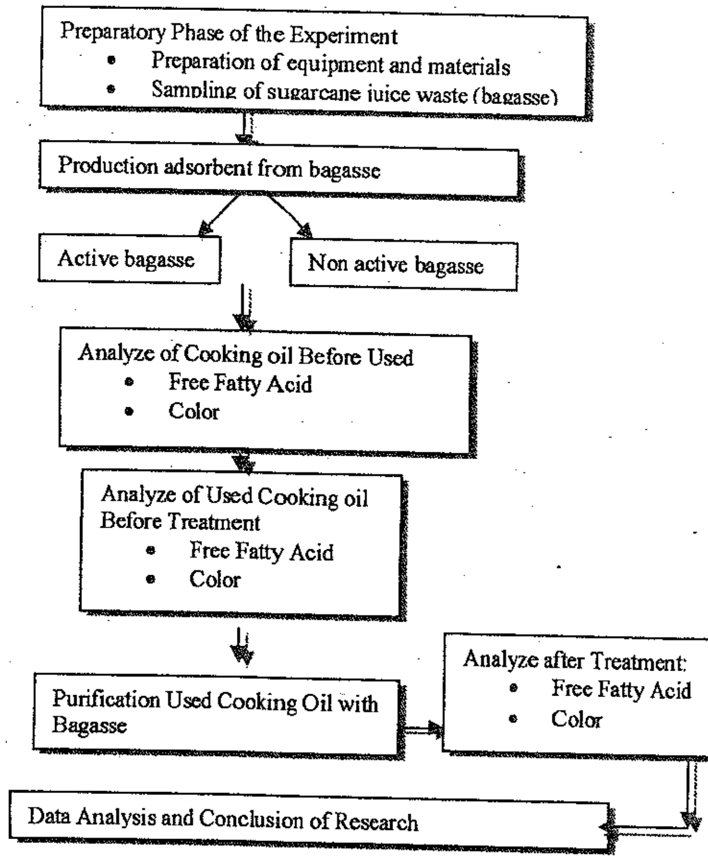


Figure 1: Flow Chart of Experiment

2.3 Preparation of bagasse adsorbent

There are several steps must be done before used the bagasse as adsorbent. Bagasse fibers must have been washed with water to remove sand, soil or other regulators. After that bagasse fibers that have been dried milled with a grinder into powder and sifted to obtain a diameter of < 600 μm, this bagasse powder used for adsorbent without activation.

To activate bagasse, heat the bagasse at 200 °C for 120 minutes in oven. Activated the heated bagasse with NaOH solution and then heated again for another 1.5 hours. Filter the mixture and then to heat them again at 200 °C for 90 minutes.

2.4 Preparation of Used Cooking Oil

Cooking oil that has been used for frying will experience color change, turbidity, and odor, which means reduce of quality (Richard D. O'Brien, 2009). In this research, the used cooking oil which will be purified has been used in 3 times of frying, to fry potatoes, chicken and dried fish. Cooking oil that has been used for cooking three different foods have become very murky, dark colored and has the smell terrible. The most extreme cooking oil changes occurred after the cooking oil used to fry the fish dry.

2.5 Purification Used Cooking Oil.

There are 2 factors that affect the oil refining process in this research, the weight and contact time. Weight is, how much we used bagasse adsorbent for the purification, and the contact time is, how long it taken to mixing adsorbent with used cooking oil. Method of oil purification with adsorbent according to Yustinah, 2009 research is described in the flowchart below.

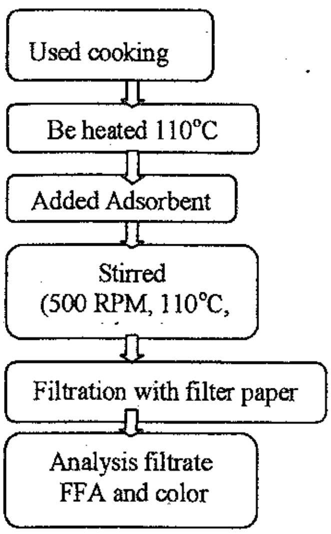


Figure 2: Flow Chart of Used Oil Purification Process

2.6 Determination of FFA.

About 28.2 g well mixed oil add with 50 ml hot ethyl alcohol and 1 % phenolphthalein. The mixture was titrated with 0.1 N NaOH with vigorous shaking until a permanent faint pink appeared and persisted at least for 1 minute (AOCS, 2009). The FFA content is calculated as percentage of oleic acid by using Equation 1.

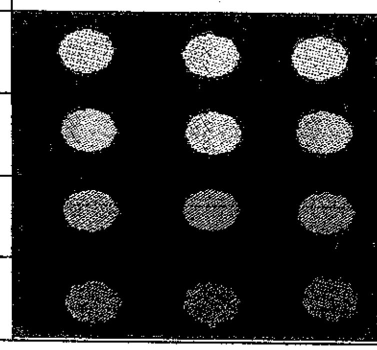
$$\% FFA = (V \times N \times 28.2) / m \qquad (1)$$

Where, m is the mass of the test portion, in grams, N the normality of NaOH, and V the volume of NaOH consumed, in milliliters.

2.7 Color

Determination of quality of the color, have done by the appearance which is made by the researcher. The number quality is from number 1 to 4 from the best to the worse quality like shown in Table 1.

Table 1. Color Appearance for Cooking Oil

No. of Quality	Color
1	
2	
3	
4	

Determined by the researcher

3. Results and Discussion

From 15 ml used cooking oil was mixed with 3 gram of adsorbent then continued with the purifying process at 60 minute contact time, reduction of Free Fatty Acid (FFA) value from purification with activation and non activation bagasse seen in Table 2.

Table 2. Percentage Reduce of Free Fatty Acid

No	Cooking Oil	Volume Cooking Oil	Adsorbent Weight	FFA (%)		Percentage reduce
				Standar Max	Sample	
1	New cooking oil	15 ml	-	0.1	0.038	-
2	Used cooking oil		3 g		0.27	-
3	Recover with non active bagasse				0.25	7.40%
4	Recover with active bagasse				0.054	80.00%

As Shown in Table 2, it is known that adsorbent bagasse has the ability to reduce the value of FFA in used cooking oil, the highest effectiveness is shown by the bagasse which has been activated with NaOH, the FFA values decreased by 80%, while the bagasse is not through the activation process does not show the decrease that so much means. Reduction in the volume of cooking oil after purification was also seen, where the active bagasse during the purification process reducing the volume of cooking oil by 32% while adsorbent without activation reducing the volume of oil during purification of 61.4%. The biggest volume loss happen to the bagasse purification process without activation, this is becouse the bagasse without activation still having the texture of origin, which is like a sponge so not only reduce FFA but also absorb cooking oil as well.

There is a feared if activation of bagasse with NaOH with high temperatures affect the pH of the cooking oil after purification.

But as shown in Table 3 there is no significant increasing of pH during the process of purification, this showed if the bagasse adsorbent works very well.

Table 3. pH Measurement for Purification Used Cooking oil

No	Cooking Oil	pH
1	New cooking oil	6.9
2	Used cooking oil	6.5
3	Recover with non active bagasse	6.5
4	Recover with active bagasse	6.7

An initial conclusion obtained from the preliminary study is that the bagasse adsorbent has proved can reduce the value of FFA. Bagasse adsorbent with activation process with NaOH showed the effectiveness which more impressive than the bagasse without activation. Reduction of volume due to purification processes also occur, where the more effective adsorbent was the activation bagasse, which have the less reduction. This means that for further research would be more focused on the purification with active bagasse.

Changes in the color of cooking oil are perceived as indicating poor-quality product, regardless of the reason or effect upon performance (Richard D. O'Brien, 2009). Used cooking oil have golden brown color and cloudy before treatment. The data obtained from the measurement of color density through color appearance was determine seen in Table 4.

Table 4. Color Comparison Table

No	Cooking oil	No. of Quality
1	New Cooking Oil	1
2	Used Cooking Oil	4
3	Recover with non active bagasse	4
4	Recover with active bagasse	3

Base on the comparison, can be seen if recover used cooking oil with active bagasse more effective to improve the quality of color than the non active bagasse. Means the active bagasse proved have ability to improve the quality of used cooking oil.