Australian Journal of Basic and Applied Sciences, 7(9): 192-196, 2013
ISSN 1991-8178

# Modification of Grassy Weeds as Potential Used Cooking Oil Absorbent

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**Abstract:** The modification of surface on lignocellulosics materials (grassy weeds) with sodium hyroxide (NaOH) were studied. The sorption test were studied by different of weight of absorbent (grassy weeds) and various time interval. The results shows that the different between modified grassy weeds and unmodified of grassy weeds for used cooking oil absorption is 120 %.The highest percentage of sorption capacity is 2 gram of modified grassy weeds with 30 minutes of absorption time.

**Key words:** modified grassy weeds, absorption, cooking oil absorbent, wastewater treatment

## INTRODUCTION

Nowdays, oil became one of the major factors of pollutant around the world. U.S National Research Council report in 1985 that it was estimated between 1.7 and 8.8 million metric tons of oil enters the world's oceans each year. Most of the factors contribute to the oil contamination results from human activities, and more than half of this is related to its transportation. Dealing with oil spills often presents a balance between protecting natural resources and public amenities. Their unpredictability makes the remedial process a very difficult one. The most important factors influencing oil spill damage are proximity to land, type of shoreline, proximity to valuable natural resources such as fisheries, wildlife refuges and hatcheries. and causing water pollution. Chemicals released by smokestacks can enter the atmosphere and then fall back to earth as rain, entering seas, rivers, and lakes many different causes and this is one of the reasons why it is such a difficult problem to solve (Woodford, C., 2006).

Consequently, this will have severe impact on the environment. Contamination of water sources by oil, chemicals, suspend solids and other similar wastes may also have negative impacts on birds, aquatic organism, such as fishes and ultimately on humans. The number one source of river or ocean water pollution today is each one of us working and living in urban areas and contributing small amounts of contaminants that add up to one huge problem for the environment (Mitchell, K., 2007).

Recent developments in chemical modification and characterization of natural fiber-reinforced components stated that alkali treatment leads to the increase in the amount of amorphous cellulose at expense of crystalline cellulose. The important modification occurring here is the removal of hydrogen bonding in network structure. Furthermore, sodium hydroxide has been seen can increase the absorption of fiber (John, M.J. and R.D. Anandijiwala, 2008).

Grassy weed or its scientific name is Imperata cyclindrical. Usually it has cylindrical shape, 2-8inches in length, and slivery white in colour and also have light fluffy dandelion-like seeds. Through the leaf, the blades can be up to 6 feet long and about 1 inch wide. Some have whitish, prominent midrib, that is often off center and margins finely serrate. For whole plant, it usually grows in densely patches, tall grass and circular infestations (Evans, C.W., 2008).

Grassy weeds have potential to be as a sorbent to absorb the oil due to the structure of fiber and similar to other type of fiber has lignocelluloses as primary building block. Plant biomass is mainly composed of cellulose, hemicelluloses and lignin, along with smaller amount of pectin, protein, extractive and ash. The composition of these constituent can vary from species to another. For grass it has more amounts of hemicelluloses (Kumar, R., C.E. Wyman, 2009).

Grass like the other sorbing material is capable of holding oil as the result of two processes: adsorption and absorption. The adsorption capacity depends primarily on the chemical structure of grass tissue that has direct contact with oil such as hyroxyl group while the absorption capacity is a function of the structure of the grass such as the diammeter of pore of grass and the cross-section on surface of grass. The absorption of oil depend on surafce properties of grass. Meanwhile, the grass adsorption capacity varies for many researches due to the different apparent densities of grass and ways ot its adsorbent form either ash or straw (Witka-Jezewska, E., 2003).

The objectives of this study is to determine sorption capacity of grassy weeds towards used cooking oil, the effect of alkaline surface modification for grassy weeds and to measure the optimum used cooking oil that can be adsorbed by varying different amount of grassy weeds used with the given time period.

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## MATERIALS AND METHOD

***Preparation of Sorbent:***

For this experiment, only one type of absorbent that is Weeds Grass is experimented. This grass is prepared in the type of powder form. To prepare this, fresh grass weeds is taken from one location and being wash to remove dirt and soil. Only green part of the plant is taken and being dried in incubator for one day in the temperature of 60°C. After dried, the grass grinded with grinning machine. Grinning machine being adjusted to the size of 150µm of the weed grass. After the grass been grinned, it being put into tea beg filter. Weight being set for 2 gram.

***Weight Difference for Sorption Test:***

This experiment is started by using used cooking oil as thing to be absorbed. 50 gram of used cooking oil was poured into beaker containing 500ml of distilled water. After that tea beg filter containing grinned grass weeds gently placed into the beaker. After 10 minutes, the material was removed using forceps and drained for 5 minutes. The tea beg next is opened and placed on Petri dish and then drained in incubator for 24 hours. After drying, the grasses scrapped from tea beg filter and weight by analytical balance to determine the oil lost.

The sorption capacity was determined according to the following equation 2.1:

q = $(St - S0)S0$ x100%

where q is the sorption capacity (g oil/g sorbant), $St$ is the total mass of the sorbed samples (g) and $S0$ is the initial mass of the sorbed materials (Chatterjee, P.K., 2002).

The test is repeated by changing the weight of the grass begins with 0.5g, 1.0g, 1.5g, 2.0g, 4g, 6g, 8g, and 10g to get the optimum sorption capacity value of the weight.

***Time Difference for Sorption Test:***

In this experiment, optimum weight from weight for sorption test is being used. 50 gram of used cooking oil is used and mixed into a beaker containing 500ml of distilled water. After that tea beg filter containing grinned grass weeds gently placed into the beaker. The tea begs is put into beaker for different time of interval and begin with 10 minutes. This repeated for 20 min, 30 min, 40 min, 50 min and 60 min. The tea beg next is opened and placed on Petri dish and then drained in incubator for 24 hours. After drying, the grasses scrapped from tea beg filter and weight by analytical balance to determine the oil lost.

The sorption capacity was determined using equation 2.1.

***Effect of Alkaline Treatment on Grass Weeds:***

To prepare the grass weeds with alkaline treatment, first grass weeds been soaked into NaOH (1.0 M) using incubator shaker for 1 day. After modification, grass is being dried and powder form being taken to be same condition as no modification. In this experiment, optimum value of weight and time for each sorption test is used to be compared with same condition without modification.

## RESULTS AND DISCUSSION

***Weight Difference for Sorption Test:***

Figure 3.1 shows a graph with the result of sorption weight on oil removal. The grass weight is obtained in the range of 0.5 to 10 grams. The patern sorption capacity are increases with the grass weight from 0.5 to 2 grams. Then, the sorption capacity are decrease after the minutes of 2 grams to 10 grams. The highest sorption capacity that being achieved is 152.5 %. Then, the grass can absorb the oil higher from the weight of the gras because the grass have enough empty space inside to be able to absorb much amount of oil. So, the grass not only be absorbed to the inside of its structure but can also be adsorbed at the surface of the grass which the grass changes its color from green to yellow. It strongly proves that the grass can be adsorbed at the surface of the grass.

Furthermore, there is increasing rate from 0.5 gram to 1.0 gram about 34%. The increasing rate from 1.0 gram to 1.5 gram is 27.33%. Next, the increasing rate from 1.5 to 2.0 gram is 5.17%. The increased rate of sorption capacity, the decreased of weight of the grass. Firstly the oil is going to occupy the empty space of the grass. Then when there is increasing of the weight, the empty space begins to decrease. When this happen, this will decrease the increasing rate when it going to achieve its maximum level of space that can be occupy by the grass.

So, the decreasing rate from 2 gram to 4 gram is 71.25%. From 4 gram to 6 gram the decreasing rate is 29.75%. Next, from 6 gram to 8 gram the decreasing rate is 18.25% and from 8 gram to 10 gram is 11.55%. Therefore, this sorption capacity begin to achieve it threshold level where the grass not being able to absorb anymore the oil. This also because not all of the oil is entered the grass as the weight increase.

Moreover, the fibrous materials are porous bodies and virtue which they absorb large amount of oil by absorption process. Generally, the greater the porosity, the greater is the absorption capacity of the structure. Larger porosity also leads to larger pore size and therefore, to larger rate of absorption (Chatterjee, P.K., 2002).

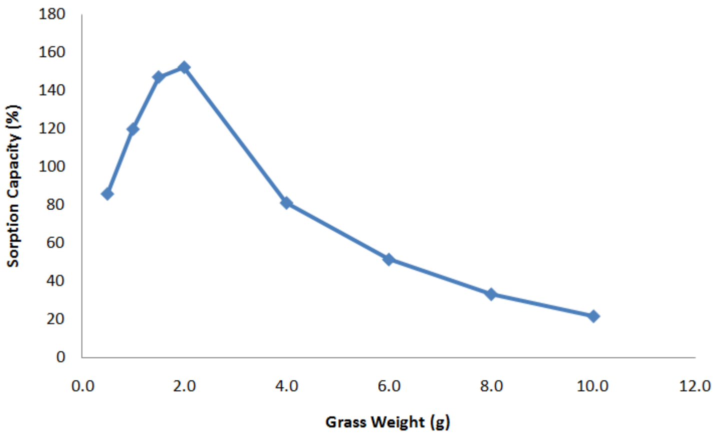


**Fig. 3.1:** Sorption capacity of grass by varying different grass weight.

**Table 3.1:** The effect of sodium hydroxide modification according to weight of grassy weeds.

| Weight sorption Test (10 minutes) | Oil Absorbed | Sorption Capacity |
|---|---|---|
| 2 grams without modification | 3.05 | 152.50 |
| 2 grams NaOH modification | 5.43 | 272.50 |

***Time Difference for Sorption Test:***

Figure 3.2 shows the results of sorption times on oil removal. The grass weight that being analyze is from 10 minutes to 60 minutes. Highest sorption weight is being used that is 2 grams. The sorption capacity increase from 10 to 30 min because the adsorption on first surface and penetrate the inner microscopic voids (Hussein, M., 2008). After 30 min, the sorption capacity becomes constant to the minutes of 60. For this grass weeds the maximum value of sorption was at 30 min due to the oil has penetrated all the surface and pores inside the grass.

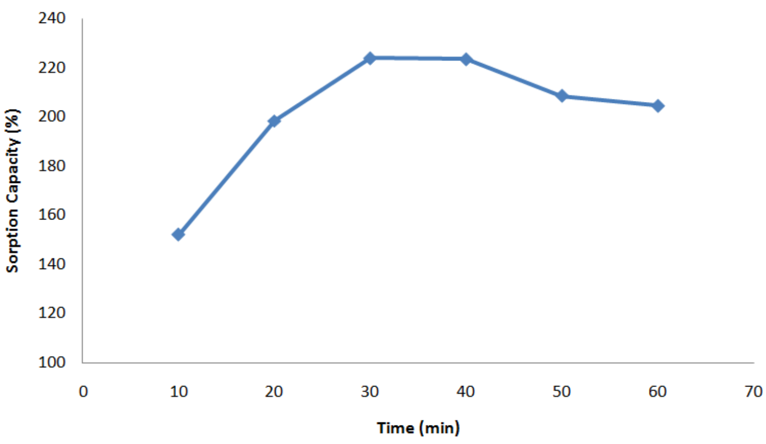


**Fig. 3.2:** Sorption capacity of grass by varying different time interval.

**Table 3.2:** The effect of sodium hyroxide modification accoding to time of sorption test.

| Time sorption Test (2 grams) | Oil Absorbed | Sorption Capacity |
|---|---|---|
| 30 min without modification | 4.48 | 224.00 |
| 30 min NaOH modification | 5.70 | 285.00 |

The increased rate are about 46.5 % from 10 minutes to 20 minutes and 25.5 % from 20 minutes and 30 minutes. After that, there is slightly drop in the sorption capacity from 30 minutes to 40 minutes where the decreasing rate is 0.5% in the minutes of 40 to 50, the value is decrease even more where the decreasing rate is 15%.

In sorption test, time is very important for oil to be absorbed into the grass. If the oil doesn't have enough time to be absorbed to all the surface of the grass, the sorption capacity of the grass of the given time would be low. Meanwhile, if there is too much time is given to the grass, it may cause surface damages to the structure of the grass fiber and the oil will be disperse out from the fiber of the grass making it lower the sorption capacity. So, to get the best result for the sorption of the grass, the experiment has to be conducted until 30 minutes.

This result also can be related to the emulsification and evaporation which lead to a decrease in the oil-water density difference, and an increase in the oil pour- point (Wei, Q.F., 2003). In the qualitative comparison in dynamic system need to consider a combination of factors, such as water- fiber and oil- fiber contact, buoyancy, hydrophobicity, accessibility of dry fibers to oil once the first layer of fibers become “wet”, kinetics of water and oil sorption, sorption capacity and time necessary to achieve “equilibarium”. Wet here means that the process that the air above the solid (grass) surface is gradually replaced by liquid. Between water fiber and oil fiber contact, oil is attracted first because of the buoyancy of the oil. So, oil attract towards the surface of the grass which the hydrophobicity effect happens. The hydrophobic effect is the observed tendency of non polar substances to aggregate in aqueous solution and exclude water molecules. It also can be call phobia of water describes the segregation and apparent repulsion between water and non-polar substances. The hydrophobic effect also explains the separation of a mixture of oil and water into its two components, and the beading of water on non-polar surfaces such as waxy leaves. After hydrophobicity happen, emulsification take place. By this, it explains the wetting process of the oil to the grass fiber.

Table 3.1 shown the data taken in comparing the effect of alkaline modification on grass weeds by weight sorption test while Table 3.2 shown the effect of alkaline modification on grass weeds by time sorption test. From here we can see that sorption capacity increase when the grass is treated with NaOH. For 10 minutes, we can see the increasing rate is 120%. Figure 3.3 shows that effect of sodium hyroxide (NaOH) modification on sorption capacity for optimum value of weight for sorption test for 2 grams. Figure 3.4 shows that the highest sorption capacity for the grass for 30 minutes, the sorption capacity also increase where the increasing rate 61%. The increasing rate is decrease half from 10 minutes of the experiment.

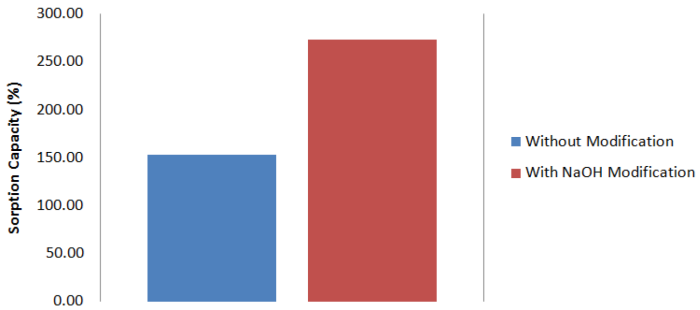


**Fig. 3.3:** Effect of NaOH modification on sorption capacity for optimum value of weight for sorption test (2 grams).

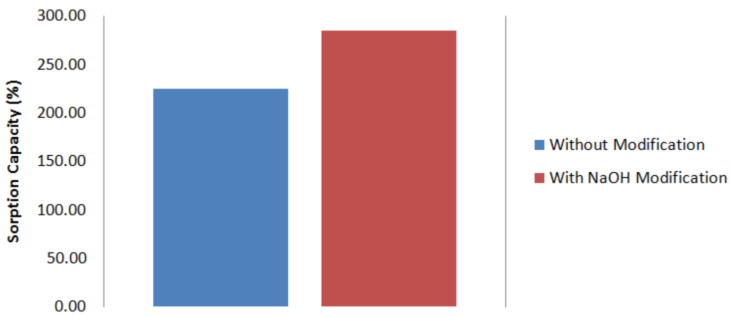


**Fig. 3.4:** Effect of NaOH modification on sorption capacity for optimum value of time for sorption test (30 minutes).

This result also proven that with the alkaline treatment the structure of the grass have been widen from the smallest pores in between lattice planes and the oil is penetrate into them. There are also some attractions like capillary action toward the grass that help when there is increase of porosity inside the grass. Generally, the greater the porosity, the greater the absorption capacity of the structure. When there is attraction forces toward the grass, this where hydrophobicity happen that contribute to the change of the structure by emulsification. So, this support the statement when we can see that absorption of the grass increase when we modify the structure of the grassy weeds.

The function of sodium hyroxide (NaOH) also increased the absorption of fiber which the activation of negative ion from hydroxyl group also increased on surface of grass. In addition,the fibrous materials are porous bodies and it is by virtue of this they absorb large amount of fluid by capillary action. Generally, the greater the porosity, the greater is the absorption capacity of the structure. Larger porosity also leads to larger pore size and therefore, to larger rate of absorption (Chatterjee, P.K., 2002).

The effect of alkaline treatment depends on the lignin content of the material. Alkaline treatment process utilizes lower temperatures and pressure that other pretreatment technologies. Compare to acid process, alkaline process cause less sugar degradation and many of caustic salts can be recovered and regenerated. Moreover, NaOH treatment of lignocellulosic materials has been found to cause swelling, leading to an increase in internal surface area, decrease in degree of polymerization, decrease in crystallinity, separation of structural linkages between lignin and carbohydrates, and disruption of the lignin structure (Kumar, R., C.E. Wyman, 2009).

The alkaline treatment on surface of grass also enhanced surface wettability of rice straw with alkaline treatment state that rice straw alkaline treatment can effectively improve the surface contact angle (Liu, B., 2011). Absorption is caused by a type of van der Waals force which exists between molecules. The force acts in a similar way to gravitational forces between planets. These sources are extremely short ranged and therefore sensitive to the distance between the grass surface and the adsorbate molecule. They are also additive, meaning the absorption force is the sum of all interactions between all the atoms. The short range and additive nature of these forces results in activated carbon having the strongest physical adsorption forces of any known material.

***Conclusion:***

From the experiment, alkaline modification to the grassy weeds improve the sorption capacity which have greater tendency to absorb more oil compared to the unmodified. The sorption capacity improve to 120% in 10 minutes and 61% in 30 minutes also shows the positive results that alkaline modification is one of the way to improve the grassy weeds sorption ability towards used cooking oil. Therefore, grassy weeds have the potential to absorbed used cooking oil and can be improved by the alkaline modification such as sodium hydroxide.

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