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# The Effectiveness of Oil Spill Remover in Marine Offshore from Rice Husk, Mango Peels and Durian Husk

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**Abstract -** *There are many ways to overcome oil spill that occurs in marine and this study shows how it is possible to use the agricultural waste to absorb the oil from the marine offshore using a 'Tetrahedral Oil Bag'. Three types of agricultural were used in this study which is rice husk, mango peel and durian husk. All three bio wastes are separated into two which is the treated biowaste and non-treated biowaste. The treated biowaste is treated using the hydrochloric acid meanwhile the non-treated acid is not treated with any kind of chemicals. Both non-treated durian husk and mango peel were just dried under the sunlight meanwhile the non-treated rice husk was carbonized in the muffle furnace at 400°C for one hour. The three types of biowaste which were separated as treated and non-treated biowaste were weighed and placed in a tetrahedral bag which is in a form of net. All the treated and non-treated biowaste were tested to show which biowaste has the highest ability to absorb the highest amount of oil film thickness in marine water sample which contains different amount of oil in it. However, among all the biowaste that were used the rice husk which were treated in the hydrochloric acid has the highest rate of absorption in all the different amount of oil film thickness that were used. Thus, the other durian husk and mango peel which were non-treated has the medium amount of oil absorption rate where both absorbs only a specific amount of oil film thickness and are more effective in absorbing oil than the treated mango peel and durian husk. In conclusion the treated rice husk managed to absorb different amount of oil film thickness and has the highest rate of oil absorption. Meanwhile it also managed to absorb the oil found in the sea water sample within the time specified.*

***Key Words***: Oil spill, biowaste, oil absorbent rate, sorption capacity

## 1. INTRODUCTION

Water is the universal substance used by all living organisms to sustain life. Clean and ample water provides the foundation of prosperous life and communities. Water pollution reduces the overall usability of water and in some cases such as with the presence of oil on the water surface.

According to another author R. Nagendran (2011), contamination of seawater due to an oil pour, as a result of an accident or human error is termed as an oil spill. Thus, oil pollution has become one of the biggest threats to the environment, humans and most marine life (Jason Chavis, 2018).

However, many steps were taken to overcome this oil spills on water surfaces which have succeeded and costs a lot of money in the cleaning process. On top of that, there are several ways to overcome this issue and treat the oil spills in a safer way which is also safer for the environment. As stated earlier there are many ways to treat the oil spills on water surfaces other than using machines. Several kinds of research have proven that absorption processes are effective for oil removal. According to (Hamizah Mokhtar, 2016), one of the effective ways in oil removal is adsorbing oil by using activated carbon. However, she also stated that the usage of activated carbon is expensive and there are some studies that have proven that agricultural residues can be alternative adsorbents for oil. According to the statements above it is proven that agricultural wastes have the ability to absorb oil from water and it can be a great alternative way in oil

Agricultural wastes were chosen as an oil absorbent is not only because it is an effective way of oil removal but to decrease the number of agricultural wastes that However, modern agricultural practices have started the process of agricultural pollution, (Lionel, K. Arnold, 2004). As per many researchers, it is proven that rice husk is one of the effective oil absorbers which is safer for the environment. Also, rice husks are stated to be the third-largest cultivated cereal crop in the world, making rice hulls one of the most abundant biowastes on Earth. This absorbent has been subsequently tested for marine diesel spill clean up. The use of adsorbents to clean-up oil spill presents nearly many advantages due to simplicity of approach and the inexpensive nature of the materials.

### 1.1 PROBLEM STATEMENT

Oil pollution is one of the most serious problems. One hundred and twenty one cases of oil pollution have been reported for six years since 2009 (Fernardo Fong, 2016). For example in May 2016 the occurrence of oil spills in coastal areas in Penang, Malaysia. The beach has been contaminated with oil is believed to be released from the ship. Agricultural based industries are becoming a more significant part of the economy Malaysia. The increase in the number of agro based industries not only affects the economy positively, but also contributes towards pollution. Also significant amount of post processing waste and residue from these industries are being produced. Hence it is important that new methods for treating agro residues are adopted and considered in order to achieve sustainable management of agricultural waste.

Several researches had proven that there is one way to utilize the agriculture waste as oil spill remediation. The cleanup of oil spill using natural adsorbents is considered as an eco-friendly and cost-effective way, emphasizing the importance of such natural and effective promising technique Abdelwahab et al., 2016). A rice husk is a third largest cultivated cereal in the world, making rice husks one of abundant agricultural waste on earth. According to John Mortensen 2004, 73% rate that the husks of rice adsorb oil pollution in the ocean is very high. By using rice husks, the cost of the spill cleanup is minimized. In addition, the amount of waste can be reduced. Most people consumed the mango flesh only but other parts of mango such as peel and kernel are being thrown as waste. Apparently, mango waste contains a very significant number of phytochemicals, which can be utilized for value-added applications in functional foods and nutraceuticals. Mango peel is a rich source of pectin, lipids, proteins, carotenoids, cellulose, hemicellulose, vitamins, and polyphenols with excellent health-promoting properties, mainly antioxidant activity (Kittiphoom, 2012). Another agricultural waste used in this study are Durian. Using durian waste as an adsorbent would be viable as durian rind contain high fibre content [9] which would assist in the process of adsorption. Durian (Durio zibethinus) is among the famous fruit which are grown and consumed locally and exported in Malaysia and some other South East Asia countries.

According to Mohamed Hussein et al. (2013), organic sorbents (i.e. agricultural wastes) were widely used because they are easily available and relatively inexpensive. Their sorption capacity is often as good as other inorganic sorbents because they can pick up from 5 to 15 times their weight of oil.

### 1.2 OBJECTIVE

1. To produce a "Tetrahedral Oil Bag" using biowaste to remove oil spillage in marine offshore.
2. To compare the effectiveness in different types of agricultural waste as an oil spill remover in marine.
3. To identify the effect of sorption efficiency and time with different amount of oil film thickness.

## 2.0 EXPERIMENTAL METHODS

### 2.1 Preparation of absorbent

The rice husk were obtained from Sekinchan, Selangor while the mango peel and durian husk will be taken from Kawasan Perindustrian IKS Perda Tasek, Pulau Pinang. The three materials were thoroughly washed and soak with water to remove any unwanted dust and materials. The rice husks were produced at 400°C for 1 hour in muffle furnace in order to produce charcoal. The carbonized rice husks were crushed with blender and sieved at a 1000um to form powder rice husks. Meanwhile the mango peel and durian husk are manually chopped to small pieces using a knife to get the mesh size. This bio waste then left to dry under the sunlight for three days and continue dried in oven until it's completely dry. They were turn into powder form using electric blender and sieved through at a 1000um. Later than, it was filtered and dried in the oven at 60°C for an hour. After drying and weighing the biowaste to 20 grams it was separated into two different waste which is the treated and non-treated biowaste. The treated waste was mixed with the 0.5M hydrochloric acid and mixed at speed of 150 rpm for two hour. All the treated and non-treated biowaste was placed in a net to form a triangle shape of oil bag to be tested. The dried biowaste were stored at room temperature until prior to use.

**Fig -1**: Processing of mango peels and durian husk

### 2.2 Preparation of artificial seawater

In this study, artificial seawater were used rather than natural seawater. The average salinity of ocean water is 35 ppt. The formula of Lyman and Fleming (1940) with a composition of 3.5% concentration NaCl were prepared. 35 grams of NaCL were added into a beaker. Then tap water were added until the total mass of the solution inside the beaker is 1,000 grams. The solution is stir with stirring rod until the salt is completely dissolved.

### 2.3 Analytical Method of Adsorption

The bio wastes that were used in this study all has its own efficiency to absorb the crude oil in the marine water sample. In addition, the biowastes were separated into two different types which is treated and non-treated biowaste. The difference between the treated and non-treated biowaste are, the biowaste was treated in hydrochloric acid. Meanwhile for the non-treated bio waste the agricultural waste is non-treated in a chemicals and tested right after it is dried under the sunlight.

Different amount of oil was poured into a 250-ml sample of artificial water (3.5% NaCL) inside 500 mL glass beaker. The amount of oil film thickness was increased in each trial from 0.6 mm, 1.2 mm and 1.6 mm significantly. The amount of oil film thickness was taken into count to see the oil sorption capacity of each treated and non-treated biowastes. Each biowaste was inserted into mess nett with the same weight of 2g. The biowaste (adsorbents) were place inside the beaker and the time of 30 and 60 min were observed and recorded.

The relation of sorption efficiency were calculate from the relations (Ola Abdelwahab et al., 2017).

$$\text{Sorption efficiency (\%)} = \frac{\text{mass of oil removed}}{\text{initial mass of oil}} \quad (1)$$

$$\text{Sorption capacity (g/g)} = \frac{\text{mass of oil removed}}{\text{mass of adsorbent}} \quad (2)$$

### Formation and Structure Tetrahedral Oil Bag

The shape of the mess net was triangle in shape according to the name of tetrahedral. The meaning of Tetrahedral scientifically is known as triangle. All the agricultural wastes that are treated and non-treated such as rice husk, mango peel and durian husk will be placed in this "Tetrahedral Oil Bag" in order to use it as an oil spill remover. The form of oil bag is chosen in the shape of triangle to make it much easier to bring it to the offshore where the oil spill occurred and treat the oil spill using this "Tetrahedral Oil bag" easily. Moreover, this triangle shaped "Tetrahedral Oil Bag" has more ability to compact more mass of agricultural waste. The figure shows the structure of the tetrahedral oil bag and the form of tetrahedral bag that contains an agricultural waste.

## 3.0 RESULTS AND DISCUSSION

The figure above is a comparison between the amount of oil film thickness with contact time in absorption of tested oil for the amount of 2g treated and non-treated rice husk, mango peel and durian husk. The amount of oil film thickness was increased in each trial from 0.6 mm, 12 mm and 20 mm significantly. The time taken in absorption for each treated and non-treated bio waste was taken into count to determine in which specific time the bio waste get to absorb the crude oil that are found in the artificial seawater. Meanwhile the amount of oil film thickness was increased in each trial is to accurately determine the amount of oil film thickness that the tetrahedral oil bag which consists of all treated and non-treated bio waste. From the figure, the sorption capacity for treated rice husk effectively absorbed all three different amount of oil film thickness in all three trials. The treated rice husk managed to absorb all the amount of oil film thickness that are found in the water sample within 8 minute. However, in 13 minute the treated mango peel was left with 0.2 of oil film thickness in the water sample while the treated durian husk took 13 minutes to absorb oil and left with 0.1 oil film thickness. Thus, the amount of oil film thickness left in the beaker for the second trial with 1.2 oil film thickness increased slightly to 0.3 for the treated mango peel and durian husk while in the third trial increased up to 0.6 for mango peel treated and 0.4 for durian husk treated.

These results indicated that 20 mm was the optimal crude oil film thickness to be treated via the biosorbent from treated rice husk. Capacity of the crude oil removal is related to the chemical composition and surface properties of the fibers as well as the concentration and specific gravity.

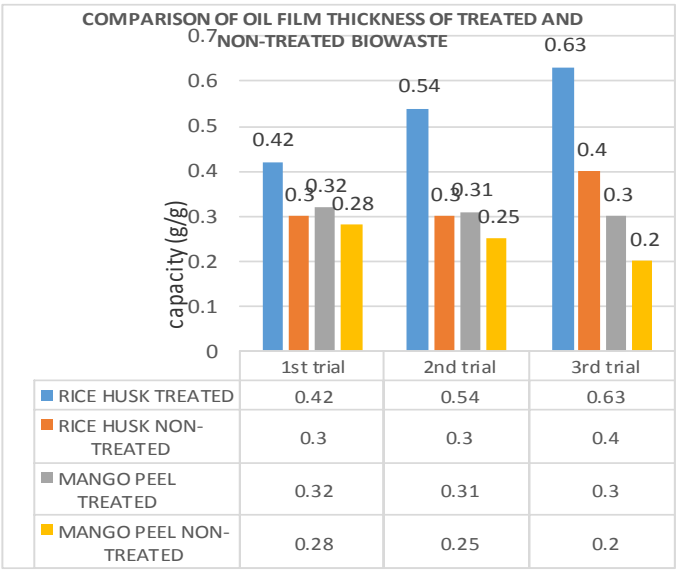


**Chart -1**: Effect of oil film thickness on the sorption capacity (g/g)

The comparison of oil absorption rate graph in all treated and non-treated bio waste, all the non-treated bio waste seems to have the lowest volume of oil absorbed compared to the treated bio waste. The horizontal axis stands for the volume of oil absorbed while the vertical axis stands for type of treated and non-treated bio waste. Thus, the treated rice husk has the highest volume of oil absorbed which is 15ml compared to the treated mango peel and durian husk. This might be a result of the dilution of the hydrochloric acid which helps the rice husk to low volume pores that increase the surface area suitable for absorption. The rice husk is highly porous and light weight. The treated mango peel has the lowest volume of oil absorbed compared to both treated rice husk and durian husk. It has the lowest volume of oil absorbed due to its peel that is too thin and only has a specific amount of oil that it could absorb.

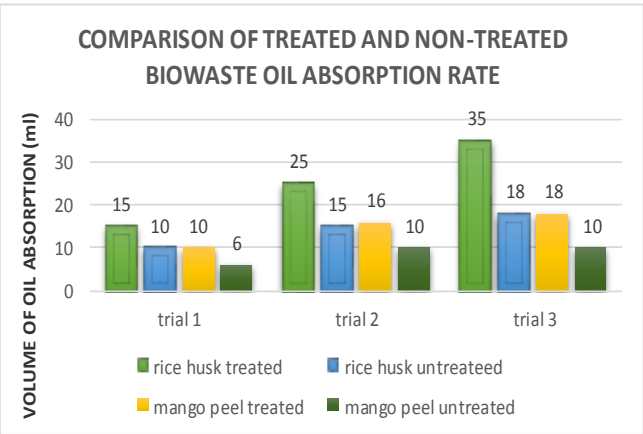


**Chart -2**: Effect of oil film thickness on the sorption capacity (g/g)

### Adsorption Isotherm

The data obtained in the present experiment were analyzed using Langmuir models. The linear and nonlinear equations of these isotherm models are shown in Table 1. The symbols of the models can be described as follows: qe is the equilibrium concentration of oil in the adsorbed phase (mg/g),

Table 1 Results of Langmuir for adsorption with crude oil

| Models | Parameters | Crude Oil |
|---|---|---|
| Langmuir | $Q_0$ mg/g | $22.75 * 10^3$ |
| | K L/mg | $1.33 * 10^3$ |
| | $R^2$ | 0.977 |

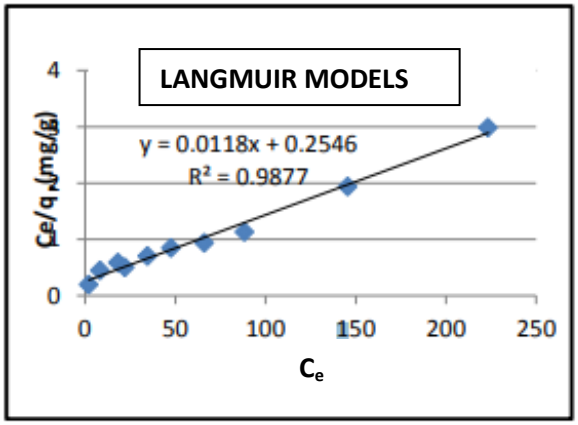


**Chart -3**: Langmuir Plot

The obtained results indicated that the used of biowaste in Tetrahedral Oil Bag were outstanding for the removal of crude oil in marine offshore.

### 4. CONCLUSIONS

Through the data and results obtained we can conclude that the rice husk is proven to absorb more oil compared to the mango peel. The treated rice husk is much effective and absorbed most of the oil in the marine water sample than the mango peel that is not-treated mango peel. However, among the treated and non-treated rice husk the treated rice husk with the hydrochloric acid is the most effective biowaste that managed to absorb the oil fully even when we have increased the oil film thickness as shown in the data and results. Hence, among the treated mango peel and non-treated mango peel, the non-treated mango peel seem to absorb more oil than the treated mango peel. It is well proven that the rice husk is the most effective biowaste that has the highest sorption efficiency in oil absorption of the marine water sample Thus, the other biowaste that were used in the experiment such as mango peel and durian husk also has its own oil sorption efficiency. Through more cheaper and safer to the environment to use in oil spill cleaning.

As a conclusion, the biowastes that were used such as rice husk, mango peel and durian husk were all able to absorb the crude oil in the marine water sample. In addition the biowaste that were separated into two different types of biowaste which is treated and non-treated. The ability of each biowaste in absorbing oil is proven through the data and results that were obtained. These different types of biowastes has its own ability to absorb oil. However, the treated rice husk in hydrochloric acid seems to be much effective than the non-treated rice husk which was carbonized in the muffle furnace. Hence the non-treated mango peel and durian husk seem to be much effective in absorbing oil than the treated mango peel and durian husk in hydrochloric acid respectively. Through all the results obtained we can conclude that the treated rice husk has the highest ability to absorb oil compared with the other treated and non-treated biowastes such as mango peel and rice husks. The rice husks has the ability to absorb different amount of oil film thickness in the specific time than the mango peel and durian husk. Hence the non-treated mango peel and durian husk both are the other type of biowaste that has the 80% of efficiency in oil absorption as it is proven in the data and results.

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