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PRELIMINARY STUDY OF CHEMICALLY MODIFIED *PARKIA SPECIOSA* AS AN ADSORBENT FOR OIL TREATMENT

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Abstract

The waste discharge containing contaminated oil to the environment rise annually due to tremendous revolution of an urbanization and industrial. The oil pollution can affect the ecology, aquatic life, environment and human health. Common practice in treating oil spill by using natural adsorbent due to it low cost and availability of the sources. This study introduced *Parkia Speciosa Pod* (Petai) as a new oil combating powder. The aim of this study is to produce a low-cost adsorbent in cleaning oil spill. Then, to investigate the effect of different weight dosage of adsorbent and study the influence of oil adsorption via different type of oil. The pod of *Parkia Speciosa* was ground and sieved before being conducted for oil treatment analysis. The powder of *Parkia Speciosa* was treated with soda treatment using sodium hydroxide in order to enhance the porosity of its surface. The treated adsorbent was testing to a few types of oils such petrol, diesel, used vegetable oil and lubricant oil. The results revealed that the percentage removal of oils for 1 g treated adsorbent for petrol, vegetable oil, diesel and lubricant oil were by 86%, 74.3%, 14.2% and 43.55% respectively. Based on the outcome, the *Parkia Speciosa* has a good potential as an adsorbent in removing oil spill.

Keywords: *Parkia Speciosa*, oil spill, oil treatment, soda treatment, adsorbent

1.0 INTRODUCTION

In this recent year, one of the most crucial energy resources in this modern era is hydrocarbon-based oil [1]. The discharge of wastewater containing oil waste to the environment growth yearly due to urbanization and industrial development [2]. Pollution of water by various types of oil constantly to be a specific and critical problem. Leakage of oil, discharge of domestic and industrial wastewater as well as increased use of herbicides and insecticides cause high impact on the aquatic environment [3]. Environment pollution contributed a major problem, which needs to draw immediate attention of the researchers, environmentalists, petroleum industry and all the related stakeholders [4].

Oils that can found in contaminated waters can be fats, lubricants, cutting liquids, heavy hydrocarbons like tars, grease, crude oils, diesel oils as well as light hydrocarbons such as kerosene, jet fuel and gasoline [5]. Oils spills damages the natural attractiveness of polluted sites. Its strong odor can be felt miles away and the excessive growth of algae alters sea colors and the landscape [1]. Marine environmental pollution by petroleum oils affects ecology, life economy, as the coast areas of the effected sea.

Countless natural and synthetic media are available for treating only waters [5]. Conventionally, some of the method used to remove oil and grease are gravity separation, dissolve air floatation, chemical coagulation, filtration, membrane process and absorption [5]. However, the technologies that are currently used to clean up the spilled oils are not eco-friendly and sustainable [4]. Emulsified oil can be effectively removed from water by absorption.

Traditionally, the commonly used adsorbent for moving oil is activated carbon [6]. Crushed and processed plant material has been used to adsorb oil from surfaces for some time [5]. For an example, a grinded '*Parkia Speciosa*'(*P. Speciosa*) as known as 'Petai' pod has been used as an adsorbent to adsorb oil. Besides natural adsorbent is the eco-friendliest and cost effectives [1]. Peels and pods are often the waste part of various fruits and beans. These wastes have not generally received much attention with a view to be used or recycled rather than discharged. *P. Speciosa* is popular in South Eastern Asia including Malaysia and North Eastern India [7]. The *P. Speciosa* is believed by the locals to have medicinal properties. The pod is regarded as waste material during the processing in the food industry [7].

As an important resource if energy, food and chemical industry, oil is being widely used in our daily life. These pollutants are not only a loss of oils but also can adversely effects on wildlife [8]. Oil spills pollution has massive effects on environment, ecology, economy as well as the society. The major sources of marine pollution are the industry, ocean transportations, sewages and farm wastes [1]. Oil operations such as seismic exploration, drilling and production, processing and transportation have affected negatively on the environment and ecosystem [1]. The impact of oil spills on the ecosystem cannot be over emphasized. Oils spilled affect marine life.

Several clean-up techniques have always been utilized in combining oil spillage like the historical booms and skimmers, used of dispersants, in-situ burning of oil on water and used of adsorbents [4]. However, the conventional methods do not seem to be economically feasible and environmental legislation, coupled with industrial efforts to acquire cost efficient sorbents, renewed interest in recovering spilled oil and concern for waste reduction at source and sink have all generated the need to look for alternative methods that has low cost, efficient and biodegradability advantages.

P. Speciosa is popular among Malaysian, due to the ability as anti-inflammatory and influential antioxidants it can be considered as one of the healthy nutrition to people. Thus, it can be served either cook or raw and sold in pods or the seeds are already separated from the pods. They are also pickled in brine and exported in jar [7]. The problem here is the peels and pods of the *P. Speciosa* has become as a waste and it comes in large amount due to people only takes its seeds only. The major problem here is become environmental pollution to the countries. Therefore, the objectives of this study are to produce low cost absorbent from *P. Speciosa* for cleaning of oil spills. Besides that, the effect of different weight dosage of adsorbent with different types of oil is investigated.

2.0 EXPERIMENTAL

Materials and Chemicals. *P. Speciosa* were collected from a market area in Terengganu, Malaysia. The pods were obtained just after the seed is taken out. Then the pods were dried under direct sunlight for about 48 hours. The chemical used were Sodium Hydroxide (NaOH) and Hydrochloric Acid (HCL).

Preparation of Biosorbent. The preparation of adsorbent was divided into two types, which is treated and untreated adsorbent. The pods of *P. Speciosa* were cut into smaller size around 2-3 cm and rinsed with distilled water. The pods were dried under direct sunlight for 48 hours to remove its moisture. The next step was dried in air oven for 3 hours at 70°C. The dried pods were ground using mechanical grinder and sieved to obtain the adsorbent size at 250 µm. For treated adsorbent preparation, the method was same with untreated at early stage but the final stage the powder of *P. Speciosa* were treated with 1 M sodium hydroxide solution by soaking the sample for 24 hours at room temperature. The treated powder was then rinsed with distilled water and soaked in hydrochloric acid for 30 minutes to neutralize the powder. Subsequently, the sample was dried again in air oven at 70°C for 24 hours before the powder can be sieved to get the particle size 250 µm.

Oil absorption Test. Both untreated and treated *P. Speciosa* powder were used as an adsorbent in oil (lubricant oil, used vegetable oil, petrol and diesel) treatment. The amount of adsorbent dosage used were 1 g and 2 g.

3.0 RESULTS AND DISCUSSION

Effect of Types of Oil on Percentage Removal. Types of oil can influence the percentage of oil removal for treated and untreated adsorbent. In the present study four types of oil used namely lubricant oil, used vegetable oil, diesel oil and petrol which shown in Fig. 1 and Fig. 2. Results in Fig. 1 indicated the percentage removal of different types of oils for 1 g/mL and 2 g/mL of treated adsorbent. Petrol has higher removal of oil for 1 g/mL adsorbent which is 84% compared to lubricant oil (43.55%), diesel oil (14.2%) and UVO (44.62%). In contrast to 2 g/mL adsorbent, UVO (44.62%) has higher removal compared to diesel (5.585%), lubricant oil (36.87%) and petrol (40.46%).

The Fig. 2 shows that the percentage removal for different types of oil for 1 and 2 g/mL of untreated adsorbent. The results show similar trend with treated adsorbent where the petrol show the highest removal (86%) as compared to UVO (66%), lubricant oil (55%) and diesel (6.5%). It is observed that 1 g/mL of adsorbent has higher percentage removal as compared to 2 g/mL adsorbent. Previous study by Abdullah et al [14], show that the lubricant oil can be absorb better using orange and banana peel.

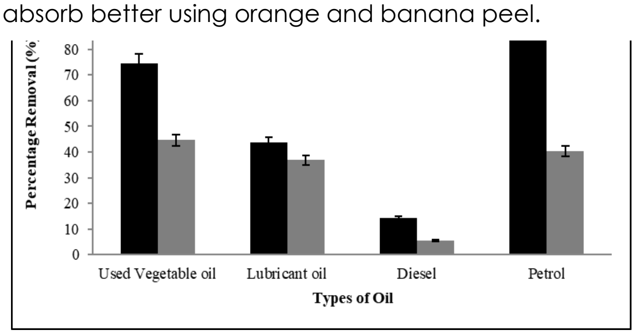

Fig. 1 Percentage Removal of Oil by Different Types of Oil (Treated Adsorbent Dosage 1 & 2 g/mL).

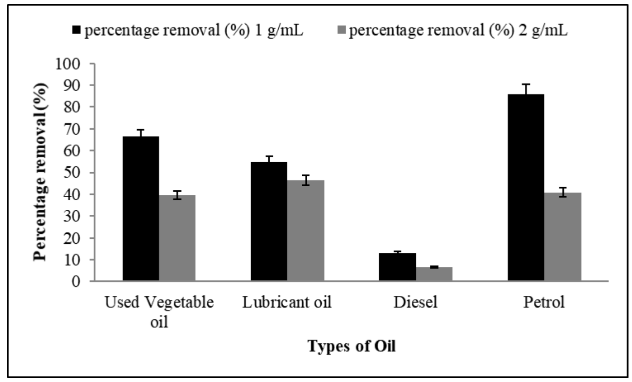

Fig. 2 Percentage Removal of Oil by Different Types of Oil (Untreated Adsorbent Dosage 1 & 2 g/mL)

Results proved that using the same adsorbent could give different percentage of oil removal. By based to the effect of oil density, amount of carbon in the oil and viscosity of the oil. The density of oil that influenced the viscosity of oil are different for each types of oil for example, vegetable oil has higher density than lubricant oil. Thus, it can be concluded that the viscosity of oil, the lower the percentage removal of the oil. This statement is supported by Ji et al. [8], which show that the percentage removal of oils is increased as the viscosity decreased. Previous study also reported that the rate of oil penetration into interior of sorbents was inversely proportional to oil viscosity This might be because viscous resistance reversed the movement of oil into the inside of sorbent. Similar result was observed from the tests in oily water medium that the sorption capacity was again found to decrease with an increase in viscosity of oil. Wei et al. [9] also demonstrated that increased in oil viscosity caused a great decreased in oil removal. This is due to light oil tend to be removed from the sorbent more readily than heavy oil.

Effect of Types of Oil on Percentage Removal. The effect of adsorbent dosage for untreated *P. Speciosa* powder at 1 and 2 g/mL was tested with different type of oil. Fig. 3 below shows the percentage removal of oil against mass of adsorbent for untreated adsorbent. Fig. 3 below shows the percentage removal of oil against mass of adsorbent for untreated adsorbent. For petrol, 1 g of *P. Speciosa* has higher percentage removal, 86% as compared to 2 g, and 41%. The same results were observed for other type oil, lubricant which removal of oil using 1 g is 55% while 2 g is 46.5%. On the other hand, diesel oil can only be removed 13% by 1 g of adsorbent and 6.5% by 2 g of adsorbent. However, for used vegetable oil (UVO), 1 g of adsorbent can remove 66% of oil and 39.5% for 2 g adsorbent.

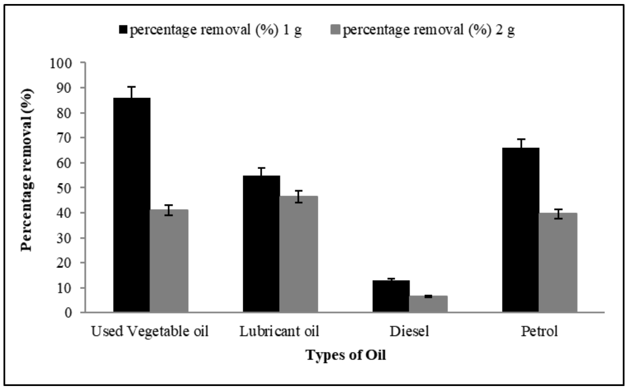

Fig. 3. Percentage Removal of Oil by Different Types of Adsorbent (Untreated)

Fig. 4 illustrated the percentage removal of oil for 1 g and 2 g adsorbent. Petrol can be removed by 1 g of adsorbent at 84% but 2 g can only remove 40.455% of the oil. For lubricant oil, 1 g of adsorbent can remove 43.55% and 2 g can remove 36.87% of the oil. Diesel oil can be removed by 1 g of adsorbent at 14.2% but 2 g of adsorbent can remove 5.585% of the oil. Lastly, 1 g of adsorbent can remove 74.34% of used vegetable oil but 2 g of adsorbent can remove 36.87% of the oil. Based on the explanation about the percentage removal, it can be concluded that the percentage removal by 1g was higher than 2 g. As the adsorbent dosage increased, the percentage removal of the oils is decreased. This is due to the constant amount of oil used, 1 mL for both 1 g and 2 g adsorbent. This is caused by the amount of adsorbent left when 2 g of adsorbent used to adsorb the oils. The limited amount of oil makes the lower dosage of adsorbent more efficient compared to high dosage. However, it vice versa with the statement stated by Rafeah et al. [10], where if sorbent dosage increased, oil removal efficiency is increased. The phenomenon is associated with an increase in available binding sites for adsorption in higher adsorbent dosage. Nevertheless, sorption capacity decreased with an increase in sorbent dosage, mainly due to the increase of unsaturated oil binding sites. In addition, saturation effect also causes a decrease in oil removal efficiency when maximum capacity has been reached. Also, from previous study by Mohd et al. [11], stated that usually increasing adsorbent dosage will increase the percentage of oil removal, where the number of sorption sites at the adsorbent surface will increase by increasing the dose of the adsorbent. Study of the effect of adsorbent dosage gives an idea of the effectiveness of an adsorbent and the ability of oil to be adsorbed with a low dosage of adsorbent.

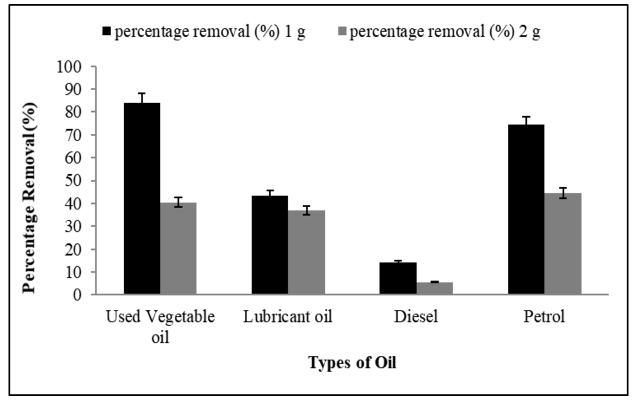

Fig. 4. Percentage Removal of Oil by Different Types of Adsorbent (Treated)

Effect of Adsorption Capacity Between Untreated and Treated Adsorbent on Percentage Oil Removal. Fig. 5 below showed that the percentage removal of the oil for treated and untreated 1 g of adosorbent. From the graph, the percentage removal of the petrol for the untreated adsorbent (86%) was higher than untreated (84%). Some goes to lubricant oil where untreated adsorbent (55%) higher than treated adsorbent (43.55%). However, there were some differences where treated adsorbent was higher for diesel oil and UVO. For diesel oil, treated adosorbent is 14.2% but removal for untreated is 13%. Also, for UVO, treated adsorbent has 74.34% removal and untreated have 66%.

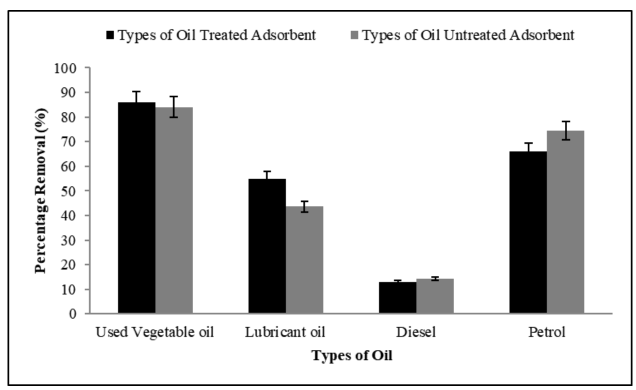

Fig. 5 Percentage Removal of Oil by Different Condition of Adsorbent (1 g)

Fig. 6 indicated the percentage removal of oil for treated and untreated 2 g of adsorbent. The percentage removal of the oil for treated and untreated adsorbent for petrol, lubricating oil and diesel oil were higher compared to treated adsorbent. Percentage removal of untreated adsorbent for petrol is 41% but treated adsorbent is 40.455%. Next, for lubricating oil, untreated adsorbent has 46.5% and treated adsorbent has 36.87%. In addition, for diesel oil, untreated adsorbent has 6.5% but treated adsorbent has 5.585%.

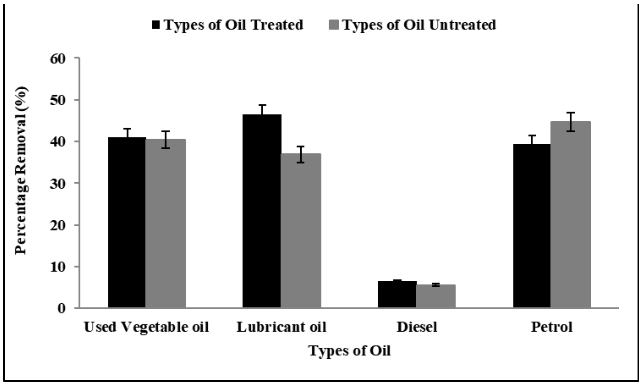

Fig. 6 Percentage Removal of Oil by Different Condition of Adsorbent (2 g)

From the result, it can be concluded that the percentage removal of oils were not constant where some of the treated and untreated have good percentage removal of oils and some were not. The treated adsorbent has been treated with Sodium Hydroxide (NaOH) and hydrochloric acid (HCl). The objective was to open the pore and natural back the adsorbent. Based on Rafeah et al. [10], the percentage removal of the oil depends on the size of the adsorbent pore. It is proved that the higher the size of the pore, the lower the percentage removal of the oils. Furthermore, wide pore size distribution will cause slow adsorption of heavy oil.

4.0 CONCLUSION

The *Parkia Speciosa* pods have a high potential of good adsorbent in removing oil spill. The treated adsorbent gave a significant result compared with untreated adsorbent. The result showed that 1 g and 2 g of adsorbent dosage can remove oil waste till 84%. Petrol oil becomes the most effective type of oil that can adsorb by this adsorbent. This preliminary study prove that the *Parkia Speciosa* pods can be convert as an adsorbent that can clean the oil spillage.

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