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Removal Oil and Grease From Oily Kitchen Wastewater By Using Raw Kapok as a Potential Adsorbent

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Abstract

Oil and grease are one of the elements that are poisonous and easily pollute the environment, especially water and soil. Adsorption techniques use natural adsorbents that do not damage or pollute the environment. The raw kapok was chosen as an adsorbent because it is a technology to overcome the problem of oil produced globally. The experiment was conducted with two type of dosage which are 5g and 15g of raw kapok to absorb the oil and the results obtained stated that raw kapok is able to absorb the cooking oil that is still not used more than the cooking oil that has been used. Due to the density of the oils, it affects the ability of raw kapok to absorb and hold oil. In addition, this absorbed oil restores several water parameters such as dissolved oxygen (DO), pH, temperature and turbidity.

1. Introduction

There is a significant amount of waste generated by industry and oil that is discarded every day. The waste that contain oil or the oil itself are mainly produced from any type of production activities such as oil and gas, food industrial, transportation and more [1]. Oil can be released in very low or very high concentrations, typically between 1 and 50%, and produces oily wastewater, which typically contains the oil [2]. There are various technologies and treatments to overcome the problem of oil or oil spills on the surface of the water such as membrane plasma treatment [3]. One of the treatment is absorption because the use of natural adsorbent sawdust, feather, human hair, and other natural materials because of their characteristics that is light, easy to float and waterproof [4]. As one of the grey wastewater that is from dispersed homes and small dining establishments, it has drawn attention from all over the world due to the existence of organic pollutants like oil, grease, and fatty acids that will have an impact on the ecosystem by choking sewer pipes and eutrophicating water bodies [5]. Cooking oil, which is released when it comes into contact with temperatures above 200 ºC in the kitchen and forms hazardous and toxic substances, is a common component of oily kitchen wastewater [6]

Oil-contaminated wastewater is majorly in O/W emulsions which has an impact on physical characteristics like temperature, pH, and the presence of oil droplets while the chemical parameters like dissolved oxygen (DO), biochemical oxygen demand (BOD), and others will be impacted [7]. Kapok fiber showed promise as a replacement material for use in oil pollution treatment by exhibiting good water repellent, high oil adsorption capacity, and well-reusable qualities [8]. In order to research the sorption condition of kapok fibre on industrial wastewater, the raw kapok fibers were in contact with a variety of wastewater types, including emulsified wastewater, immiscible oil-and-liquid wastewater, and non-oily wastewater [9].

Through this study, the adsorbents have a significant capacity for absorbing oil off the water's surface, which lowers treatment costs and lessens detrimental effects on ecosystems [9]. Not only that, but the discoveries made in this study will help to solve the issue of biochemical oxygen demand (BOD), dissolved oxygen (DO), p All

of the tests utilized in this study are fundamental ones that examine how oil interacts with water. Furthermore, the project's goals have been met by demonstrating the oil adsorbents' capacity to hold oil after it has been absorbed. Therefore, to support this topic, researchers, teachers, and students can use this study as their reference. Accordingly, references from this study are also capable of raising community awareness of the necessity of protecting water sources from the presence of oil.

2. Methods

There are several methods used to obtain result of oil absorption, capability of raw kapok to retain oil after absorbed and water quality parameter such as dissolved oxygen (DO), pH, temperature and turbidity.

2.1 Preparation of Oil adsorbents and Oily Kitchen Wastewater

Prepare an amount of raw kapok by purchasing from Shoppe because it is the crucial part to conduct the study, so that the objectives of this study can be achieved. The original raw kapok from the tree itself is purchased to provide two types of adsorbent oil with different mass. The two of oil adsorbent from raw kapok which are 5g and 15g. Since raw kapok is utilized for both types of oil adsorbents with two different masses, there is no need for these oil adsorbents to undergo any particular procedure or process, like soaking in hydrochloric acid or dry into the oven. A small net used to keep the raw kapok in shape after absorbing the oil. For oily kitchen wastewater that used Grab sampling method, took 500ml of kitchen wastewater from Kolej Kediaman Pagoh Cafe and mixed with 80ml oil.

2.2 Oil Absorption Test

Cooking oil will be weight in for 80ml is used for both used and unused types. Next, there are four beakers will fill with 500 milliliters of kitchen waste water and 80 milliliters of oil; two with sample for 5g raw kapok and four with sample for 15g raw kapok. The two beakers for 5g and 15 raw kapok represent for unused and used oil. After each minutes which 5, 10, 15 and 20 minutes, the oil adsorbents will be remove and weight the mass. The values that will obtain are entered into equation 3.1 to obtain the efficiency of oil and grease (O&G) in %.

$$O\&G\ (\%) = \frac{W_A - W_B}{W_A}\ X\ 100\% \tag{1}$$

Where:
WA= Weight of total oil
WB= Weight of oil absorbed

2.3 Capability of Oil adsorbents to Retain the Oil

Oil adsorbents that are removed after the absorption time is set, they are hung and there is a bowl below to catch the oil that drips out of the oil adsorbents for 20 minutes. After 20 minutes have passed, the oil dripping into the bowl is weighed to obtain the W_c value. Below shows the equation 3.2.

$$Retained\ Oil\ (mg) = \ W_A - W_C \tag{2}$$

Where:
WA= Weight of oil adsorbent with the absorbed oil (mg)

2.4 Dissolved Oxygen (DO) and pH

A Hach Multi-Meter has been used to determine the DO and pH of every sample of oily kitchen wastewater since this meter has two detectors. So, the readings can be taken at the same time. The instrument is thoroughly rinsed with distilled water and then wiped with a new tissue prior to measuring the pH by submerging it. To improve accuracy and consistency, pH readings were taken three times for each sample.

2.5 Temperature

To obtain a temperature reading for each sample in the eight beakers, a Hach Multi-meter was used to obtain a reading. Each sample was read three times to increase consistency and accuracy.

2.6 Turbidity

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In order to obtain turbidity readings for samples from eight beakers, a Hach Tungsten Lamp Turbimeter was used. The wastewater sample is poured into the sample cell and the lid is tightly closed. The sample placed into sample holder in the instrument. Readings were taken three times to ensure an average turbidity reading. Below shows Table 3.3 example table to obtain turbidity data

3. Result and Discussion

Below shows Table 3.1 the type of oil used in this study with quantity, mass and their density for reference discussion in this chapter.

Table 3.1 The type of oil with their quantity, mass and density

Type of oil	Quantity (ml)		Mass		Density of Oil (kg/l)
	ml	l	g	kg	
Unused cooking oil	80	0.08	103	0.103	1.288
Used cooking oil	80	0.08	113	0.113	1.413

3.1 Effects on Oil Absorption on Both Oils for Both Oil Adsorbents

Below shows a graph where percentage of oil absorption vs time on unused cooking oil for 5g and 15g absorbents for unused cooking oil. This graph is based on Table 4.2.

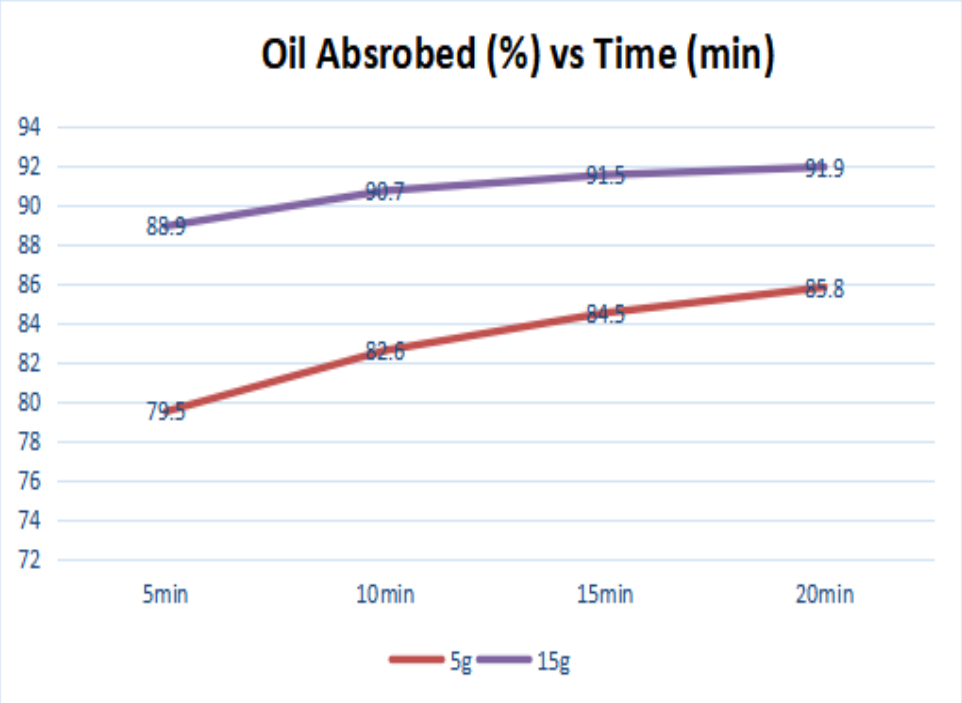

Figure 3.1 Percentage of oil absorption vs time on unused cooking oil for 5g and 15g absorbents

]Based on Figure 4.2 of the oil absorbent in both cooking oils, the longer the time is explained, the oil absorbed also increases. For unused cooking oil, the increase in absorbed oil is different for 5g and 15g. The highest oil absorption is oil absorbent 15g with a value of 94.9% in 20 minutes while for oil absorbent 5g at the same time it is 85.8%. This shows that the longer the time, the more oil is absorbed by raw kapok. To see this increase, the graph below. This result shows that raw kapok as an oil adsorbent because it capability to absorb the oil in high percentage because the capacity of raw kapok is 13-14% higher than capability of the 100% nettle non-woven [10].

Meanwhile this Figure 4.2 shows the graph of percentage oil absorption vs time on used cooking oil with 5g and 15g raw kapok as the potential adsorbent.

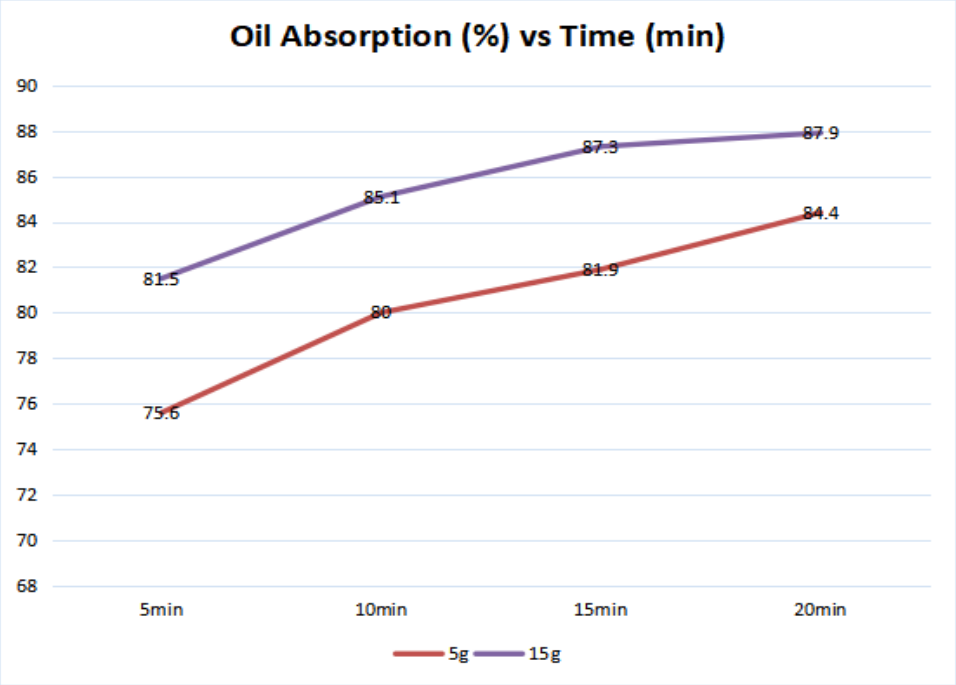

Figure 3.2 Percentage of oil absorption vs time on used cooking oil for 5g and 15g absorbents

Meanwhile on Figure 4.3 shows for used cooking oil, the increase in absorbed oil is different for 5g and 15g. The highest oil absorption is oil absorbent 15g with a value of 87.9% in 20 minutes while for oil absorbent 5g at the same time it is 84.4% minutes. However, the 15g of raw kapok absorbed used cooking oil in this result just 87.9% which less than the 15g of raw kapok absorbed unused cooking oil with 94.9% in Figure 4.2. The 7% difference shows the efficiency of raw kapok to absorb used cooking oil is slightly lower than the efficiency of raw kapok to absorb unused cooking oil. When referring to Table 4.1, the density for used cooking oil is 1.413kg/l which is higher than the density of still unused oil with 1.288 kg/l. The conclusion from the results is that the higher the density, the lower the ability of raw kapok as an oil adsorbent [8].

Table 3.2 Parameter of Kitchen Wastewater

Sample with Unused Cooking Oil

DO		pH		Temperature		Turbidity	
Initial	After	Initial	After	Initial	After	Initial	After
9.18	8.56	8.05	8.23	24.0	24.9	357	127
8.88	8.84	8.03	8.21	24.0	24.9	307	101
8.88	8.53	7.98	8.19	24.3	24.9	367	125
8.98	8.64	8.02	8.21	16.81	24.9	343.67	117.67

Sample with Used Cooking Oil

DO		pH		Temperature		Turbidity	
Initial	After	Initial	After	Initial	After	Initial	After
8.54	8.59	8.12	8.18	25.2	25.5	309	189
8.48	8.44	8.12	8.17	25.9	25.9	361	187
8.48	8.34	8.17	8.18	25.9	25.5	358	172
8.50	8.46	8.14	8.17	25.67	25.63	342.67	182.67

Based on Table 4.3, the initial and after DO of the unused cooking oil is slightly higher than the used cooking oil. This is because the temperature of sample with unused is also lower than sample with used cooking oil. The value of dissolved oxygen is parallel to the temperature. (US EPA, 2018). While for pH, sample with used cooking oil is high because it has gone through the burning process that causes rapid oxidation in oils at high pH (Kim et al., 2016). For turbidity, both readings for unused and used cooking oil are higher than the readings after using raw kapok as oil adsorbent.

3.2 Result on Oil Retain After Absorption Test

Table 4.4 shows the mass of oil that has been removed from 5g and 15g kapok by hanging the raw kapok with the bowl underneath. The oil that has been drip out from raw kapok are the result in this table.

Table 3.3 Oil Removal after Absorption Test

		Oil Removal (g)			
		Unused Cooking Oil		Used Cooking Oil	
	Oil Adsorbent (g)	5	15	5	15
Time(min)	5	1	5	2	4
	10	3	8	6	8
	15	4	10	9	12
	20	6	13	12	13

From this table, for the unused cooking oil, the highest oil that removed out from the 15g raw kapok is 13g while the 5g raw kapok has removed 6g oil after 20 minutes. Meanwhile for used cooking oil, the 15g adsorbent has 13g oil removal and the 5g raw kapok has 12g oil removal after 20 minutes hanging. This result proves that the higher density is parallel to the mass, so the used cooking oil with 1.413kg/l has dripped out of the raw kapok while the lower density has less dripped out. The ability of raw kapok as the oil adsorbent to hold oil after being absorbed depends on the density of an oil [11].

4. Conclusion

In conclusion, raw kapok is still capable of being an oil adsorbent as one of the technologies to get rid of excess oil spilled in drains, rivers and the sea. Through experiments and the results obtained, the ability of raw kapok as an oil adsorbent depends on a factor such as density which is parallel to mass. The higher the density, the higher the mass. Low density oil can be accommodated more by raw kapok after 20 minutes instead of high density oil. The research conducted is also not complex to prove raw kapok as one of the natural oil adsorbents. In addition, raw kapok guarantees the well-being of the environment because it is eco-friendly. For the future study, there should be an new adsorbent oil innovation where this new adsorbent is form by several natural adsorbent such as raw kapok mixed with human hair.

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References

This guide contains examples of common types of APA Style references. Section numbers indicate where to find the examples in the Publication Manual of the American Psychological Association (7th ed.).

Journal

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