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New Natural Fibre As An Oil Absorbent Pad

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Abstract: *Oil pollution in our oceans is one of the biggest environmental problems the world is facing today. When oil spills happen, they don't just harm marine life but also affect people's health, damage the fishing and tourism industries, and hurt the economy. Most current clean-up methods rely on synthetic material which is costly. This research aims on creating a new kind of oil absorbent pad made from natural fibres like kapok and corn husks. These materials are not only biodegradable and affordable, but they're also surprisingly effective. Each oil absorbent pad is made with 50gram kapok and 50gram corn husks, offering a simple yet sustainable solution for small-scale oil spill cleanups at Tier 1. By using natural fibres it is hope to reduce the impact of oil pollution, protect marine ecosystems, safeguard human health, and ease the economic burden caused by these environmental disasters.*
Keywords: *Oil absorbent pad, Oil spill, Marine Pollution, Naturak Materials, Tier 1.*

1. INTRODUCTION

Marine oil pollution is an escalating global issue that poses a significant threat to marine ecosystems, biodiversity, and coastal economies. Oil spills occur due to various causes, including discharges near oil wells, pipeline and equipment failures, land runoff, and natural disasters (Gote, Dhila & Muley, 2023). While natural events such as earthquakes and hurricanes can damage oil tankers and lead to spills, most incidents are the result of human error (Gote, Dhila & Muley, 2023). The spilled oil typically consists of lipids, hydrocarbons, and petroleum-derived products such as diesel, gasoline, and kerosene (Gote, Dhila & Muley, 2023). Traditional oil absorbent materials often contain synthetic polymers that, when released into the ocean, can further harm the environment. Oil spills severely impact marine life, suffocating fish and other aquatic organisms (Gote, Dhila & Muley, 2023; Ishak, et al, 2023). In response to the urgent need for effective and environmentally friendly oil absorbent solutions, this study proposed the development of a sustainable absorbent pad made from natural fibre waste, specifically kapok and corn husks. As illustrated in Figure 1, utilizing these natural materials not only addresses waste management but also offers a viable alternative to conventional synthetic oil absorbents.

Fig. 1 Kapok and Corn Husks

2. LITERATURE REVIEW

A. The Effect of the Oil Spill

Oil spills represent a severe environmental crisis that must be addressed urgently and consistently to protect our ecosystems (Okoro, Adedipe, Bori & Usman, 2019). The consequences of oil spills are substantial, imposing significant economic costs and ecological damage.

B. Conventional Methods of Oil-Spill Clean Up

Various conventional methods are currently employed to address the challenge of oil–water separation. These include mechanical, chemical, thermal, and biological treatments, as illustrated in Fig.2. (Padaki et al., 2015). Mechanical methods often involve the use of devices such as skimmers, pumps, and booms, which are commonly deployed during oil spill cleanup operations (Jamaly et al., 2015; Ramanathan et al., 2021).

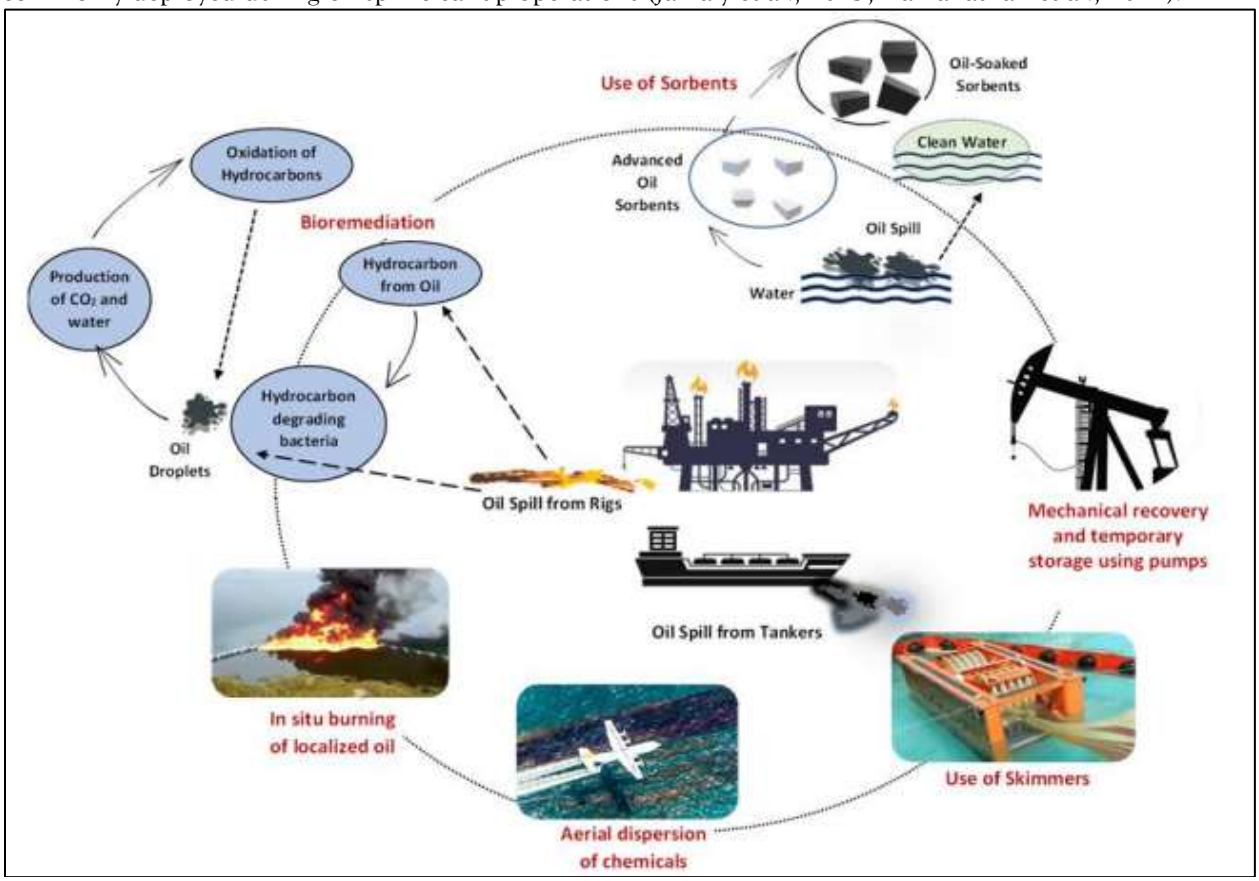

Fig. 2 Common methods used in oil spill clean up

C. Kapok

Kapok fibre is a natural fibre that shows interesting characteristics as an oil-absorbent material (Zhang, et al, 2017). It is abundantly available and exhibits high oil absorption capacity, leading to an attractive option for oil spill cleanup. Kapok fibre can be used as a raw sorbent material for oil spill cleanup, and it can be modified to improve its performance (Idrus, et al., 2024; Idrus et, at., 2006). In addition, kapok is extensively utilized as a sorbent material due to its renewable, abundant, environment-friendly, low cost, high sorption, hydrophobicity, and reusability (Kamar, et al., 2024). Kapok fibre can also be combined with other materials to create oil collectors with superhydrophobic coatings for efficient oil layer sorption and oil-in-water emulsion separation (Zang, et al. 2017). However, kapok as a sorbent material has challenges in hydrophobicity, water absorption, cleanliness of reused kapok, and structural integrity of kapok (Kamar, et al., 2024; Ishak, Zaid & Ramli, 2020).

D. Corn Husks

Corn is one of the oldest known food grains and one of the most planted crops in the world. Corn is cultivated in more than 170 regions worldwide, and its production is highly concentrated in regions such as Asia (Lugo, et al., 2024). Corn husk is a by-product generated during the processing and harvesting of corn, which is the second-largest agricultural crop globally. The utilization of corn husk is currently being explored due to its abundant availability, low cost, and biodegradable nature (Ratna, Ghosh, & Mukhopadhyay, 2022). Corn husks can be used as an absorbent for oil spills. They are a readily available, cost-effective, and biodegradable option. Corn husks, particularly raw ones, have a high cellulose content, which enhances their oil absorption capacity. Due to its abundance as waste and low expense, the perspective of extracting fibres from corn husks has been scrutinized. Moreover, corn stalk is non-toxic, and low energy is needed to develop a removal system with this biosorbent (Lugo, et al., 2024).

E. Advantages of Using Natural Fibres

The reason kapok and corn husks are utilized is because their advantages. According Idrus et al., (2024) it is because cost-effective: making use of cheap and easily available agricultural waste, environmentally friendly, reduces reliance on potentially harmful synthetic chemicals, and increases efficiency in the oil cleaning process on the sea surface. In addition, it has also an advantage for the society such as environment preservation, reducing the impact of oil pollution on the marine ecosystem, community health on improve the quality of sea water used for daily needs, such as fishing and recreation, economic sustainability for protecting the fisheries and tourism sector which is highly dependent on the cleanliness and health of the sea (Idrus et al., 2024).

3. RESEARCH METHODOLOGY

A. The Research Methodology

The initial method involved collection of kapok (Ceiba pentandra) and corn husks (Zea Mays Linnaeus). Kapok fibre is purchased from a local market in Sekinchan, Perak, while corn husk is collected from a night market in Manjung, Perak, All specimens are air-dried in a lab dryer at UniKL MIMET at 80 °C for two hours to eliminate moisture content. After drying, the materials are stored in a laboratory tray and kept in the laboratory at room temperature. Then, these natural materials need to be blended for 2 minutes. The blending process can leverage the strengths of different fibers and can create a comfortable fiber that is durable and resistant to wrinkles (Islam et al., 2024). Once the natural fibre is blended, the carding machine is applied for 1 hour to mix the kapok with the corn husks, as displayed in Fig. 3. This process is done manually until these combinations turn into a piece of oil-absorbent pad, as displayed in Fig. 4.

Fig.3 The Carding Process for Kapok and Corn Husks

Fig. 4 New Innovative Oil Absorbent Pad

B. The Ratio of Natural Fibre

Table 1 presents the ratio of kapok and corn husks used in the production of the newly developed oil absorbent pad. Each pad is composed of a combination containing 50 grams of kapok and 50 grams of corn husks, highlighting the balanced integration of these two natural materials in the formulation.

Table 1. Ratio Of Natural Fibre

Natural Fibre	Ratio
Kapok	50 gram
Corn Husks	50 gram

4. RESEARCH ANALYSIS

A. Simulation of Oil Absorbent Pad

Fig. 4 Kapok and Corn Husks Before and After Oil Spill

Fig.4. shows the output of the new oil absorbent pad before and after the simulation process. The simulation was conducted at a sink with dimensions within the range of 24 to 36 inches (60.94 cm x 91.44 cm), which can easily hold 200 grams of oil and 6 liters (1.6 gallons) of tap water without issue. The weight of the oil absorbent pad before the simulation is 32.43 and the weight after the simulation is 356.81 gram.

B. Lab Analysis

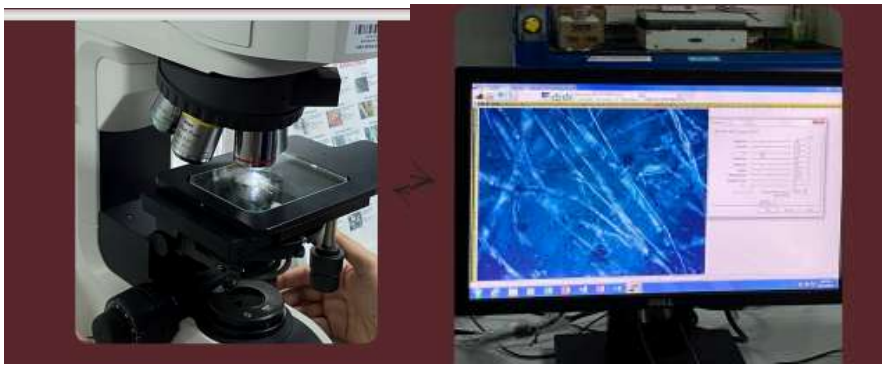

Fig. 5 Experiment at Lab Tribology in STRIDE

The oil absorbent pad was brought to the Tribology Laboratory at STRIDE, located in Lumut, Perak, Malaysia, for analysis, as shown in Fig. 5.

C. Lab Result

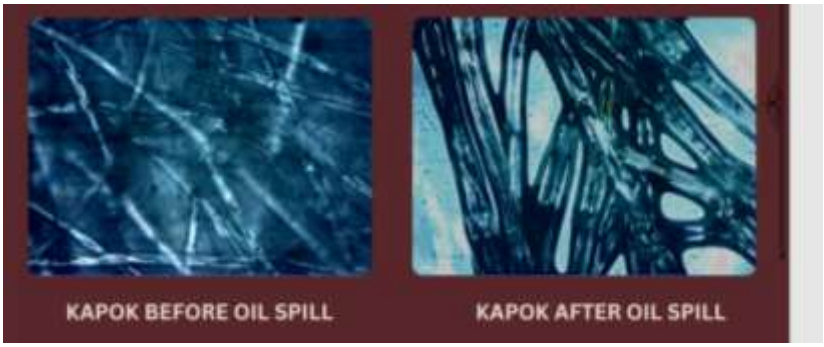

Fig. 6 Lab Result Kapok Image of 10X

Fig. 6. and Fig. 7. show the scanning electron microscope (SEM) images of kapok and corn husks, respectively, at 10× magnification.

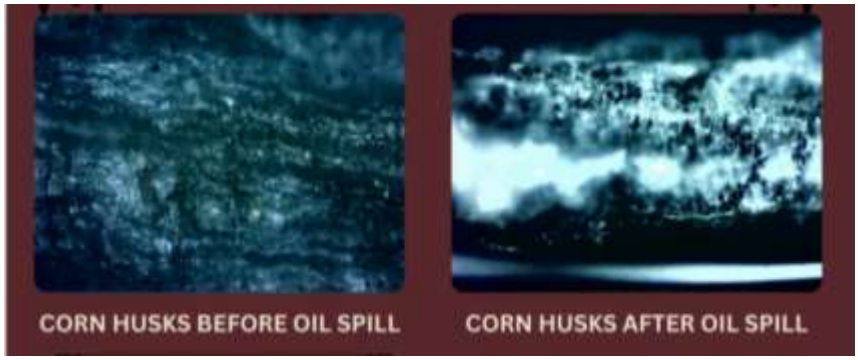

Fig. 7 Lab Result Corn Husks Image of 10X magnification

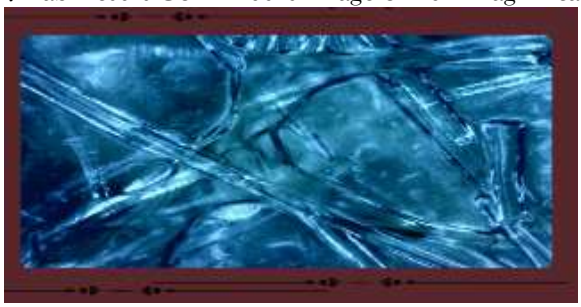

Fig. 8 Lab Result Combination of Kapok and Corn Husks Image of 10X magnification

Fig. 8. shows the image of a combination of kapok and corn husks after oil absorption. Before being subjected to oil sorption, both fibres are generally thinner. After oil absorption, both fibres appear to be swollen, which indicates that oil is successfully stored in their structure.

5. CONCLUSION AND RECOMMENDATION

A. Conclusion

The new oil absorbent pad was produced using a combination ratio of 16:16 for kapok and corn husk. The sorbent materials were assembled using a simple fabrication method involving heating and compression, and then packaged into a net casing for structural support and ease of handling. The performance of kapok and corn husk as oil sorbent materials was evaluated based on their sorption capacity, which measures the amount of oil they can absorb. Lab tests confirmed that the 16:16 kapok and corn husk oil absorbent pad is effective in soaking up oil. It combines good oil absorption capacity with hydrophobic properties, making it a practical and eco-friendly solution for marine oil spill cleanup.

B. Recommendation

For next research is recommended to have several ratios of the combination of the natural fibers. Based on the results of the research, kapok and corn husk are highly recommended as sustainable and effective materials for oil absorption. Their natural hydrophobic properties, biodegradability, and cost-effectiveness make them ideal alternatives to synthetic absorbents. It proved reliable performance in terms of oil sorption capacity and retention, offering a practical solution for marine oil spill response. It is recommended that further research and development focus on optimizing the fabrication process and scaling production for real-world applications, particularly in coastal and environmentally sensitive areas.

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