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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

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Editors

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A PRELIMINARY STUDY OF CHEMICALLY ACTIVATED CARBON DERIVED FROM SHRIMP WASTE

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Abstract: Good quality water is needed to deliver clean and safe drinking water that is free of dangerous contaminants. The contamination of water by various hazardous compounds, such as organic pollutants and heavy metals, has emerged as a significant environmental concern. This is because it can greatly affect the quality of drinking water for future generations. Activated carbon has a large surface area and is widely used for many different things, such as removing contaminants from water. The biosorption technique using activated carbon is more effective than conventional methods due to its low cost, biodegradability, and eco-friendliness. Thus, the aim of this study is to synthesize the activated carbon derived from shrimp shell waste and to identify the characterization of shrimp shell waste activated carbon. Shrimp shell activated carbon was synthesized using the carbonization and activation methods using NaOH. However, its characterization was analyzed using FTIR. Furthermore, chitin is a biopolymer with a high nitrogen content and great adsorption capabilities that may be obtained naturally and renewable from shrimp shell. Shrimp shell can be utilized as an intermediate for activated carbon, a porous substance that can be used to remove organic compounds and heavy metals from wastewater. Activated carbon derived from shrimp shells is used in wastewater treatment. High amounts of harmful and carcinogenic phenolic compounds are found in wastewater. Hence, it can be concluded that the shrimp shell activated carbon was effective in treating wastewater due to it's high adsorption characteristics.

Keywords: *Water quality, contaminants, activated carbon, shrimp shell waste, NaOH.*

INTRODUCTION

The existence of biological, chemical, or physical elements or factors that affect a water body's useful usage is known as water contamination, or water pollution (Singh et al., 2022). The type of water body, its location, and the beneficial uses it supports significantly influence the degree of contamination required to deteriorate it. Various factors, including sewage and wastewater, marine dumping, and agricultural activities, can cause water contamination. Sewage and wastewater, even after undergoing treatment, may still include detrimental chemicals, bacteria, and pathogens. Each house discharges sewage and wastewater into the sea, along with fresh water. The presence of microorganisms in wastewater leads to disease proliferation, posing a risk to both humans and animals' health. Furthermore, marine dumping is exactly what it sounds like: the disposal of waste into the ocean's waters. Even, many countries are still collecting and disposing of household waste into the oceans. Most of these materials require a period ranging from two to 200 years to fully disintegrate.

According to Malaysian Industrial Development Authority, the world's municipal solid waste (MSW) is 2.01 billion metric tonnes annually of which, 33 per cent is not adequately managed in an environmentally safe manner. The lack of solid waste planning and financial investment in waste management has not only resulted in lowering the water quality, but also inadequate and poorly operated facilities contributing to environmental pollution, which is hazardous to public health. Hence, this study was conducted to combat this problem. Thus, the objectives of this study are to synthesize the activated carbon by using aquaculture waste such as shrimp shell waste to treat rubber effluent and to identify the characterization of shrimp shell waste activated carbon. This study indirectly reduces the amount of shrimp shell waste. Waste from shrimp shells can contaminate the land, water, and atmosphere with diseases, heavy metals, nitrogen, and phosphorus if it is not properly disposed of. Eutrophication, greenhouse gas emissions, odors, disease outbreaks, and a loss in biodiversity can also occur if the waste is not managed properly (Popović et al., 2023).

Utilising waste materials such as shrimp shell activated carbon as biosorbents in treating the rubber effluent wastewater makes it cost-effective and eco-friendly. The use of biosorbents represents a highly efficient method of biosorption employing biological materials for the removal of pollutants from water or air. These materials, including plants, algae, fungi, bacteria, or animal waste, are collectively referred to as biosorbents. They possess the distinctive capability to adhere pollutants to their surface or structure through various processes such as surface complexation, ion exchange, adsorption, and precipitation (Torres, 2020). The utilization of carbonaceous biosorbent through offers the potential to effectively reduce waste, mitigate environmental obstacles, and yield value-added products (Tavasuria Elangovan et. al, 2023). Overall, this study has many benefits for the community.

Shrimp shell activated carbon was prepared through carbonization and activation methods. Based on Tavasuria et. al, (2023), the shrimp shell activated carbon was characterized using FT-IR spectroscopy and nitrogen adsorption-desorption analysis. Generally, the shrimp waste contains protein (30-40%), calcium carbonate (30-50%) and chitin (20-30%) (Wid & Alca,2016). Eddya et. Al, (2020) and Selvaraj et. al, (2023) also emphasized that shrimp shell consists of chitin and chitosan which are naturally occuring polymers. Chitosan is obtained by eliminating enough acetyl groups (CH_3–CO) from chitin through deacetylation (Selvaraj et. al, 2023). Chitosan is the second most common carbohydrate polymer after cellulose and widely distributed in nature. It can be found in the skeletons of prawns, lobsters, and crabs. Chitosan provides the advantages of superior adsorption, biodegradability, biocompatibility, adaptability (Subash et. al, 2023) and environmental protection because of its enormous quantity of amino and hydroxyl groups (Chakravarty & Edwards, 2022). Thus, it found to be effective in wastewater treatment.

METHODOLOGY

Pre-treatment of shrimp shell

The shrimp shell wastes were collected from Pasar Awam Tapah, Perak. To get rid of any dirt or extraneous debris, the shrimp shell waste was first cleaned with distilled water and then dried at 80°C for 48 hours (Wei et al., 2023). After that, a magnetic stirrer was used to agitate about 100 g of pre-carbonized shrimp shell waste in 2 M sodium hydroxide (NaOH) at 80 °C for two hours to extract any possible contaminants and protein from the shells. A little peptide solution was obtained by washing the final product with distilled water. After being dried for two hours at 65°C in the oven, the resultant solid was agitated in 3 M hydrochloric acid (HCl) for three hours at 30°C using a magnetic stirrer (Wei et al., 2023). The aim of this pre-treatment procedure is to extract the minerals from the leftover shrimp shell.

Figure 1. Pretreatment of shrimp shell waste

Carbonization and activation of shrimp shell waste

After pretreatment, 100 g of shrimp shells were dried in the oven for 80 °C, and the powder was ground using a mortar and pestle until it became a fine powder. Then, the shrimp shell powder was pre-carbonized in a muffle furnace at 500 °C for two hours carbonized. 100 g of pre-carbonized powder of shrimp shells was soaked and activated with 0.1 M sodium hydroxide, NaOH, at a mass ratio of 1:2. Then, the mixture was placed in the magnetic stirrer for about 2 hours at 85°C to dilute the solution. After that, the pH of the mixture was measured using a pH meter. If the mixture is alkaline, the mixture was added with distilled water and hydrochloric acid to neutralize the mixture at a pH of 7. Then the pH of the mixture was measured again and adjusted to neutralize at a pH of 7. After the mixture cooled down, the mixture was washed with the distilled water until it became clean and then filtered. The filtered activated carbon shrimp waste was placed in the oven at 65°C for 2 hours and then dried at 500°C for 2 hours in a muffle furnace (nitrogen atmosphere). The activated carbon powder was sieved to make sure the size of the particle is only 1-2 mm. The sample was kept in a centrifuge tube in a desiccator for further use.

Characterization of Shrimp Shell Carbonized Powder and Activated Carbon Powder

The shrimp shell carbonized powder and activated carbon powder were ground, respectively, and then analysed with Fourier transform infrared spectroscopy (FTIR). FTIR analysis was conducted to identify the characterizations of shrimp shell carbonized powder and activated carbon using NaOH, such as the presence of functional groups on the surface of the activated carbon powder.

FINDINGS

Characterization of Shrimp Shell Carbonized Powder and Activated Carbon using FTIR Results

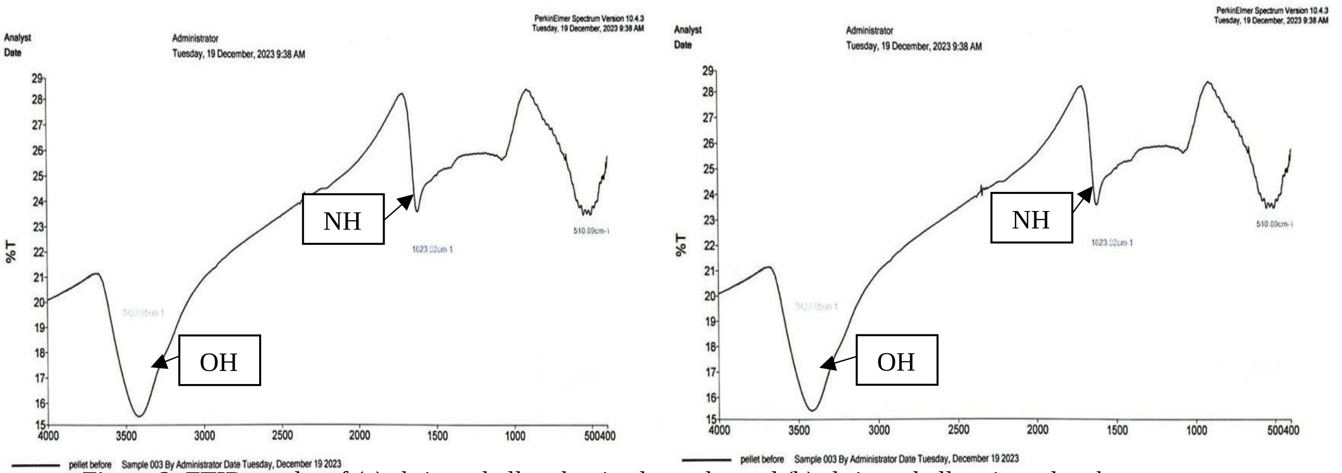

Figure 2. FTIR results of (a) shrimp shell carbonized powder and (b) shrimp shell activated carbon

Figure 2. represents the FTIR vibrational spectra of shrimp shell carbonized powder and chemically activated carbon powder using NaOH, respectively. The appearance of the main absorption peaks does not differ significantly between carbonized powder and activated carbon powder as tabulated in Table 1 which indicates that the existence of chitosan as an active ingredient in shrimp shell. The first peak of shrimp shell carbonized powder is 3422 cm^{-1}, and the activated carbon is 3396 cm^{-1} representing strong and broad vibrations of O-H bonds. This indicates the presence of hydroxyl group in both samples. The second main peak of shrimp shell carbonized powder and shrimp shell activated carbon is 1623 cm^{-1}. Both spectra represent vibrations of N-H bonds which demonstrates amine groups in chitosan. Examining both FTIR spectra reveals that the addition of NaOH to shrimp shell carbonized powder does not entirely alter the surface groups of the carbonized powder that absorbs substances. It does make the functional groups that help metals stick to the carbon much stronger, like the hydroxyl and amine groups. This makes the activated carbon from shrimp shells much better at removing heavy metals from wastewater. This may be due to NaOH activation at high temperatures, which increases and promotes shrimp shell activated carbon's large surface area, porous structure, and strong adsorption characteristics.

Table 1. Characteristics of IR frequencies of vibrations

Sample	Bond	Frequency Range, cm^{-1}	Appearance
Shrimp shell carbonized powder	O-H	3422 (stretch)	Strong, broad
	N-H	1623 (stretch)	Medium
Shrimp shell activated carbon	O-H	3396 (stretch)	Strong, broad
	N-H	1623 (stretch)	Medium

CONCLUSIONS

In summary, carbonized powder and activated carbon derived from shrimp shell waste were successfully synthesized. The FTIR results revealed two main bands in both samples: O-H bonds (alcohols and phenols) and N-H (amine) stretching vibrations. However, there is a slight difference in terms of wavelength number for both samples. As a result, shrimp shell activated carbon is more effective in treating wastewater or rubber effluent because of its high adsorption frequency, which represents a large surface area, porous structure, and strong adsorption characteristics. Future research should investigate additional activation agents, such as steam, acids, and CO_2, as this study concentrated on activating shrimp shell wastes with sodium hydroxide.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

REFERENCES

Chakravarty, J., & Edwards, T. A. (2022). Innovation from waste with biomass-derived chitin and chitosan as green and sustainable polymer: A review. Energy Nexus, 8, 100149. https://doi.org/10.1016/j.nexus.2022.100149

Eddya, M., Tbib, B., & El-Hami, K. (2020). A comparison of chitosan properties after extraction from shrimp shells by diluted and concentrated acids. Heliyon, *6*(2). https://doi.org/10.1016/j.heliyon.2020.e03486

Selvaraj, H., Periyannan, K., Balachandar, S. (2023) Extraction and Characterization of Chitosan from the Shell Wastes of Indian Shrimp Using Different Methods of Deacetylation. Indian Journal of Science and Technology 16(15): 1118-1125. https://doi.org/ 10.17485/IJST/v16i15.2040

Singh, N., Poonia, T., Siwal, S. S., Srivastav, A. L., Sharma, H. K., & Mittal, S. K. (2022, January 1). Chapter 9 - Challenges of water contamination in urban areas (A. L. Srivastav, S. Madhav, A. K. Bhardwaj, & E. Valsami Jones, Eds.). ScienceDirect; Elsevier. https://www.sciencedirect.com/science/article/abs/pii/B9780323918381000087

Subash, A., Naebe, M., Wang, X., Kandasubramanian, B., (2023) Biopolymer – a sustainable and efficacious material system for effluent removal. J. Hazard. Mater., 443, 130168, 0.1016/J.JHAZMAT.2022.130168

Tavasuria Elangovan, Putri Shareen Rosman, Jimmy Nelson Appaturi, & Rajabathar Jothi Ramalingam. (2023). Effects of Biosorption Technique Using Various Fruit Waste Activated Carbon in Improving Chenderiang River Water Quality. Journal of Advanced Research in Applied Sciences and Engineering Technology, 33(2), 15–24. https://doi.org/10.37934/araset.33.2.1524

Topić Popović, N., Lorencin, V., Strunjak-Perović, I., & Čož-Rakovac, R. (2023). Shell Waste Management and Utilization: Mitigating Organic Pollution and Enhancing Sustainability. Applied Sciences, 13(1), 623. https://doi.org/10.3390/app13010623

Torres, E. (2020). Biosorption: A Review of the Latest Advances. Processes, 8(12), 1584. https://doi.org/10.3390/pr8121584

Wei, X., Qiu, B., Xu, L., Qin, Q., Zhang, W., Liu, Z., Wei, F., & Lv, Y. (2023). High performance hierarchical porous carbon derived from waste shrimp shell for supercapacitor electrodes. Journal of Energy Storage, 62, 106900. https://doi.org/10.1016/j.est.2023.106900

Wid, N., & Alca, I. (2016). Extraction and Characterization of Chitosan from Shrimp Shell Waste in Sabah. ResearchGate. https://www.researchgate.net/publication/312498253_Extraction_and_Characterization_of_Chitosan_from_Shrimp_Shell_Waste_in_Sabah

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