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2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM

THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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EDITORS

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

EFFICIENCY OF WASTEWATER TREATMENT USING ACTIVATED CARBON FROM NEWSPAPER WASTE AND PRAWN SHELL

Tavasuria Elangovan*, Nurul Najiha Mohd Nizam, Qayyum Akmal Alias

Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, Tapah Road, 35400 Perak, Malaysia

**Corresponding author*: *tavasuria@uitm.edu.my; tavasuria@yahoo.com*

Abstract: The increasing concern over environmental waste and the demand for effective adsorbents have led to innovative methods of producing activated carbon from sustainable sources. The activated carbon can eliminate many contaminants, including organic molecules, heavy metals, and chemicals from wastewater. Maintaining good water quality is crucial for preventing waterborne diseases. Hence, this study explores the synthesis and characterization of activated carbon from newspaper and prawn shells waste, as well as the analysis of physicochemical parameters of wastewater before and after treatment for 15 minutes and 30 minutes. The activated carbon was assessed using FTIR spectroscopy to determine its properties. The wastewater taken from Mardec Industrial Latex Sdn. Bhd., Tapah, Perak, was tested on several physicochemical parameters, including dissolved oxygen (DO), biochemical oxygen demand (BOD5), pH, temperature, total suspended solids (TSS), and heavy metals, specifically copper (Cu). The biosorption process employed activated carbon extracted from newspapers and shrimp shells waste. The temperature and dissolved oxygen (DO) were detected using a multiprobe kit, pH was assessed using a pH meter, TSS was determined by using a vacuum pump filtration method, and copper (Cu) concentration was analyzed using Atomic Absorption Spectroscopy (AAS). In conclusion, highly porous activated carbon synthesized from newspaper and prawn shell waste exhibits excellent adsorption capabilities due to its functional groups and compositions, such as chitosan and cellulose, which significantly reduce contaminants in treated wastewater samples. Thus, this study highlights the potential of employing low-cost, environmentally friendly substances for the synthesis of activated carbon in wastewater treatment, thereby enhancing waste management and fostering environmental sustainability.

***Keywords*:** *Activated carbon, newspaper waste, prawn shell, biosorption, wastewater treatment*

INTRODUCTION

Water is the fundamental medium for supporting living organisms, making it the most essential element for the origin of life. Water pollution arises when dangerous substances, including chemicals and microorganisms, contaminate the aquatic ecosystems such as lakes, rivers, aquifers, and the sea. Consequently, water quality declines and can pose risks to both human health and the environment. Water pollution is caused by various factors, including industrial waste, municipal solid waste, marine dumping, untreated sewage and wastewater discharge into water bodies, and the use of chemicals and pesticides in agriculture (Denchak, 2023).

Industrial operations have primarily contributed to water pollution over time (Wastewater Treatment Market Report, n.d.). These operations generate waste containing pollutants and hazardous chemicals that, if inadequately treated, are often discharged into nearby freshwater systems. Though treated wastewater and sewage may still contain dangerous chemicals, bacteria, and pathogens. Bacteria and pathogens can lead to illness and several health issues (Denchak, 2023). Therefore, before being released into the environment, contaminated wastewater from industries must be purified through wastewater treatment. Wastewater can be treated using various techniques, such as chemical, biological, and physical processes (Waste Water Treatment – HSE, n.d.).

Biological treatments, such as biosorption using activated carbon, efficiently improve the taste of water, remove dissolved organic pollutants (Factory, 2024), and a variety of contaminants, including heavy metals (Agico, 2024), chlorides, and odours (Ltp, 2025). To support sustainable waste management, this study aimed to synthesize and characterize activated carbon made from municipal solid waste, particularly newspaper and prawn shell waste. This study aimed to assess the effectiveness of activated carbon in treating wastewater through the biosorption process. Reusing waste contributes to effective waste management and supports the environmentally sustainable biosorption

method for treating contaminated water. Waste from newspapers and prawn shells, which are produced every day as food waste, can be converted into valuable products for water treatment at low or zero cost. This method enhances waste management and mitigates its adverse effects on the environment, water quality, and public health (Waste Water Treatment – HSE, n.d.).

MATERIALS AND METHODS

The newspaper waste and prawn shell waste underwent pretreatment following collection. A potassium hydroxide (KOH) solution was mixed with newspaper waste and soaked for 2 hours at 80°C using a magnetic stirrer. This procedure was conducted to eliminate lignin from newspapers and yield cellulose. The prawn shells were then rinsed with distilled water. Subsequently, they were subjected to pretreatment with sodium hydroxide (NaOH) to remove the protein, followed by hydrochloric acid (HCl) treatment to remove calcium carbonate and minerals from the shells. After these procedures, the prawn shells were cleansed and dried. After the pretreatment of both wastes, the carbonization and activation processes were conducted to produce a mixture of activated carbon derived from newspaper and prawn shell waste.

Carbonization and Activation of Newspaper and Prawn Shell Wastes

The dried pretreated paper waste and prawn shell waste were ground and placed in separate crucibles, which were sealed with crucible lids. The crucibles were then placed inside a muffle furnace set to 400°C for 2 hours. After the heating process, the carbonized newspaper waste powder and prawn shells powder were weighed and allowed to cool in a desiccator (Arulkumar et al., 2012).

Before activation, the carbon powder derived from newspaper waste was mixed equally with prawn shell powder in a 1:1 ratio. In this study, a chemical activating agent, specifically 0.1M Sodium Hydroxide (NaOH), was utilized. A total of 4.24g of the mixture of carbonized newspaper and prawn shell waste was soaked in 200mL of 0.1M NaOH at 85°C for 2 hours using a magnetic stirrer. Thereafter, the pH of the mixture was adjusted to 7.03 by adding hydrochloric acid (HCl). To achieve this, 5mL of 0.5M HCl and 15mL of distilled water were added to neutralize the activated carbon. Following the neutralization, the solution was filtered, and the remaining activated carbon was dried in an oven at 110°C for 12 hours. The sample was then heated in a muffle furnace at 500°C for 2 hours. After removing it from the muffle furnace, the activated carbon was ground and sieved to obtain a uniform particle size. The final product was stored in a centrifuge tube inside a desiccator for future use (Arulkumar et al., 2012). The activated carbon was also analyzed using Fourier Transform Infrared Spectroscopy (FTIR) to identify its properties, such as functional groups, ensuring its effectiveness in the adsorption of pollutants.

Wastewater Treatment Using Biosorption Method and Analysis of Physicochemical Parameters

Wastewater samples were collected at Mardec Industrial Latex Sdn. Bhd., Tapah, Perak, using three cleaned and preserved HDPE bottles. One bottle was preserved with a chemical such as 0.5M nitric acid (HNO_3) for heavy metal testing, while the other bottles were cleaned using distilled water and dried before sample collection. The wastewater was collected, and its colour and odour were recorded in the field. One bottle was wrapped with cloth, and the remaining bottles were stored carefully inside the icebox at 4°C to preserve the samples. They were then brought to the lab for immediate analysis of their temperature and DO using a multiprobe kit, and pH using a pH meter. The five-day BOD (BOD_5) was determined using the DO value (Tavasuria Elangovan et al., 2023) and followed by analysis of TSS, and heavy metals such as Cu using AAS before the treatment. After that, the wastewater samples were treated with activated carbon derived from newspaper and prawn shell waste through the biosorption method. For the treatment process, 0.2g of activated carbon was added to 100mL of the wastewater sample. The activated carbon was soaked with the wastewater sample and stirred for 15 and 30 minutes, respectively, on a magnetic stirrer. After treatment, the samples were filtered, and the same parameters, colour, odour, pH, DO, BOD_5, temperature, Cu and TSS were measured again.

RESULTS AND DISCUSSION

Characterization of Activated Carbon

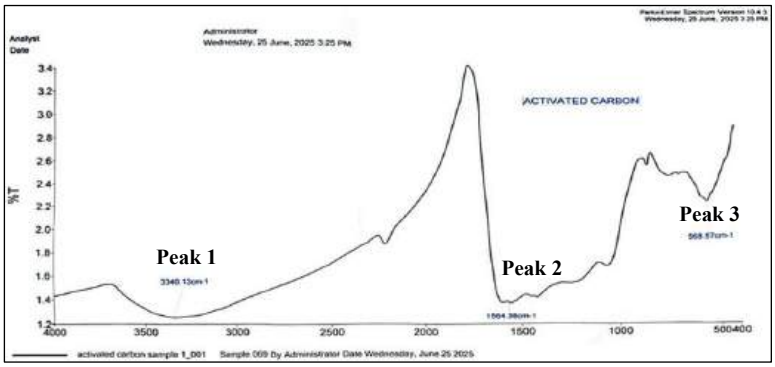

Figure 1. Thermally and Chemically Activated Carbon Powder of Newspaper and Prawn Shell

Based on Figure 1, the FTIR Spectrum showed the distinct functional groups found on thermally and chemically activated carbon that contribute to its surface reactivity and adsorption efficiency. The first main peak is the highest and broadest peak at 3340.13 cm^{-1}, corresponding to O–H bonds (Tavasuria Elangovan & Nunshaimah, 2024). These bonds, representing hydroxyl groups, not only enhance the hydrophilic nature (Ismail et al., 2023; Quintana et al., 2024) but also indicate the blend of cellulose from newspaper and chitosan from prawn shell. This interaction enhances the adsorption properties of activated carbon. The second main peak is at 1564.36 cm^{-1} and is attributed to C=C or C=O stretching. The C=C bond is an unsaturated carbon, and the carbonyl group C=O bond is a common surface oxide that forms during the activation process, which influences the adsorption properties of activated carbon. Meanwhile, the third peak at 568.57 cm^{-1} relates to C–H bending (carbon hydrogen bond), reflecting residual aliphatic structures within the carbon matrix. These findings demonstrate that newspaper and prawn shell activated carbon with diverse oxygenated and aromatic surface groups, which are beneficial for adsorption applications such as dye removal, heavy metal capture, and water treatment.

Analysis of Physicochemical Parameters of Wastewater

Table 1 shows that there is an improvement in the quality of wastewater after the biosorption treatment method using activated carbon compared to before the treatment. The colour and odour of the wastewater sample were enhanced. The pH of the untreated sample is 10, which is more alkaline, but it was reduced to 9.81 after being treated for 30 minutes. This reduction in pH is significant as it indicates a shift towards a more neutral state, which is more conducive to biological processes. Other parameters, such as DO, Cu and TSS values before treatment, showed that the water is polluted and needs further treatment. After being treated for 30 minutes, the value decreased. But the contact time and dosage of activated carbon still need to be increased in the future to reach the standard limit value based on the National Water Quality Standard (Jabatan Alam Sekitar, 2022). BOD_5's value increased after 15 minutes and decreased after 30 minutes of treatment. It showed that the biological oxygen level increased initially due to microbial activity and then reduced after increasing the contact time of adsorption to 30 minutes. Overall findings prove that newspaper and prawn shells activated carbon effectively reduces the pollutants in wastewater.

Table 1. Physicochemical Analysis of Wastewater

Parameter	Before treatment	After 15 minutes	After 30 minutes	NWQS Value	Class	Compliance
Color	White	Grayish white	Grayish white	-	-	-
Odor	Very strong pungent odor	Mild odor	Mild odor	-	-	-
pH	10.00	9.85	9.81	6.5 – 8.5	-	Too alkaline
Dissolved Oxygen (mg/L)	2.63	4.43	4.72	>7	Class III	Slightly polluted
Temperature (°C)	25.5	23.3	22.9	Normal ± 2°C (for Class I–III)	-	Compliant
BOD_5 (mg/L)	1.37	1.82	1.51	1	Class IIA	Clean
Heavy metal (Cu) (mg/L)	0.032	8.111	2.833	Natural levels or absent (<0.02)	Class V	Heavily Polluted
Total Suspended Solid (mg/L)	1629	1829	263	25	Class IV	Polluted

Note: NWQS value adapted from Jabatan Alam Sekitar (2022)

CONCLUSIONS

The treatment of wastewater samples using activated carbon derived from biomass, such as newspaper and prawn shells waste, efficiently treated the wastewater. This is proven through the analysis of physicochemical parameters before and after treatment. The treatment enhanced the colour, odour, and temperature after treatment for 15 and 30 minutes, respectively. The results showed that 87% of Cu and 83.86% of TSS were reduced after treatment for 30 minutes. The DO of wastewater has increased to 79.47% after 30 minutes of treatment. Overall, the optimum contact time of biosorption is 30 minutes, which shows higher efficiency than 15 minutes of treatment. There is no study to determine its sustainability for large-scale production. Thus, it is recommended in future to emphasize the large-scale production of newspaper and prawn shell activated carbon and its effectiveness in treating wastewater.

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SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar