

# **HARMONY IN PROGRESS:**

**INTEGRATING SCIENCE, TECHNOLOGY,  
AND  
SOCIAL INNOVATION  
FOR SUSTAINABLE DEVELOPMENT GOALS**



**e-Book of Extended Abstract  
Negeri Sembilan International (NSIEx) & Research Symposium  
2025**

# **PST016 - FAST, GREEN & CLEAN: 5-MINUTE DYE REMOVAL USING CHICKEN FEATHER ACTIVATED CARBON**

Rozidaini Mohd Ghazi<sup>1\*</sup>, Muhammad Akashah Sehat<sup>1</sup>, Jessie Chai Xin Ying<sup>1</sup>, Nur Annisa Binti Mohd Nazri<sup>1</sup>, Nik Raihan Nik Yusoff<sup>1</sup>, Asanah Radhi<sup>2</sup>, Ikarastika Rahayu Abdul Wahab<sup>3</sup>, and Musfiroh Jani<sup>1</sup>

<sup>1</sup>Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan, Malaysia

<sup>2</sup>Faculty of Bioengineering and Technology, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan

<sup>3</sup>Faculty of Agro-Based Industry, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan

\*Corresponding author: rozidaini@umk.edu.my

## **ABSTRACT**

Water pollution from synthetic dyes such as methylene blue (MB) is a pressing environmental challenge, particularly in textile and related industries. Conventional treatment methods often require long contact times, high chemical usage, and generate secondary waste. In this innovation, we present an eco-friendly, cost-effective, and ultra-fast adsorbent derived from chicken feathers, an abundant agricultural by-product typically discarded as waste. Through a controlled activation process, chicken feathers are transformed into high-surface-area activated carbon (CFAC) with enhanced adsorption capacity. The novelty of this product lies in its ability to achieve 98–100% MB removal within just 5 minutes using only 0.1 g of CFAC in a 5 ppm dye solution. This rapid performance surpasses many commercial activated carbons, offering significant advantages in energy and time efficiency. Furthermore, the use of chicken feathers as the raw material addresses two sustainability goals simultaneously: Clean Water and Sanitation (SDG 6) and Responsible Consumption and Production (SDG 12). The usefulness of this innovation extends to various industrial applications, including textile wastewater treatment, laboratory-scale dye removal, and as a rapid-response solution for accidental dye spills. Its low production cost, minimal dosage requirement, and biodegradability make it suitable for adoption in both developed and developing regions. This innovation demonstrates that waste can be transformed into a powerful environmental solution, proving that clean water can be achieved fast, green, and clean.

**Keywords – chicken feather activated carbon, methylene blue, agricultural by product**

## **INTRODUCTION**

Synthetic dyes such as methylene blue (MB) are widely used in the textile, printing, and paper industries (Paschoalini et al., 2019). Their discharge into water bodies, even at low concentrations, poses serious environmental and health risks due to toxicity, persistence, and resistance to natural degradation. Conventional dye removal methods often involve high operational costs, long treatment times, and generate secondary waste, making them unsuitable for rapid or on-site applications (Kofidis et al., 2018). Among various treatment methods, adsorption has emerged as an efficient and cost-effective technique for dye removal. Activated carbon (AC) is widely utilized due to its high porosity and large surface

area, making it an ideal adsorbent for MB (Paul Chen et al., 2003). However, commercially available AC is expensive, leading to research on alternative low-cost adsorbents derived from agricultural and industrial waste materials (Yadav et al., 2021).

At the same time, agricultural by-products such as chicken feathers are generated in large quantities by the poultry industry (Raji & Pakizeh, 2013). These keratin-rich wastes are typically discarded or incinerated, contributing to landfill accumulation and environmental pollution.

The motivation behind developing this product is to address two environmental challenges simultaneously: water pollution from synthetic dyes and the improper disposal of agricultural waste. By transforming chicken feathers into high-surface-area activated carbon, we create a low-cost, sustainable adsorbent capable of achieving 98–100% methylene blue removal within just 5 minutes using only 0.1 g of material (Sehat, 2025). This innovation offers a fast, green, and clean solution aligned with the principles of the circular economy and the United Nations Sustainable Development Goals (SDGs).

## OBJECTIVE

- i. To evaluate the adsorption performance of the developed activated carbon for methylene blue dye removal.
- ii. To promote waste valorisation by converting agricultural by-products into high-value environmental remediation materials.

## DESCRIPTION OF THE PROJECT

The developed product is an activated carbon (AC) derived from chicken feathers, a keratin-rich agricultural by-product that is often discarded as waste. It possesses a high surface area, a porous structure, and is both lightweight and eco-friendly. Only 0.1 g of this material is required for treatment, and it can achieve 98–100% removal of methylene blue (MB) within just 5 minutes, making it a highly efficient adsorbent. Remarkably, it can also achieve up to 99% removal at concentrations as high as 250 ppm within 1 hour using the same dosage, demonstrating its exceptional adsorption capacity (Figure 1).

In terms of functionality, this AC offers rapid adsorption of synthetic dyes, particularly methylene blue, from contaminated water. It works effectively at low dye concentrations (5 ppm) with minimal adsorbent usage. The presence of keratin protein from the chicken feathers enhances its surface properties, improving dye binding efficiency. Furthermore, it can be used in both batch and portable filtration systems, allowing flexibility in application.

The product is highly useful from an environmental and economic standpoint. It significantly reduces water pollution by efficiently removing toxic dyes, while also addressing waste management by valorising chicken feather waste and reducing landfill burden. Its low-cost raw materials and minimal dosage requirement make it affordable for large-scale use. Industrially, it is relevant for textile wastewater treatment, small-scale dye laboratories, and emergency dye spill clean-ups.

In terms of practicality, the AC is lightweight and easy to transport, making it ideal for use in rural or remote areas. Its preparation and application are straightforward, requiring no

advanced technical training. The production process is scalable for commercial or community-level applications and is compatible with existing wastewater treatment systems, ensuring ease of integration into current practices.

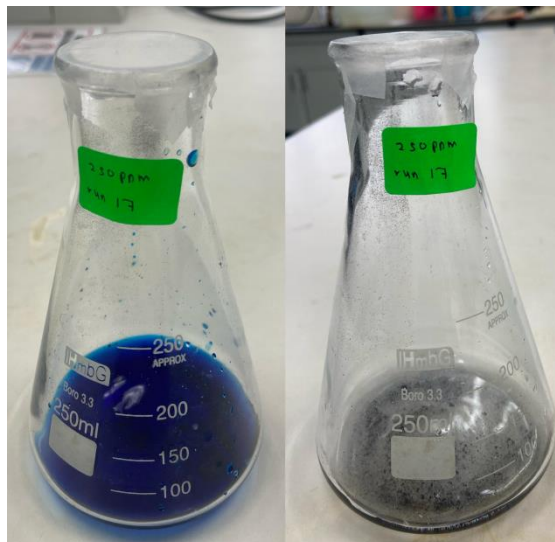


Figure 1: Adsorption of MB at an initial concentration of 250 mg/L.

## NOVELTY

This product uniquely utilises keratin-rich chicken feathers to produce eco-friendly activated carbon capable of removing 98–100% methylene blue in just 5 minutes at 5 ppm, and up to 99% removal at 250 ppm within 1 hour using only 0.1 g. The combination of rapid adsorption, high capacity, minimal dosage, and sustainable waste valorisation makes it a rare dual-performance solution in dye wastewater treatment.

## CONCLUSION

The developed chicken-feather activated carbon (CFAC) offers a sustainable, low-cost, and highly efficient solution for dye-contaminated wastewater treatment. It demonstrates exceptional performance, achieving 98–100% methylene blue removal within 5 minutes at low concentrations and up to 99% removal at high concentrations (250 ppm) within 1 hour using only 0.1 g of adsorbent. By transforming agricultural waste into a high-value product, this innovation addresses both environmental pollution and waste management challenges, aligning strongly with SDG 6 and SDG 12. The CFAC's combination of rapid action, high adsorption capacity, and environmental sustainability makes it a practical and impactful advancement for cleaner water systems.

## REFERENCES

- Kofidis, T., Strüber, M., Wilhelmi, M., Anssar, M., Simon, A., Harringer, W., & Haverich, (2018). Reversal of severe vasoplegia with single-dose methylene blue after heart transplantation. *The Journal of Thoracic and Cardiovascular Surgery*, 122(4), 823–824.
- Paul Chen, J., Yoon, J. T., & Yiacoumi, S. (2003). Effects of chemical and physical properties of influent on copper sorption onto activated carbon fixed-bed columns, 41(8), 1635–1644.
- Paschoalini, A. L., Savassi, L. A., Arantes, F. P., Rizzo, E., & Bazzoli, N. (2019). Heavy metals accumulation and endocrine disruption in *Prochilodus argenteus* from a polluted neotropical river, 169, 539–550.
- Sehat, M.A. (2025). BSc Thesis. Universiti Malaysia Kelantan.
- Yadav, A., Sharma, P., Asit Baran Panda, & Vinod Kumar Shahi. (2021). Photocatalytic TiO<sub>2</sub> incorporated PVDF-co-HFP UV-cleaning mixed matrix membranes for effective removal of dyes from synthetic wastewater system via membrane distillation. *Journal of Environmental Chemical Engineering*, 9(5), 105904–105904.