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# Production and Characterization of Biochar Pellets from Cassava Starch and Plasma-Produced Carbon Black as Adsorbents for Methylene Blue Removal from Water

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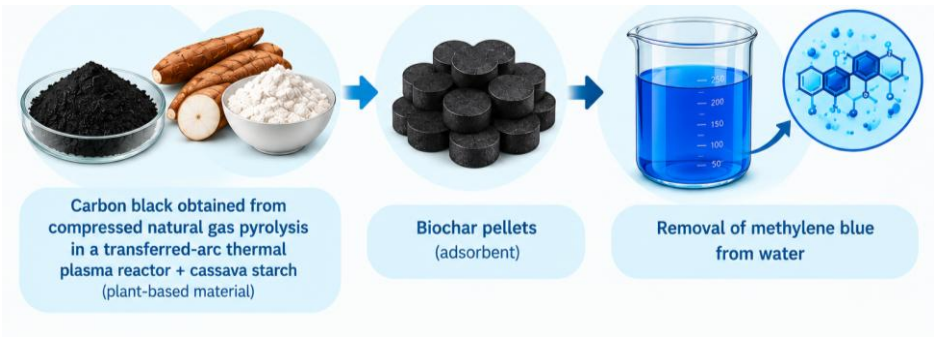
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## Introduction

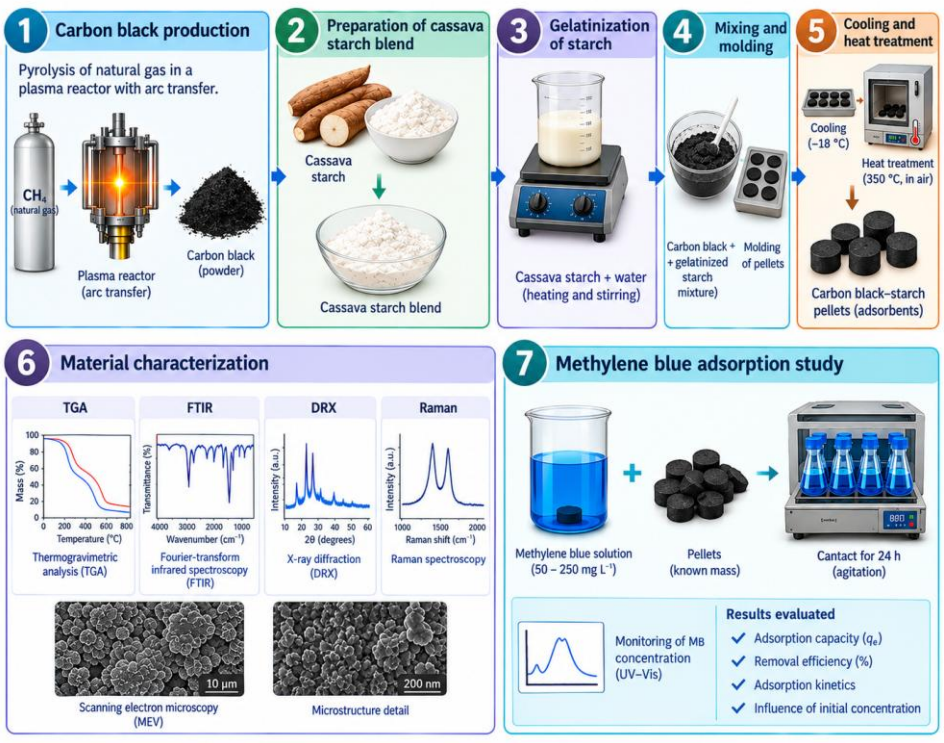
The removal of organic dyes from contaminated water requires adsorbent materials that combine high adsorption efficiency with easy recovery after treatment. Although carbonaceous powders are promising for this purpose, their fine particulate nature can complicate handling and separation from aqueous media. In this work, biochar pellets based on cassava starch and plasma-produced carbon black were prepared and evaluated as macroscopic adsorbents for methylene blue removal from water.

## Goals

Develop and characterize carbon black obtained from compressed natural gas pyrolysis in a transferred-ar thermal plasma reactor and cassava starch biochar pellets for the removal of methylene blue from water.




## Methodology




## Results

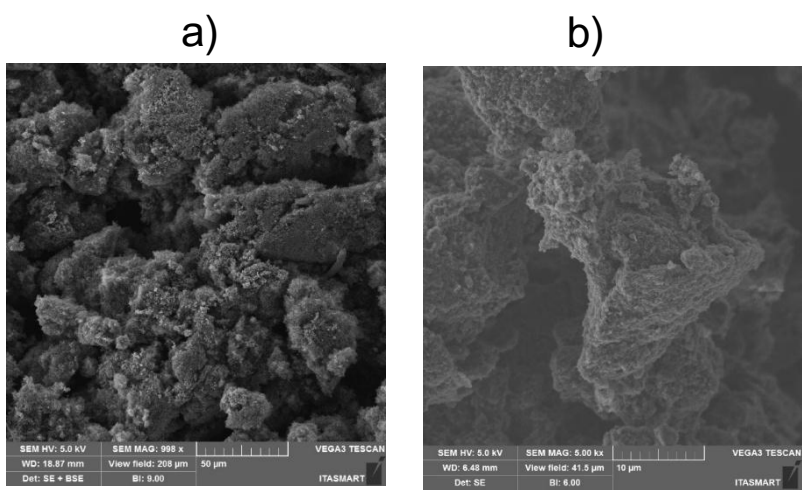



**Figure 1:** SEM micrographs of (a) untreated carbon black (CBM) and b) the cassava starch/carbon black composite pellet thermally treated at 350 °C (CBMC350).

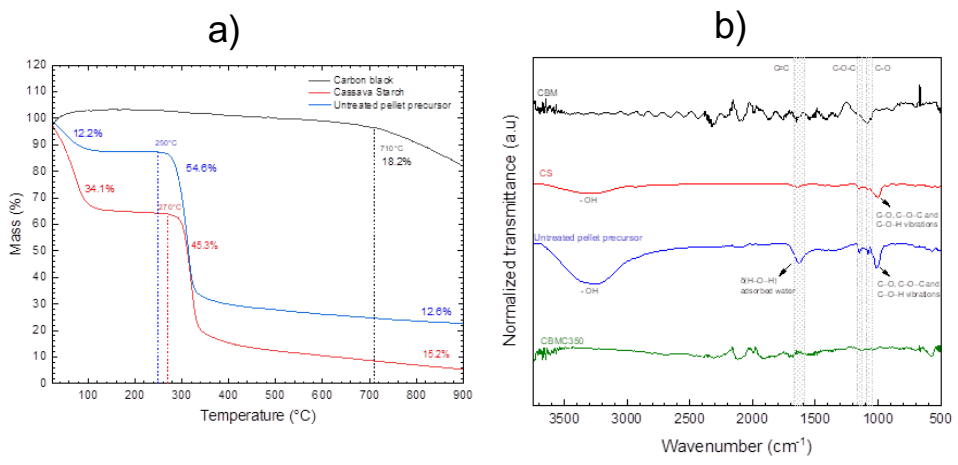



**Figure 2:** Thermogravimetric curves of plasma-derived carbon black, cassava starch, and the untreated carbon black–cassava starch pellet precursor (a) and , Normalized ATR–FTIR spectra of plasma-derived carbon black, native cassava starch, the untreated carbon black–cassava starch pellet precursor, and the pellet treated at 350 °C.

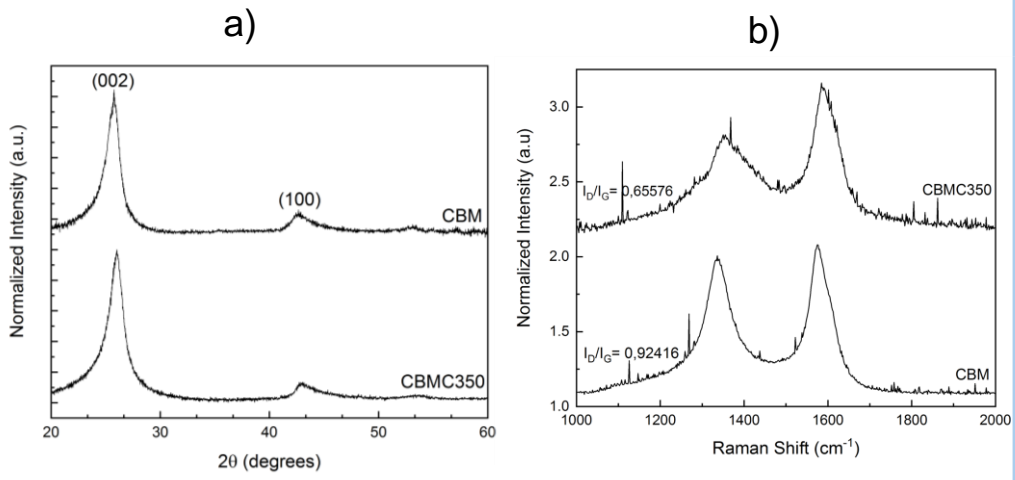



**Figure 3:** X-ray diffraction pattern of the carbon black–cassava starch pellet thermally treated at 350 °C (CBMC350) (a) and Normalized Raman spectra of untreated carbon black (CBM), carbon black thermally treated at 350 °C (CBM350), and the cassava starch/carbon black composite pellet thermally treated at 350 °C (CBMC350) (b).

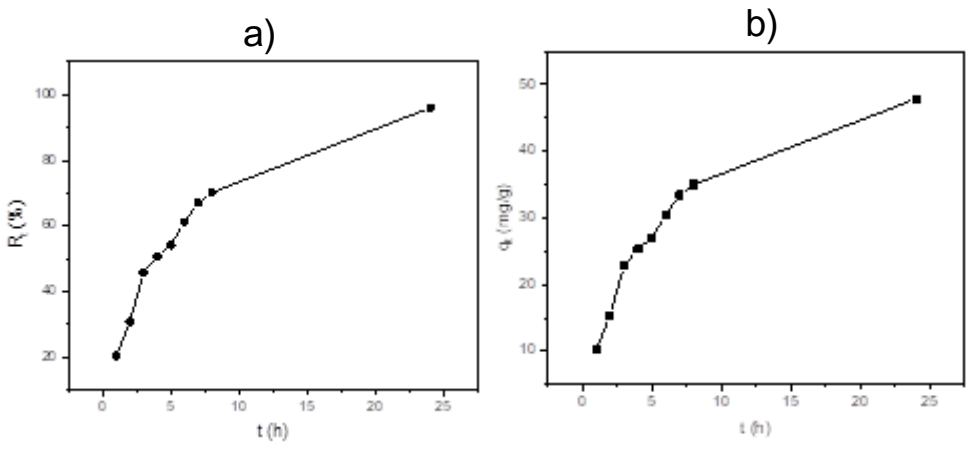



**Figure 4:** Time-dependent methylene blue adsorption by CBMC350 pellets, expressed as (a) removal efficiency ($R_t$) and (b) adsorption capacity ($q_t$).

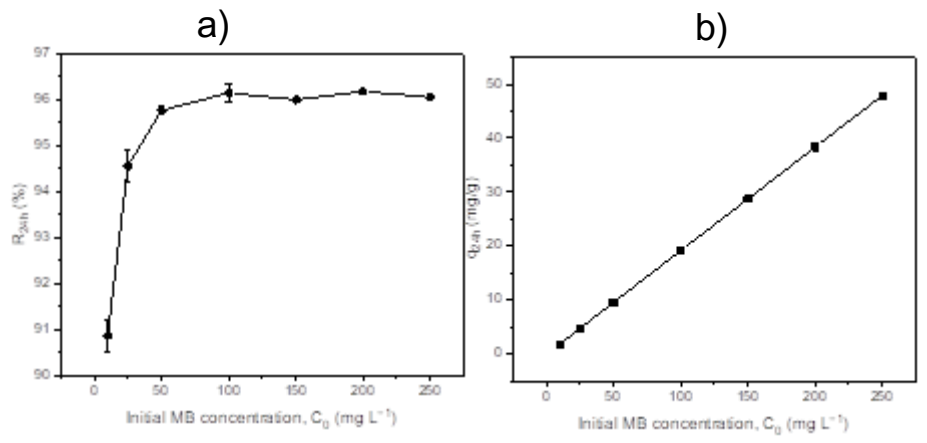



**Figure 5:** Effect of the initial methylene blue concentration ($C_0$) on (a) removal efficiency after 24 h ($R_{24h}$) and (b) adsorption capacity after 24 h ($q_{24h}$) for CBMC350 pellets.

## Conclusions

The results therefore support CBMC350 as a proof-of-concept macroscopic adsorbent with substantial methylene blue uptake under the evaluated conditions, while longer contact times, higher dye loadings, and independent adsorption replicates remain necessary for definitive kinetic and equilibrium assessment.

## References and Acknowledgments

G. Martínez Cadena, D. Vargas Hernández, D. L. Villegas Coronado, J. C. Tánori Córdova, and A. D. Maldonado Arce, “Synthesis, characterization, and application of carbon black nanoparticles in the removal of methylene blue dye,” *Adsorption 2024 31:1*, vol. 31, no. 1, pp. 8-, Dec. 2024, doi: 10.1007/S10450-024-00566-4.

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