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Methylene Blue removal using different wastes from agricultural activities

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Introduction

Water treatment is required due to the use of dyes in multiple industries, such as food, paper, textile, and cosmetic industries [1] [2].
Methylene blue (MB) (Fig. 1) is a cationic dye mainly used in the textile industry. Exposure to this dye can be harmful, it could cause nausea, vomiting, mental disturbances, and eye injuries. It also prevents sunlight from entering the water, which harms the development of life in the aquatic environment [3].
Different methods are available for removing dyes from water, including adsorption, mainly in activated carbons (AC). The cost of AC prevents its use as a routine method [4]. Furthermore, the utilization of agricultural wastes, such as coconut shell (CS) or cork (CK) (Fig. 2), makes it an eco-friendly and low-cost method.

Materials

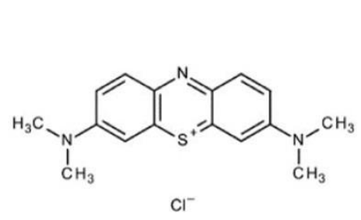

Fig. 1. Molecular structure of methylene blue

Fig. 2. Coconut shell and cork used

Methods

In this research, MB was removed from aqueous solutions using CS and CK. All adsorbents were prepared following the steps shown in Fig. 3.
A kinetic study was carried out, putting a constant mass of adsorbents (25 mg) in equilibrium with 25 mL of the MB solution, with 75 mg/L.
The suspensions were placed in a thermo shaker, at 298 K under an agitation speed of 20 $r \cdot min^{-1}$, for different times. The isotherms were obtained after contact time of 24h andthe influence of pH and temperature was also evaluated.
The MB was quantified by spectrophotometry at 669 nm.

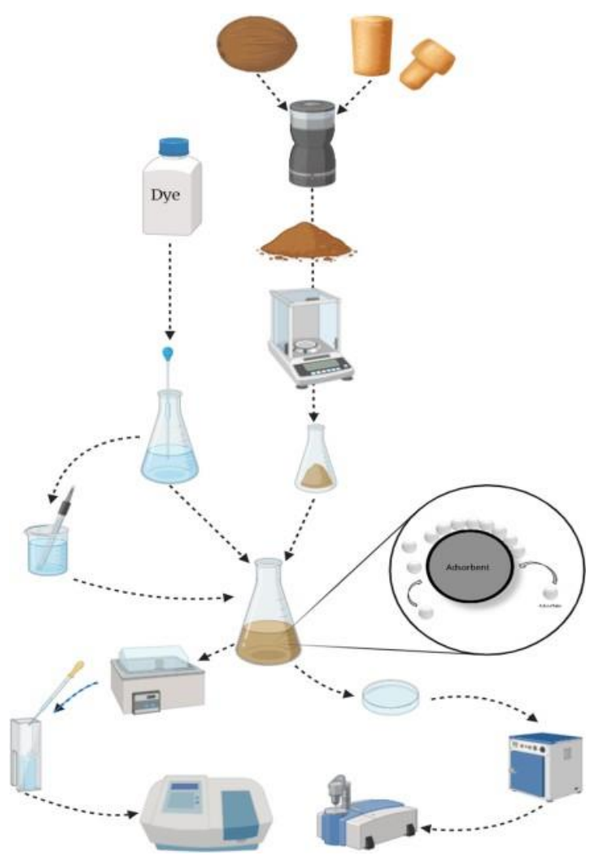

Fig. 3. Steps involving preparation of adsorbents, removal of MB from solution and quantification

Results/ Discussion

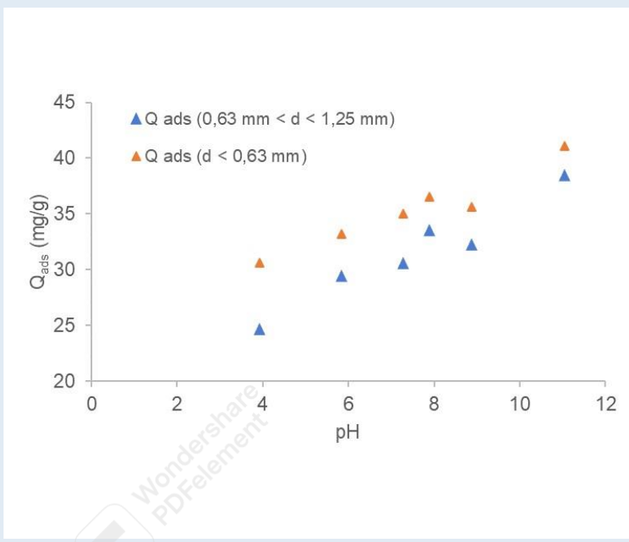

Fig. 4. Influence of pH on MB adsorption

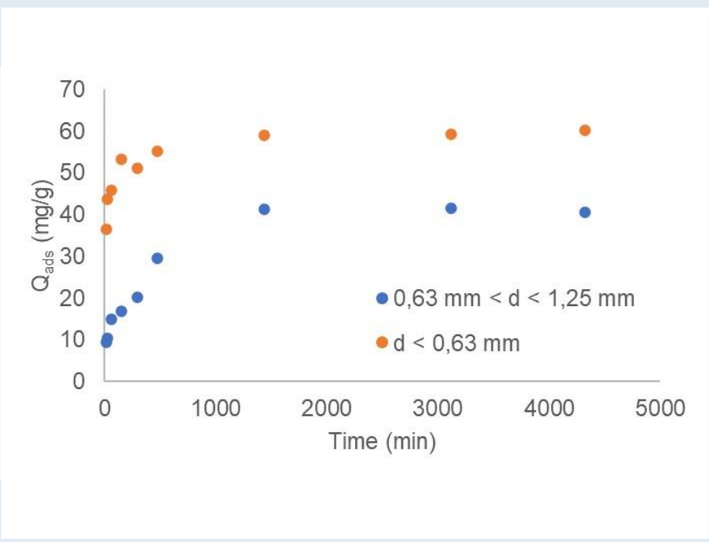

Fig. 5. Kinetic study of MB adsorption on coconut shell with different grain sizes

MB adsorption was performed at the pH around 6 and 10 for CS and CK, respectively.
The influence of adsorbent granulometry allows us to state that the adsorbent with low granulometry presents a high adsorption capacity.
The temperature had no effect on the MB adsorption on CS but the MB adsorption on CK was an exothermic process.
The CS showed a considerable adsorption capacity for MB (124,29 mg/g) which was significantly superior to that achieved with CK (77,97 mg/g).

Conclusion

Agriculture wastes, such as CS and CK, demonstrated high efficiency in the MB removal from the liquid phase.
The biomass used are low-cost adsorbent, which present a potential for future implementation on wastewater treatment, mainly in rural areas in underdeveloped countries.

References

[1] Yadav, K., Ramesh Latelwar, S., Datta, D., Jana, B., (2023) Efficient removal of MB dye using litchi leaves powder adsorbent: Isotherm and kinetic studies, Journal of the Indian Chemical Society, 100, (4), 100974, https://doi.org/10.1016/j.jics.2023.100974.
[2] Xue H., Wang X., Xu, Q., Dhaouadi, F., Sellaoui L., Seliem, M., Lamine, A., Belmabrouk, H., Bajahzar, A., Bonilla-Petriciolet, A., Li, Z., Li, Q., (2022) Adsorption of methylene blue from aqueous solution on activated carbons and composite prepared from an agricultural waste biomass: A comparative study by experimental and advanced modelling analysis, Chemical Engineering Journal, 430, Part 2, 132801, https://doi.org/10.1016/j.cej.2021.132801.
[3] Bingül, Z., (2022) Determination of affecting parameters on removal of methylene blue dyestuff from aqueous solutions using natural clay: Isotherm, kinetic, and thermodynamic studies, Journal of Molecular Structure, 1250, Part 1, 131729, https://doi.org/10.1016/j.molstruc.2021.131729.
[4] Cansado, I.P.P., Geraldo, P.F., Mourão, P.A.M., Castanheiro, J.E., Carreiro, E. and Suhas. (2024) Utilization of biomass waste at water treatment. Resources, 37, 1-13.