Sugarcane bagasse as a strategy for the sustainable development of magnetic adsorbents for dye remediation

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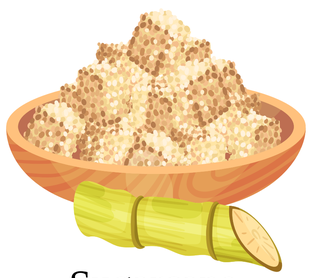
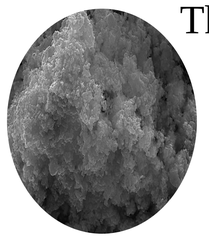
INTRODUCTION



Sugarcane bagasse

Hydrothermal Carbonization

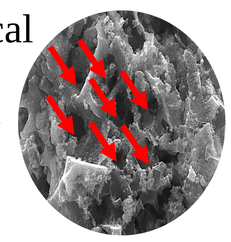
Magnetic Nanoparticles



Magnetic Carbon (MC)

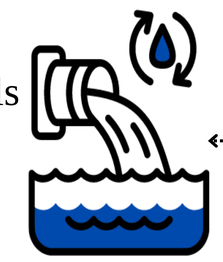
Thermochemical Activation

KOH



Magnetic Activated Carbon (MAC)

Porous Materials for Adsorption



Methylene Blue Dye

Textile Industry

Relation to Green Chemistry

* Safety products;

* Renewable raw materials;

* Atom economy;

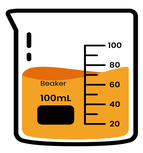
OBJECTIVE

Evaluate the structure and texture of these KOH-activated materials and their performance in the adsorption of the methylene blue dye (MB).

MATERIALS AND METHODS

MC production

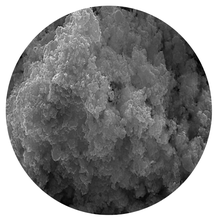
Sugarcane bagasse



Iron (III) nitrate

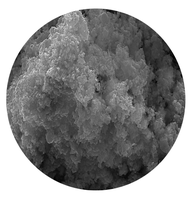
Hydrothermal Carbonization

230 °C, 12 h

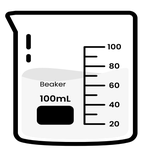


MC

MAC production



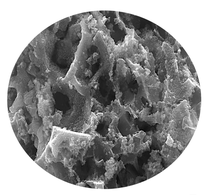
MC



KOH

Thermochemical Activation

700 °C, 1:2 and 1:4 (w:w)



MAC-2 and MAC-4

Characterization

Structural and textural analysis

- *Functional groups:*

Fourier Transform Infrared Spectroscopy (FTIR).

- *Surface area:*

N_2 Adsorption-Desorption Isotherm (BET and BJH)

Application

Methylene Blue Adsorption

- 1.00 g L^{-1} of MC and MACs in MB solution (300 mg L^{-1});
- Stirring at 180 rpm for 4 h;
- MB determined by UV-Vis Spectrophotometry in λ = 664 nm.

RESULTS AND DISCUSSION

✓ Structural and textural analysis

- 3600 - 3125 cm^{-1}: O-H vibrations modes;
- 2290 - 2820 cm^{-1}: Symmetrical and asymmetric stretching of C-H bonds;
- 1735 cm^{-1}: C=O of the ketone and aldehyde groups;
- 1600 - 1511 cm^{-1}: related to the vibrations of C=C bonds;
- 1200 - 950 cm^{-1}: overlap of several bands but are mainly attributed to C-O-C vibrations of bonds;
- 550 cm^{-1} and 440 cm^{-1}: stretching of Fe-O.
- Activation in the 1:2 ratio provided a greater specific surface area than the 1:4 ratio.

Table 1. Specific surface area (a_{BET}), pore volume (v_p) and adsorptive capacities (q_e) from MB.

Materials	a_{BET} ($m^2\ g^{-1}$)	v_p ($cm^3\ g^{-1}$)	q_e (mg g^{-1})
MC	52.7	0.19	40.2
MAC-2	319.6	0.27	181.8
MAC-4	168.9	0.30	84.0

Magnetic

✓ Batch adsorption experiment

Activation with KOH in a ratio of 1:2 (MAC-2) showed significant adsorptive capacity of MB. Activation in a ratio 1:4 (MAC-4) was less effective.

CONCLUSION

Production of MAC with KOH in a 1:2 ratio was promising due to the presence of oxygenated functional groups, high specific surface area and adsorption capacity, while activation in a 1:4 ratio resulted in the destruction of some pores. The reuse of bagasse contributes to sustainable development and the circular bioeconomy.

REFERENCES

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