ECP 2025 Conference

The 4th International Electronic Conference on Processes

20–22 October 2025 | Online

MDPI

Screening of raw materials from agricultural and forestry activities for application in the removal of dyes from water

Isabel Pestana Paixão Cansado[1,2], Pedro F. Geraldo[1,3], Paulo A.M. Mourão[1,2], José Eduardo Castanheiro[1,2]

[1]MED—Mediterranean Institute for Agriculture, Environment and Development & Change – Global Change and Sustainability Institute, Polo da Mitra 7000-083, Nª Srª da Tourega, Évora, Portugal

[2]University of Évora, Chemistry and Biochemistry Department, School of Sciences and Technology, Rua Romão Ramalho nº 59, 7005-671 Évora, Portugal

[3]University of Licungo, Avenida Julius Nverere, Campus de Coalane, Bloco II, nº 1621, R/C, CP. 106, Mozambique

INTRODUCTION

The adulteration of water and wastewater, as a result of the intense human, industrial and agricultural activities, is becoming a very serious problem. Depending on the water and wastewater characteristics, a diversity of physical, chemical, biological and combined processes can be used on its treatment.

The presented work was motivated by the search for a low-cost and efficient adsorbent for dye removal from wastewater. Although ACs in general have superior performance in removing pollutants (dyes, pesticides, drugs) [1] when compared to their precursors and other natural adsorbents. However, to improve the ACs textural properties and their performance in methylene blue (MB) removal from water, these were submitted to a modification process involving the introduction of nitrogen into their matrix during the activation procedure.

METHOD

ACs were prepared by chemical activation with KOH and simultaneously modified with urea, such as illustrated in Figure 1.

The adsorbents were characterized physically and texturally, using a diversity of techniques, such as, EA, adsorption of nitrogen and FTIR analysis.

Figure 1 – Illustration of the experimental procedure used

CONCLUSION

Screening a diversity of low-cost, available raw materials allows for the identification of those that present a high adsorption capacity, directly or after being converted into ACs, for MB removal from water.

ACs in general have superior performance in removing pollutants (dyes, pesticides, drugs) when compared to their precursors. However, the introduction of nitrogen, from urea, improved their textural properties their performance in methylene blue (MB) removal from water.

The high MB adsorption capacity of these adsorbents allow to proposed them for the removal pesticides, pharmaceuticals and dyes, from wastewater.

RESULTS & DISCUSSION

ACs produce were characterized by FTIR, as shown in Figure 1, nitrogen adsorption, determination of pHpzc and elemental analyses.

The activation promote the lost of carboxylic groups. However, the addition of nitrogen didn't seems to induce a significant chemical surface change, but it promote the development of textural properties.

These adsorbent were tested for the removal of methylene blue from water, and the some data are presented in Table 1.

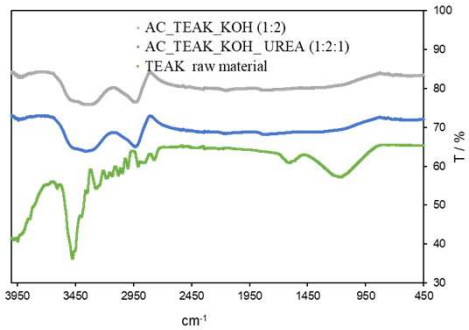

Figure 2 – FTIR spectra of different ACs, prepared from Teak, with KOH and urea

Table 1 – MB adsorption capacity of ACs, produced from a Teak and coconut shell under different activation conditions and different MB initial concentrations

Adsorbents	$[MB]_i$ (mg/L)	Contact time / min.	MB (mg/g)	MB (%)
AC_Teak_KOH_1:1	52.5	2880	99.4	84.4
AC_Teak_KOH_1:2	52.5	2880	128.0	99.9
AC_Teak_KOH_Urea (1:1:0.5)	52.5	2880	125.5	99.9
AC_Teak_KOH_urea (1:1:1)	52.5	2880	130.6	99.8
AC_CS_KOH_urea (1:2:1)	72	1440	157.1	86.1

The change in the ratio between precursor/KOH from 1:1 to 1:2 promote an increase on the MB removal from water from 99.4 to 128 mg/g (Table 1).

The adition of urea promote an increase in the MB adsorption amount on almost all ACs evaluated.

FUTURE WORK / REFERENCES

[1] Cansado, I.P.P., Geraldo, P.F., Mourão, P.A.M., Castanheiro, J.E., Carreiro, E.P., and Suhas. Utilization of Biomass Waste at Water Treatment. *Resources*, vol. 13, no. 3, Mar. 2024, doi: 10.3390/resources13030037.