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Preparation of high surface area activated carbon from waste-biomass of sunflower piths: Kinetics and equilibrium studies on the dye removal

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Highlights

- Use of waste sunflower pith as a precursor for activated carbon for the first time.
- High surface area AC prepared by NaOH and KOH (2690 $m^2 g^{-1}$ and 2090 $m^2 g^{-1}$).
- Microstructure of the SP in its natural form are shown by micro-computed tomography.
- Carbonization leads to SP into thin, separated carbon flakes of 200 nm thickness.
- Meso and micropores in the N-SPAC lead to a high MB adsorption (965.349 mg/g)

Abstract

Sunflower pith (SP), a vast agricultural waste is herein used as a precursor material for highly porous low density activated carbon production. Porosity and flake-like microstructure of the SP in its natural form are shown by micro-computed tomography (Micro-CT). Carbonization process turns the SP into thin, separated carbon flakes of 200 nm thickness. Two types of alkaline based chemical activation with KOH and NaOH are performed to yield SP based activated carbon (AC), K-SPAC and N-SPAC, respectively. Microstructural changes upon carbonization and activation process are elaborated by RAMAN, FTIR and SEM analyses. BET Surface area of the NaOH-activated N-SPAC was calculated as 2690 m^2/g and was higher than KOH-activated K-SPAC with 2090 m^2/g. Maximum adsorption capacity of N-SPAC was calculated as 965mg/g whereas it was 580 mg/g for K-SPAC. Adsorption kinetic studies for N-SPAC revealed that at a low initial concentration of dye (500 mg/L), the pseudo first-order kinetic model was predictive. On the other hand, at high initial MB concentration (1000 mg/L), the results indicate that the adsorption kinetics follow the Elovich model with intraparticle diffusion as one of the rate-determining steps.
In conclusion, overall results suggest that thanks to its highly porous microstructure, the SP is an alternative renewable AC precursor choice for dye removal applications.

Keywords: Sunflower pith, Char, Activated Carbon, CTscan, Adsorption