Adsorption of congo red and methylene blue dyes on an ashitaba waste and a walnut shell-based activated carbon from aqueous solutions: Experiments, characterization and physical interpretations

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Abstract

Activated carbons were prepared from ashitaba waste and a walnut shell to study the adsorption mechanism of congo red and methylene blue dyes in aqueous solution. These adsorbents were characterized via XRD, FTIR and SEM techniques and the dye adsorption isotherms at three temperatures were quantified. A statistical physics model was applied to interpret the adsorption mechanism of tested dyes and adsorbents. Modeling results showed that these dyes were practically separated in the solution leading to an absence of the aggregation process. Adsorption orientations of dye molecules on the adsorbents changed depending on the temperature and nature of systems. The adsorption capacity of ashitaba waste activated carbon for the removal of congo red was significant thus indicating strong interactions between this dye and tested adsorbent. Calculated adsorption energy varied from 7.25 to 20.43 kJ/mol and they showed that the adsorption of both adsorbates occurred via physical interactions at different temperatures where the removal process was endothermic.

Keywords: Ashitaba waste, Walnut Shell, Methylene blue, Congo red, Physical modeling, activated carbon.