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Assessment of vegetable wastes for basic violet 14 removal: role of sorbent surface chemistry and porosity

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ABSTRACT

In this work, two vegetable wastes (i.e. grape stalks and cork bark) have been investigated as potential sorbents for the removal of the dye basic violet 14 or commonly named basic fuchsin from aqueous solution. The physical and chemical properties of grape stalks and cork bark defined by elemental analysis, polarity index, acidic functional groups, FTIR analysis, surface area and porosity were investigated to explain the different sorption behaviour of these two sorbents towards basic fuchsin removal. Effect of solution pH on basic fuchsin sorption onto both vegetable wastes has been investigated and sorption kinetics and isotherms determined. Results have been compared to those obtained using a commercial activated carbon. Langmuir maximum sorption capacity of grape stalks (106.8 mg g^{-1}) estimated by the orthogonal distance regression method was of similar magnitude to that obtained by activated carbon (158.5 mg g^{-1}) but cork bark (29.9 mg g^{-1}) resulted to be about five times less effective than activated carbon. The textural results indicate that grape stalks and cork bark present a remarkable macropore surface area with a minor contribution of mesopores. The large pore size exhibited by both sorbents surface seems to be unable to efficiently uptake such small basic fuchsin molecules. The lower sorption capacity shown by cork bark compared to that of grape stalks may be explained by surface chemistry effects. Basic fuchsin sorption is not favoured by the presence of acidic functional groups on the sorbent surface. Acidic groups such as hydroxyl groups may promote the formation of hydration clusters that effectively reduce and/or hinder electrostatic and π interactions between basic fuchsin and the sorbents surface. FTIR analysis revealed that lignin moieties on the sorbents surface play a significant role on the dye sorption. As a final remark, the knowledge of some physical and chemical properties of the sorbents can be helpful for predicting their sorption affinity for organic pollutants.

Keywords: Basic fuchsin; Cork bark; Grape stalks; Activated carbon; FTIR; Lignin moieties; π interactions; Orthogonal distance regression method

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