

ADSORPTION OF BINARY MIXTURE OF CATIONIC AND ANIONIC DYES ONTO UNTREATED BANANA PEELS AND ACTIVATED CARBON PRODUCED FROM BANANA PEELS

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ABSTRACT

The existence of dyes in wastewater is very harmful because of their toxicity, carcinogenicity, and mutagenicity. Among the methods used for the removal of dyes from wastewater (advanced oxidation processes, membrane filtration etc.), adsorption is considered superior due to its simplicity and effectiveness towards a wide range of dyes [1]. Regarding the adsorbents used for water treatment, commercial activated carbon (AC) has been extensively used revealing very good adsorption capacity [2]. Due to its high cost, there is a tension to use as adsorbents agricultural by-products or produce AC by chemical and/or physical modification. One such example is banana peels. Although the simultaneous adsorption of more than one dyes on various adsorbents has extensively been studied [3],[4], no effort has been reported for the potential use of banana peels. In the present work, the interaction mechanisms involved in the simultaneous adsorption of the cationic dye Methylene blue (MB) and the anionic dye Orange G (OG) onto two types of adsorbents: untreated banana peels (BP), and activated carbon produced from banana peels (BPAC), are studied. Physicochemical treatment was performed to find the most efficient BPAC for the adsorption of the mixture of MB and OG and the highest adsorption capacity was obtained with NaOH treatment and pyrolysis temperature of 700 °C (BPAC-NaOH-700). The adsorbents were characterized by BET, Hg Porosimetry, SEM and ATR-FTIR. A parametric analysis was carried out by examining the effect of pH, initial dye concentration, contact time and temperature on the adsorption capacity of BP and BPAC-NaOH-700. For BP, the adsorption capacity was found to be $q_{max,1}=37.61$ mg/g for MB and $q_{max,2}=16.39$ mg/g for OG, while for BPAC-NaOH-700 it was found that $q_{max,1}=323.23$ mg/g for MB and $q_{max,2}=76.16$ mg/g for OG. The higher values of $q_{max,i}$ for BPAC-NaOH-700 are in agreement with the high values of S_{BET} ($S_{BET}=524$ m²/g for BPAC-NaOH-700 and $S_{BET}=0$ m²/g for BP). The results indicate that low-cost adsorbents fabricated from untreated BP are capable of removing pollutants from wastewater, and their adsorption capacity is enhanced profoundly when porous BPAC of high specific surface area is used.

KEYWORDS: Binary adsorption, Dyes, Banana peels, Activated carbon

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