



Efficiency of dye adsorption by biochars produced from residues of two rice varieties, Japanese *Koshihikari* and Vietnamese *IR50404*

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ABSTRACT

Adsorption of Methylene Blue (MB) and Bromocresol Green (BG) were examined by using biochars produced from rice residues, straw and husk of Japanese *Koshihikari* and Vietnamese *IR50404* rice varieties, to evaluate their capacity to adsorb dyes and possible adsorption mechanism. Cationic MB dye was more effectively adsorbed than anionic BG dye by all biochars examined. Vietnamese *IR50404* biochars showed higher capacity of adsorption of two dyes than Japanese *Koshihikari* biochars, approximately about 1.5 times for MB and 1.7 times for BG. In varying pH from 2 to 10, alkaline condition increased adsorption of cationic MB dye - approximately by 27.7–33.5% for rice straw biochars and by 86.2–92.2% for rice husk biochars; albeit a slight decrease in adsorption of anionic BG dye by 27.2–32.9% for rice straw biochars and by 47–70.6% for rice husk biochars. The pH experimental results indicated the existence of negative charges in the biochars and their electrostatic interaction with dyes. The adsorption kinetic study supported intra-particle diffusion of dyes, proceeding via a complex mechanism consisting of both surface adsorption and intra-particle transport within the pores of biochars. Thermodynamic analysis of adsorption suggested that the process was spontaneous with negative ΔG^0 values and endothermic with positive ΔH^0 values ($\Delta G^0 = 35.27\text{--}41.94$ kJ/mol; $\Delta H^0 = 3.92\text{--}23.69$ kJ/mol). This paper discussed possible explanation of dye adsorption with physisorption through porous diffusion, hydrogen bonding, $\pi\text{--}\pi$ interaction or $\pi^+\text{--}\pi$ interaction, common to both anionic and cationic dyes, with additional electrostatic interaction for cationic dyes with biochars in aqueous solution.

Keywords: Biochar; Adsorption; Rice straw; Rice husk; Methylene Blue; Bromocresol Green

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