FCP: From biomass waste to activated carbon for removal of methylene blue from the aqueous environment

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Abstract

Adsorption of organic pollutants onto activated carbons, especially based on plant waste, has a good interest by scientists due to its low cost and less energy consumption. This study deals with the development of activated carbon based on FCP powder by phosphoric acid (H_3PO_4) activation, named AC-FCP, and their application as adsorbents of methylene blue dye. Due to their high toxicity, the dye content in wastewater must be within tolerable limits before their discharge into the aquatic environment. With a small quantity, these dyes can diffuse over a large surface of an aquatic environment causing inhibition of photosynthesis by depriving light penetration into the water. The activated carbon obtained was characterized by physicochemical methods like Brunauer-Emmett-Teller (BET) theory, morphological studies (SEM), Energy dispersive X-ray (EDX), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), complementary analyses and thermodynamics. The effects of various parameters on removal efficiency and adsorption capacity of methylene blue onto AC-FCP were studied by testing the effect of the mass, initial concentration, contact time, pH, and temperature. The characterization of AC-FCP shows that our activated carbon has a high surface area charged negatively, a microporous and mesoporous structure, and an amorphous structure. The removal efficiency is at 99,28 % with an adsorption capacity of 72.58 $mg.g^{-1}$ in a contact time of 110 min. the adsorption mechanism is favorable, and reversible, forming a monolayer with a chemosorption mechanism which is defined by The Langmuir isotherm and Pseudo-second-order kinetic. Our activated carbon AC-FCP has the best characteristics for the high removal of toxic dyes like methylene blue in aqueous environments with low cost and less energy.

Keywords: FCP, Adsorption, kinetics, methylene blue