

Adsorption of anionic dyes on corn stalks modified with polyaniline: kinetics and thermodynamic studies

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Nowadays particular attention is given to synthesis of new adsorbents – composites, based on plant wastes which covered by polyaniline. For example, these composites can improve the adsorption capacity of raw plant wastes toward anionic dyes. Kinetic and thermodynamic studies of dye adsorption on new adsorbents – composites are needed for their broad and effective implementation in the practice of wastewater treatment. Besides, mathematical modeling of adsorption bases on experimental kinetic curves and adsorption isotherms and allows getting information about the mechanism of adsorption.

The aim of this paper was to analyze kinetics and thermodynamics of adsorption of anionic dyes (Acid Red (AR) and Acid Orange (AR)) on adsorbent – composite CS-PAN (corn stalks, modified with polyaniline and doped with H_3PO_4), using different models and to suggest the mechanism of adsorption of anionic dyes on CS-PAN.

The studies have shown that the optimal time of adsorption of anionic dyes on CS-PAN at 303 and 313 K are 150 min and at 328 K – 120 min. The experimental adsorption kinetic curves of anionic dyes on CS-PAN were examined by pseudo-first-order and pseudo-second-order kinetic models and by external and intra-particle diffusion models. The experimental adsorption capacity values were in agreement with values of the theoretical adsorption capacity that were calculated with the pseudo-second order model. High values of correlation coefficients (> 0.99) were obtained for the pseudo-second-order kinetic model, the external and intra-particle diffusion models. This means, that anionic dyes are transported from the solution to the surface of CS-PAN occurs in several steps such as external or film diffusion, pore diffusion, surface diffusion and adsorption on the pore surface, or a combination of more than one step through the adsorption process.

It was showed that adsorption of anionic dyes on CS-PAN better described by the Langmuir adsorption isotherm equation than the Freundlich adsorption isotherm equation. Thermodynamic adsorption parameters were calculated and the mechanism of adsorption of anionic dyes on the adsorbent-composite was proposed. Thus, adsorption of anionic dyes on CS-PAN is as a result of electrostatic interactions, where forces of interaction are the physical forces in adsorption reactions (e.g. dipole-dipole, dispersion, London-van der Waals and H-bonding) between anionic dyes and imino-groups of CS-PAN.