

ABSTRAK

STUDI ADSORPSI SERBUK KULIT NANAS TERAKTIVASI ASAM OKSALAT DALAM MENYERAP RHODAMINE B SEBAGAI BAHAN AJAR MATERI IKATAN KIMIA

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Rhodamine B merupakan zat warna *xanthene* kationik yang banyak digunakan pada industri tekstil, sulit terdegradasi, dan berpotensi mencemari lingkungan, khususnya perairan. Penelitian ini bertujuan untuk menentukan model isoterm, kinetika, kapasitas adsorpsi, dan efisiensi penggunaan serbuk kulit nanas teraktivasi asam oksalat dalam menurunkan konsentrasi Rhodamine B. Adsorben dikarakterisasi dengan *Fourier Transform Infrared Spectroscopy* (FTIR) dan *Scanning Electron Microscope* (SEM) untuk mengidentifikasi gugus fungsi dan morfologi permukaan. Proses adsorpsi dilakukan dengan mencari pengaruh pH, waktu kontak, massa adsorben, dan konsentrasi awal larutan Rhodamine B terhadap persen *removal* zat warna dan kapasitas adsorpsi. Hasil penelitian menunjukkan adsorpsi Rhodamine B oleh serbuk kulit nanas teraktivasi asam oksalat optimum terjadi pada kondisi pH 10, waktu kontak 50 menit, massa adsorben 0,07 g, dan konsentrasi awal Rhodamine B 3,5 mg/L. Data kesetimbangan adsorpsi lebih sesuai digambarkan oleh model isoterm Freundlich ($R^2 = 0,9878$) yang mengindikasikan proses adsorpsi bersifat heterogen dan *multilayer* dengan nilai energi bebas (E) pada isoterm Dubinin-Randushkevich (D-R) sebesar 2,017 kJ/mol. Kapasitas adsorpsi maksimum teoretis (q_{max}) berdasarkan Langmuir diperoleh sebesar 2,9994 mg/g. Analisis kinetika menunjukkan proses adsorpsi lebih sesuai model *pseudo-second order* (PSO) ($R^2 = 0,998$; $q_{e\text{ cal}} = 0,3613$ mg/g). Selain itu, efisiensi serbuk kulit nanas teraktivasi asam oksalat dalam menyerap Rhodamine B menghasilkan persen *removal* sebesar 90%. Dengan demikian, serbuk kulit nanas-asam oksalat dapat dimanfaatkan sebagai adsorben biomassa lignoselulosa yang efektif dalam menghilangkan limbah cair zat warna.

Kata kunci: Adsorpsi, Isoterm, Kinetika, Nanas, Rhodamine B

ABSTRACT

STUDY ADSORPTION OF RHODAMINE B ONTO OXALIC ACID-ACTIVATED PINEAPPLE PEEL POWDER AS TEACHING MATERIAL FOR CHEMICAL BONDING TOPICS

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Rhodamine B is a cationic xanthene dye widely used in the textile industry; it is resistant to degradation and poses a potential risk of environmental pollution, particularly in aquatic ecosystems. This study aimed to determine the isotherm model, kinetics, adsorption capacity, and efficiency of using oxalic acid-activated pineapple peel powder to reduce Rhodamine B concentrations. The adsorbent was characterized using Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) to identify functional groups and surface morphology. The adsorption process was evaluated by examining the effects of pH, contact time, adsorbent mass, and initial Rhodamine B solution concentration on dye removal percentage and adsorption capacity. The results indicated that the optimal adsorption of Rhodamine B by the oxalic acid-activated pineapple peel powder occurred at pH 10, a contact time of 50 minutes, an adsorbent mass of 0.07 g, and an initial Rhodamine B concentration of 3.5 mg/L. Adsorption equilibrium data were best described by the Freundlich isotherm model ($R^2 = 0.9878$), indicating a heterogeneous, multilayer adsorption process, with a free energy value (E) of 2.017 kJ/mol derived from the Dubinin-Radushkevich (D-R) isotherm. The theoretical maximum adsorption capacity (q_{max}) based on the Langmuir model was 2.9994 mg/g. Kinetic analysis showed that the adsorption process followed the pseudo-second-order (PSO) model ($R^2 = 0.998$; $q_{e\text{ cal}} = 0.3613$ mg/g). Furthermore, the oxalic acid-activated pineapple peel powder achieved a 90% removal efficiency for Rhodamine B. Thus, this material can serve as an effective lignocellulosic biomass adsorbent for the removal of dye-containing wastewater.

Keywords: Adsorption, Isotherm, Kinetic, Pineapple, Rhodamine B