

SINTESIS KOMPOSIT MAGNETIT/SELULOSA/KITOSAN SEBAGAI ADSORBEN ZAT WARNA MALASIT HIJAU

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INTISARI

Sintesis komposit magnetit/selulosa/kitosan sebagai adsorben zat warna malasit hijau telah dilakukan. Selulosa diisolasi dari kayu akasia (*Acacia mangium*) secara kimia melalui serangkaian proses, meliputi delignifikasi dengan basa kuat NaOH 15% (b/v), pemutihan (*bleaching*) dengan NaOCl 3% (b/v), dan hidrolisis dengan HCl 2,5 M. Selulosa hasil isolasi digabungkan dengan magnetit menggunakan metode kopresipitasi dan NH₄OH 25% (v/v) dimanfaatkan sebagai agen pengendap. Material magnetit/selulosa yang terbentuk dicampurkan dengan gel kitosan kemudian ditetaskan ke dalam NaOH 0,7 M. Komposit magnetit/selulosa/kitosan hasil sintesis dikarakterisasi menggunakan instrumen *Fourier Transform Infra-Red Spectroscopy* (FTIR), *X-Ray Diffraction* (XRD), *Scanning Electron Microscope Energy Dispersive X-Ray Spectrometer* (SEM-EDX), dan *Vibrating Sample Magnetometer* (VSM). Kajian mengenai kinetika adsorpsi, isoterm adsorpsi, dan termodinamika adsorpsi komposit magnetit/selulosa/kitosan terhadap zat warna malasit hijau dilakukan melalui optimasi kondisi adsorpsi dengan memvariasikan pH larutan, waktu kontak adsorpsi, konsentrasi awal adsorbat, dan suhu adsorpsi.

Hasil karakterisasi menunjukkan bahwa sintesis komposit magnetit/selulosa/kitosan telah berhasil dilakukan. Komposit hasil sintesis memiliki sifat magnetik yang dibuktikan dengan kemampuannya dalam merespon medan magnet eksternal, sehingga pemisahan adsorben setelah proses adsorpsi dapat dilakukan dengan lebih mudah. Kajian adsorpsi menunjukkan bahwa proses adsorpsi zat warna malasit hijau oleh komposit magnetit/selulosa/kitosan optimum terjadi pada pH 5 dan mengikuti model kinetika orde kedua-semu Ho-McKay dengan konstanta laju adsorpsi 0,010 g mg⁻¹ menit⁻¹. Isoterm adsorpsi mengikuti model isoterm Langmuir dengan nilai K_L 0,018 L mol⁻¹ dan kapasitas adsorpsi maksimum 128,205 mg g⁻¹. Parameter termodinamika menunjukkan bahwa proses adsorpsi terjadi secara spontan dan bersifat endotermis.

Kata kunci: adsorpsi, komposit magnetit/selulosa/kitosan, malasit hijau

SYNTHESIS OF MEGNETITE/CELLULOSE/CHITOSAN COMPOSITES AS MALACHITE GREEN DYE ADSORBENT

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ABSTRACT

Synthesis of magnetite/cellulose/chitosan composite as malachite green dye adsorbent has been done. Cellulose was isolated from *Acacia mangium* wood through a series of chemical processes, including delignification with 15% NaOH (w/v), bleaching with 3% NaOCl (w/v), and hydrolysis with 2.5 M HCl. The isolated cellulose was combined with magnetite using the coprecipitation method, where 25% NH₄OH (v/v) served as the precipitating agent. The resulting magnetite/cellulose material was mixed with a chitosan gel and subsequently dropped into 0.7 M NaOH. The synthesized magnetite/cellulose/chitosan composite was characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), Scanning Electron Microscope Energy Dispersive X-Ray Spectrometer (SEM-EDX), and Vibrating Sample Magnetometer (VSM). Adsorption studies, including adsorption kinetics, isotherms, and thermodynamics, were performed by optimizing adsorption conditions through variations in solution pH, contact time, initial adsorbate concentration, and adsorption temperature.

Characterization results confirmed the successful synthesis of the magnetite/cellulose/chitosan composite. The synthesized composite exhibited magnetic properties, as demonstrated by its responsiveness to an external magnetic field, enabling easier separation of the adsorbent post-adsorption. Adsorption studies revealed that the optimal adsorption of malachite green dye occurred at pH 5 and followed the pseudo-second-order kinetic model proposed by Ho-McKay, with an adsorption rate constant of 0.010 g mg⁻¹ min⁻¹. The adsorption isotherm followed the Langmuir model, with a K_L value of 0.018 L mol⁻¹ and a maximum adsorption capacity of 128.205 mg g⁻¹. Thermodynamic parameters indicated that the adsorption process was spontaneous and endothermic.

Keywords: adsorption, magnetite/cellulose/chitosan composites, malachite green