

## **SYNTHESIS OF CHITOSAN/ZEOLITE/MAGNETITE COMPOSITE AND THE APPLICATION AS ADSORBENT OF Zn(II) IN AQUEOUS SOLUTION**

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### **ABSTRACT**

Synthesis of chitosan/zeolite/magnetite composite as adsorbent for Zn(II) decontamination has been conducted. Synthesis was started by modification of activated-zeolite with pure magnetite using coprecipitation method, then modified with cross-linked chitosan by glutaraldehyde. Composite was characterized using Fourier Transform Infrared (FTIR), X-Ray Diffractometer (XRD), Vibrating Sample Magnetometer (VSM), and Transmission Electron Microscope (TEM). The effect of pH value of Zn(II), contact time, and Zn(II) concentration on adsorption of composite toward Zn(II) were investigated. The kinetics data of adsorption process were analyzed by four models, such as Santosa and Muzakky first order adsorption, Lagergren pseudo-first order adsorption, Langmuir and Hinshelwood adsorption and Ho pseudo-second order adsorption. Adsorption isotherms were determined using Langmuir and Freundlich isotherm equation. As a magnetic material, recovery capability of chitosan/zeolite/magnetite composite was examined using external magnet.

FTIR characterization showed that the functional groups of chitosan/zeolite/magnetite composite consist of chitosan, zeolite, and magnetite functional groups combination, Si-O, R-NH<sub>2</sub>, -OH and Fe-O respectively. XRD showed that the crystallinity of magnetite in chitosan/zeolite/magnetite composite decreased. Hysteresis curve of VSM showed the reduction of magnetic properties significantly from pure magnetite to zeolite/magnetite composite and chitosan/zeolite/magnetite composite. TEM image showed that chitosan/zeolite/magnetite composite has smaller size compared to zeolite/magnetite composite. Adsorption kinetic of chitosan/zeolite/magnetite composite toward Zn(II) followed Ho and Mckay pseudo-second order with reaction rate constant (k) was  $7.087 \times 10^{-3}$  g/mg.min, while Freundlich isotherm model with adsorption capacity value was 44.642 mg/g or  $6.828 \times 10^{-4}$  mol/g respectively. Recovery of examination showed that chitosan/zeolite/magnetite composite was rapidly and easily separated from Zn(II) solution after adsorption using external magnet.

Keywords: Chitosan, Zeolite, Composite, Adsorption, Magnetite

## SINTESIS KOMPOSIT KITOSAN/ZEOLIT/MAGNETIT DAN APLIKASI SEBAGAI ADSORBEN UNTUK Zn(II) DI DALAM LARUTAN

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### INTISARI

Sintesis komposit kitosan/zeolit/magnetit sebagai adsorben untuk mendekontaminasi ion Zn(II) di dalam larutan telah dilakukan. Sintesis komposit diawali dengan modifikasi zeolit alam teraktivasi dengan magnetit kemudian dimodifikasi dengan kitosan tertaut silang glutaraldehid. Komposit dikarakterisasi dengan *Fourier Transform Infrared* (FTIR), *X-Ray Diffractometer* (XRD), *Vibrating Sample Magnetometer* (VSM), dan *Transmission Electron Microscope* (TEM). Kinetika adsorpsi komposit kitosan/zeolit/magnetit terhadap logam Zn(II) dikaji dalam 4 model kinetika yaitu orde satu Santosa dan Muzakky, orde satu semu Lagergren, orde dua Langmuir dan Hinshelwood, dan orde dua semu Ho dan McKay. Isoterm adsorpsi komposit kitosan/zeolit/magnetit dipelajari menggunakan persamaan isoterm adsorpsi Langmuir dan Freundlich. Sebagai material yang mengandung magnetit, dilakukan uji recovery material komposit kitosan/zeolit/magnetit setelah adsorpsi menggunakan medan magnet eksternal.

Uji FTIR menunjukkan gugus-gugus fungsional pada material komposit kitosan/zeolit/magnetit terdiri dari gabungan kitosan, zeolit, dan magnetit yaitu Si-O, R-NH<sub>2</sub>, -OH and Fe-O. Uji kristalinitas dengan XRD menunjukkan penurunan kristalinitas magnetit dalam komposit kitosan/zeolit/magnetit. Kurva histeresis VSM yang semakin pendek antara magnetit murni, komposit zeolit/magnetit, dan komposit kitosan/zeolit/magnetit menunjukkan penurunan sifat kemagnetan. Uji morfologi dengan TEM menunjukkan bahwa ukuran partikel komposit kitosan/zeolit/magnetit lebih kecil dibandingkan dengan komposit zeolit/magnetit. Kinetika adsorpsi Zn(II) oleh komposit kitosan/zeolit/magnetit mengikuti kinetika orde dua semu Ho dan McKay dengan nilai K sebesar  $7,087 \times 10^{-3}$  g/mg.menit dan mengikuti Isoterm adsorpsi Freundlich dengan nilai kapasitas adsorpsi sebesar 44,642 mg/g atau  $6,828 \times 10^{-4}$  mol/g. Uji recovery menunjukkan komposit kitosan/zeolit/magnetit dapat dipisahkan dengan mudah dan cepat menggunakan medan magnet eksternal.

Kata kunci: Kitosan, Zeolit, Komposit, Adsorpsi, Magnetit