

SINTESIS SILIKA GEL TERIMOBILISASI DITIZON DARI ABU DASAR BATUBARA DAN APLIKASINYA UNTUK ADSORPSI ION LOGAM Zn(II)

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INTISARI

Penelitian sintesis silika gel terimobilisasi ditizon dari abu dasar batubara dan aplikasinya untuk adsorpsi ion logam Zn(II) telah dilakukan. Penelitian ini bertujuan untuk mensintesis silika gel dari abu dasar batubara, mengimobilisasi ditizon pada silika gel dan mengaplikasikan material tersebut untuk adsorpsi ion logam Zn(II) dengan variasi pengaruh pH, massa adsorben, waktu kontak, dan konsentrasi awal dari ion logam terhadap efektivitas adsorpsi.

Penelitian diawali dengan preparasi dan aktivasi abu dasar batubara. Abu dasar batubara yang telah teraktivasi digunakan untuk proses sintesis silika gel. Silika gel yang dihasilkan diimobilisasi dengan ditizon dalam medium NaOH. Karakterisasi terhadap material dilakukan dengan *Scanning Electrone Microscop* (SEM), Spektrofotometri Serapan Atom (AAS), Spektroskopi Inframerah (FTIR), dan Difraksi Sinar-X (XRD). Adsorpsi ion logam Zn(II) dilakukan pada variasi pH, massa adsorben, waktu kontak, dan konsentrasi awal larutan ion logam Zn(II). Konsentrasi ion logam Zn(II) dalam larutan sebelum dan setelah adsorpsi ditentukan menggunakan AAS.

Hasil karakterisasi menunjukkan bahwa sintesis silika gel dan immobilisasi ditizon pada permukaan silika gel telah berhasil dilakukan ditandai dengan adanya situs aktif berupa gugus siloksan, silanol, -SH, -NH, serta adanya mineral kuarsa dan ditizon. Kondisi optimum adsorpsi ion logam Zn(II) dengan silika gel dan silika gel terimobilisasi ditizon diperoleh pada pH 4, massa adsorben berturut-turut yaitu 0,01 dan 0,02 g, waktu kontak 60 dan 30 menit, serta konsentrasi awal ion logam Zn(II) sebesar 80 mg L⁻¹. Adsorpsi ion logam Zn(II) menggunakan silika gel dan silika gel terimobilisasi ditizon mengikuti model kinetika orde kedua semu dengan nilai konstanta laju berturut-turut yaitu 0,369 dan 0,186 g mg⁻¹ min⁻¹. Adsorpsi ion logam Zn(II) menggunakan silika gel dan silika gel terimobilisasi ditizon mengikuti model isoterm Langmuir dengan kapasitas adsorpsi (q_m) yang dihasilkan berturut-turut sebesar 17,06 dan 40,98 mg g⁻¹. Kapasitas adsorpsi ion logam Zn(II) dengan silika gel terimobilisasi ditizon yang lebih besar menunjukkan bahwa immobilisasi ditizon pada permukaan silika gel mampu meningkatkan kapasitas adsorpsi.

Kata kunci: adsorpsi, abu dasar batubara, ditizon, logam Zn²⁺, silika gel

***SYNTHESIS OF DITHIZONE IMMOBILISED SILICA GEL FROM
BOTTOM ASH AND ITS APPLICATION TO ADSORPTION OF Zn(II)
METAL IONS***

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ABSTRACT

This study of synthesis of dithizone immobilised silica gel from bottom ash and its application to adsorption of Zn(II) metal ions was aimed at synthesise and characterize silica gel from coal bottom ash, to determine the effect of adsorbent weight, pH, contact time, and concentration of metal ions on the adsorption of Zn(II) metal ions from silica. coal bottom ash gel, tested the activity of dithizone-immobilized silica gel from coal bottom ash on adsorption of Zn(II) metal.

This research was begun with the preparation of coal bottom ash and its activation using HCl. The activated coal bottom ash (CBA) was used for silica gel synthesis process. The resulting silica gel was used for ditionon immobilization in NaOH medium. CBA before activation, after activation, and silica gel were characterized by Scanning Electrone Microscop (SEM), Atomic Absorption Spectrophotometry (AAS), Infrared Spectroscopy (FTIR), and X-ray Diffraction (XRD). Dithizone-immobilized silica gel was characterized by SEM, FTIR and XRD. Adsorption of Zn(II) metal ions was carried out at various pH, adsorbent mass, contact time, and initial concentration of Zn(II) metal ion solution. The concentration of Zn(II) metal ions in the solution was determined using AAS.

The characterization results show that the synthesis of silica gel and dithizone immobilization on the surface of silica gel has been successfully obtained as indicated by the presence of active sites of siloxane, silanol, -SH, -NH groups, as well as the presence of quartz and dithizone minerals. The optimum conditions for the adsorption of Zn(II) metal ions with silica gel before and after dithizone immobilization were obtained at pH 4, adsorbent mass of 0.01 and 0.02 g, contact time of 60 and 30 minutes, and initial concentration of Zn(II) metal ions of 80 mg L⁻¹. Adsorption of Zn(II) metal ions using silica gel and ditionon-immobilized silica gel followed a pseudo second-order kinetics model with rate constant values of 0.369 and 0.186 g mg⁻¹ min⁻¹, respectively. Adsorption of Zn(II) metal ions using silica gel and ditionon-immobilized silica gel followed the Langmuir isotherm model, possibly forms a single layer with the resulting adsorption capacity (qm) of 17.06 and 40.98 mg g⁻¹ respectively. The greater adsorption capacity of Zn(II) metal ions with ditionon-immobilized silica gel indicates that the immobilization of ditionon on the silica gel surface has increased the adsorption capacity.

Keywords: adsorption, coal bottom ash, dithizone, metal ion Zn²⁺, silica gel