

SINTESIS SILIKA GEL BERBASIS ABU DASAR BATUBARA-PASIR SILIKA DAN PEMANFAATANNYA SEBAGAI ADSORBEN ION LOGAM Cu(II)

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INTISARI

Penelitian mengenai sintesis silika gel dari abu dasar batubara-pasir silika dan pemanfaatannya sebagai adsorben ion logam Cu(II) telah dilakukan. Abu dasar batubara-pasir silika diaktivasi dengan HCl lalu direaksikan dengan NaOH sampai terbentuk natrium silikat kemudian ditambahkan HCl hingga diperoleh silika gel. Karakterisasi adsorben dilakukan dengan XRF, FTIR, dan XRD. Kajian parameter adsorpsi Cu(II) oleh adsorben silika gel abu dasar batubara-pasir silika (SGADPS), antara lain optimasi pH, massa adsorben, waktu kontak, dan konsentrasi awal adsorbat, sedangkan kajian desorpsinya meliputi interaksi dengan HCl 0,1 M, Na₂EDTA 0,1 M, NaNO₃ 0,1 M, dan akuabides. Kandungan Cu(II) dalam filtrat dianalisis dengan AAS.

Berdasarkan hasil karakterisasi adsorben, sejumlah pengotor berhasil dihilangkan melalui proses aktivasi dan sintesis. Komponen utama silika gel hasil sintesis adalah unsur Si sebesar 84,44% dengan situs aktif berupa gugus silanol dan siloksan, serta bersifat amorf sesuai hasil XRF, FTIR, dan XRD. Adsorpsi optimum Cu(II) oleh SGADPS terjadi pada pH 4, massa adsorben 0,15 g, waktu kontak 60 menit, dan konsentrasi awal 50 mg L⁻¹. Kinetika adsorpsi Cu(II) oleh SGADPS mengikuti orde dua semu dengan konstanta laju sebesar 3,17 g mg⁻¹ menit⁻¹. Isoterm adsorpsi mengikuti isoterm Langmuir dengan kapasitas adsorpsi sebesar 28,33 mg g⁻¹ dan energi adsorpsi sebesar 30,38 kJ mol⁻¹. Desorpsi Cu(II) dari SGADPS didominasi oleh HCl 0,1 M lalu diikuti oleh Na₂EDTA 0,1 M yang membuktikan adanya adsorpsi kimia antara adsorben dengan adsorbat.

Kata kunci: abu dasar batubara-pasir silika, adsorpsi, Cu(II), silika gel

SYNTHESIS OF SILICA GEL BASED ON COAL BOTTOM ASH-SILICA SAND AND ITS UTILIZATION AS AN ADSORBENT FOR Cu(II) METAL ION

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ABSTRACT

Research on the synthesis of silica gel from coal bottom ash-silica sand and its utilization as an adsorbent for Cu(II) metal ions has been carried out. Coal bottom ash-silica sand was activated with HCl, and then reacted with NaOH until sodium silicate was formed, after which HCl was added to obtain silica gel. The adsorbents were characterized using XRF, FTIR, and XRD. The study of Cu(II) adsorption parameters by silica gel coal bottom ash-silica sand (SGADPS) included optimization of pH, adsorbent mass, contact time, and initial concentration of adsorbate, while the desorption studies included interactions with 0.1 M HCl, 0.1 M Na₂EDTA, 0.1 M NaNO₃, and double-distilled water. The Cu(II) content in the filtrate was analyzed using AAS.

Based on the results of adsorbent characterization, several impurities were successfully removed through the activation and synthesis processes. The main component of the synthesized silica gel was 84.44% Si with active sites in the form of silanol and siloxane groups, and was amorphous according to the results of XRF, FTIR, and XRD. The optimum adsorption of Cu(II) with SGADPS occurred at pH 4, adsorbent mass of 0.15 g, contact time of 60 min, and initial concentration of 50 mg L⁻¹. The adsorption kinetics of Cu(II) by SGADPS followed a pseudo-second order with a constant rate of 3.17 g mg⁻¹ min⁻¹. The adsorption isotherm followed the Langmuir isotherm, with an adsorption capacity of 28.33 mg g⁻¹ and an adsorption energy of 30.38 kJ mol⁻¹. Desorption of Cu(II) from SGADPS was dominated with 0.1 M HCl followed by Na₂EDTA 0.1 M, which proved the chemical adsorption between SGADPS and Cu(II) ions.

Keywords: adsorption, coal bottom ash-silica sand, Cu(II), silica gel