



## **SORPSI Au(III)/Cu(II)/Ni(II) PADA MATERIAL MAGNETIK PASIR BESI TERLAPIS SILIKA-KITOSAN**

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### **INTISARI**

Sorpsi Au(III)/Cu(II)/Ni(II) pada material magnetik pasir besi terlapis silika-kitosan (PB/Sil/Kit) yang disintesis melalui metode *sol-gel* telah dilakukan. Material magnetik pasir besi (PB) dilapisi silika termodifikasi kitosan dengan cara mencampurkan PB dan natrium silikat ke dalam larutan kitosan disertai pengadukan hingga terbentuk gel. Karakterisasi gugus fungsional PB/Sil/Kit dilakukan dengan *Fourier Transform Infrared* (FTIR). Analisis morfologi permukaan adsorben dilakukan dengan *Scanning Electron Microscopy* (SEM) yang didukung dengan analisis kandungan unsur menggunakan *Energy-dispersive X-ray spectroscopy* (EDX). Adsorpsi dilakukan dalam tiga seri sistem yaitu Au(III)/Cu(II), Au(III)/Ni(II), dan Au(III)/Cu(II)/Ni(II) pada pH 5 selama 60 menit. Konsentrasi ion logam tiap sistem divariasi pada 25 - 300 mg/L. Konsentrasi Au(III) sebelum dan sesudah adsorpsi dianalisis dengan spektroskopi serapan atom (SSA). Isoterm adsorpsi dikaji dengan isoterm Langmuir dan Freundlich. Desorpsi Au(III) dilakukan terhadap dua model larutan (limbah elektronik dan limbah pengrajin emas) menggunakan tiourea-HCl. Variasi konsentrasi logam kompetitor digunakan untuk mengetahui persentase Au(III) yang terdesorpsi dengan adanya kompetitor logam Cu(II) dan Ni(II).

Berdasarkan analisis gugus fungsi, serapan karakteristik Fe-O pada  $570,9\text{ cm}^{-1}$  dan Si-O-Fe pada  $794,6\text{ cm}^{-1}$  mengindikasikan pelapisan silika terhadap PB dan bilangan gelombang  $1087,8\text{ cm}^{-1}$  menunjukkan ikatan antara silika dengan kitosan pada gugus Si-O-C. Serapan pada  $3448,7\text{ cm}^{-1}$  menunjukkan adanya gugus -OH dan -NH dari kitosan. Analisis kandungan unsur menunjukkan bahwa PB/Sil/Kit mengandung unsur N, Si, O, dan Fe. Hasil kajian isoterm adsorpsi Langmuir menunjukkan bahwa adsorben selektif terhadap logam Au(III) dengan nilai kapasitas adsorpsi berturut-turut sebesar 381,67; 338,98; dan 272,47 mg/g dalam sistem Au(III)/Cu(II), Au(III)/Ni(II), dan Au(III)/Cu(II)/Ni(II). Proses desorpsi juga menunjukkan bahwa tiourea-HCl selektif untuk desorpsi Au(III). Nilai persentase desorpsi sebesar 84,5% untuk model sistem limbah elektronik dan 91,3% untuk model sistem limbah pengrajin emas.

Kata kunci : adsorpsi, desorpsi, emas, pasir besi, silika, kitosan



## **SORPTION OF Au(III)/Cu(II)/Ni(II) ONTO IRON SAND MAGNETIC MATERIAL COATED SILICA-CHITOSAN**

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### **ABSTRACT**

The Au(III)/Cu(II)/Ni(II) sorption onto iron sand magnetic material coated silica-chitosan (PB/Sil/Kit) synthesized by sol-gel method has been investigated. The iron sand magnetic material (PB) was coated with chitosan modified silica by mixing PB and sodium silicate solution into chitosan solution to form a gel. Characterization of functional groups PB/Sil/Kit was performed by Fourier Transform Infrared (FTIR). Surface morphology analysis of adsorbent was carried out by Scanning Electron Microscopy (SEM) supported by the analysis of element content using Energy-dispersive X-ray spectroscopy (EDX). The adsorption was carried out in three series, Au(III)/Cu(II), Au(III)/Ni(II), and Au(III)/Cu(II)/Ni(II) system at pH 5 for 60 min. Concentration of metal ion was varied in a range of 25 - 300 mg/L. Au(III) concentration before and after adsorption was analyzed by Atomic Absorption Spectroscopy (AAS). Isotherms adsorption was studied with Langmuir and Freundlich isotherm. Desorption was conducted toward two solution models (electronic waste and goldsmiths waste) using thiourea-HCl solution. The concentration of metal competitor was varied to know the desorption percentage of Au(III), Cu(II) and Ni(II).

Based on functional group analysis, adsorption characteristics of Fe-O at  $570.9\text{ cm}^{-1}$  and Si-O-Fe at  $794.6\text{ cm}^{-1}$  indicated silica coated on the PB and at  $1087.8\text{ cm}^{-1}$  indicated the bond between silica and chitosan on the functional group Si-O-C. Adsorption at  $3448.7\text{ cm}^{-1}$  indicated -OH group and -NH group of chitosan. Element content analysis was showed that the PB/Sil/Kit contained N, Si, O, and Fe elements. Langmuir isotherm study was showed that the adsorbent was selective for Au(III) with adsorption capacity of 381.67; 338.98; and 272.47 mg/g for system Au(III)/Cu(II), Au(III)/Ni(II), and Au(III)/Cu(II)/Ni(II) respectively. Desorption process also showed that thiourea-HCl solution was selective for Au(III) desorption with the percentage of 84.5% for the electronic waste model and 91.3% for the goldsmith ore model.

Keyword : adsorption, desorption, gold, iron sand, silica, chitosan