

ABSTRAK

SINTESIS DAN KARAKTERISASI FILM PVA- HAp- Fe_3O_4 SEBAGAI ADSORBEN ION Pb (II) dan Cd (II)

Pencemaran logam berat seperti timbal (Pb(II)) dan kadmium (Cd(II)) merupakan permasalahan lingkungan yang memerlukan penanganan efektif karena bersifat toksik dan dapat terakumulasi dalam organisme. Penelitian ini bertujuan untuk mengetahui pengaruh variasi suhu kalsinasi hidroksiapatit (HAp) terhadap karakteristik serta kemampuan adsorpsi film komposit PVA-HAp- Fe_3O_4 terhadap ion Pb(II) dan Cd(II). Hidroksiapatit disintesis dari tulang sapi melalui metode kalsinasi pada suhu 700, 800, 900, dan 1000°C selama 3 jam, kemudian dikompositkan dengan PVA dan Fe_3O_4 menggunakan metode *solution casting*. Material dikarakterisasi menggunakan *Fourier Transform Infrared Spectroscopy* (FTIR), *X-ray Diffraction* (XRD), *Scanning Electron Microscopy* (SEM), dan uji sudut kontak, sedangkan kemampuan adsorpsi dianalisis menggunakan *Atomic Absorption Spectrophotometry* (AAS). Hasil penelitian menunjukkan bahwa peningkatan suhu kalsinasi memengaruhi karakteristik film komposit. Analisis FTIR mengonfirmasi terbentuknya gugus hidroksil (OH^-), fosfat (PO_4^{3-}), dan karbonat (CO_3^{2-}), sedangkan XRD menunjukkan keberadaan fase hidroksiapatit dan magnetit pada seluruh sampel. Hasil SEM menunjukkan ukuran partikel dan tingkat aglomerasi meningkat seiring kenaikan suhu kalsinasi, sementara seluruh film memiliki sifat hidrofilik dengan nilai sudut kontak 51,43°–63,30°. Film komposit dengan HAp hasil kalsinasi 900°C memberikan kemampuan adsorpsi terbaik terhadap Pb(II) dengan efisiensi adsorpsi 89,78% dan kapasitas adsorpsi 22,449 mg/g. Adapun kemampuan adsorpsi tertinggi terhadap Cd(II) diperoleh pada variasi 700°C dengan efisiensi adsorpsi 74,29% dan kapasitas adsorpsi 18,57 mg/g. Berdasarkan hasil penelitian dapat disimpulkan bahwa variasi suhu kalsinasi hidroksiapatit berpengaruh terhadap karakteristik dan kemampuan adsorpsi film komposit PVA-HAp- Fe_3O_4 . Suhu kalsinasi 900°C menghasilkan performa adsorpsi terbaik terhadap Pb(II), sedangkan suhu 700°C memberikan kemampuan adsorpsi tertinggi terhadap Cd(II).

Kata kunci: Hidroksiapatit, PVA, Fe_3O_4 , suhu kalsinasi, adsorpsi, Pb(II), Cd(II).

ABSTRACT

SYNTHESIS AND CHARACTERIZATION OF PVA-HAp- Fe_3O_4 FILMS AS ADSORBENTS FOR Pb(II) AND Cd(II) IONS

Heavy metal pollution, such as lead (Pb(II)) and cadmium (Cd(II)), is an environmental problem that requires effective management because these metals are toxic and can accumulate in organisms. This study aims to determine the effect of variations in hydroxyapatite (HAp) calcination temperature on the characteristics and adsorption capacity of PVA-HAp- Fe_3O_4 composite films toward Pb(II) and Cd(II) ions. Hydroxyapatite was synthesized from bovine bone via calcination at temperatures of 700, 800, 900, and 1000°C for 3 hours, then composite films were prepared with PVA and Fe_3O_4 using the solution casting method. The materials were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and contact angle testing, while adsorption capacity was analyzed using Atomic Absorption Spectrophotometry (AAS). The results showed that an increase in calcination temperature affected the characteristics of the composite films. FTIR analysis confirmed the formation of hydroxyl (OH^-), phosphate (PO_4^{3-}), and carbonate (CO_3^{2-}) groups, while XRD revealed the presence of hydroxyapatite and magnetite phases in all samples. The SEM results show that particle size and the degree of agglomeration increase with rising calcination temperature, while all films exhibit hydrophilic properties with contact angles ranging from 51.43° to 63.30°. The composite film with HAp calcined at 900°C exhibited the best adsorption capacity for Pb(II), with an adsorption efficiency of 89.78% and an adsorption capacity of 22.449 mg/g. The highest adsorption capacity for Cd(II) was obtained at 700°C, with an adsorption efficiency of 74.29% and an adsorption capacity of 18.57 mg/g. Based on the research results, it can be concluded that variations in hydroxyapatite calcination temperature affect the characteristics and adsorption capacity of PVA-HAp- Fe_3O_4 composite films. A calcination temperature of 900°C produced the best adsorption performance for Pb(II), while a temperature of 700°C provided the highest adsorption capacity for Cd(II).

Keywords: hydroxyapatite, PVA, Fe_3O_4 , calcination temperature, adsorption, Pb(II), Cd(II).