

PENGHILANGAN ION Pb(II) DARI MEDIA AIR DENGAN PROSES FOTO-FENTON HETEROGEN MENGGUNAKAN LIMBAH KARAT BESI SEBAGAI KATALIS

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INTISARI

Penelitian ini bertujuan untuk mengkaji penghilangan ion Pb^{2+} melalui proses foto-Fenton heterogen dengan menggunakan limbah karat besi sebagai katalis. Limbah karat besi dipreparasi dengan cara digerus hingga berbentuk serbuk, kemudian dilakukan perlakuan pengeringan pada suhu $100^{\circ}C$ dan kalsinasi pada suhu $450^{\circ}C$. Karakterisasi katalis dilakukan menggunakan instrumen XRF, FT-IR, XRD, SEM, DRUV/Vis, dan SAA. Proses foto-Fenton dilakukan dalam sistem *batch* dengan memvariasikan dosis katalis, konsentrasi H_2O_2 , waktu penyinaran, dan pH larutan. Selain itu, dilakukan perbandingan efektivitas antara penggunaan limbah karat besi dengan suhu pengeringan $100^{\circ}C$ dan $450^{\circ}C$, serta perbandingan proses foto-Fenton heterogen dan foto-Fenton homogen dalam menurunkan konsentrasi ion Pb^{2+} . Pada penelitian ini, konsentrasi ion Pb^{2+} dalam larutan ditentukan dengan instrumen AAS.

Hasil penelitian menunjukkan bahwa limbah karat besi mengandung Fe_2O_3 dalam bentuk *maghemite* ($\gamma-Fe_2O_3$) dan *hematite* ($\alpha-Fe_2O_3$). Kalsinasi pada suhu $450^{\circ}C$ menurunkan energi celah pita (E_g) dan meningkatkan luas permukaan katalis. Kondisi optimum diperoleh pada dosis katalis 25 mmol L^{-1} atau setara dengan karat besi seberat 45 mg, konsentrasi H_2O_2 125 mmol L^{-1} , penyinaran dibawah sinar UV selama 60 menit, dan larutan pada pH 7. Katalis hasil kalsinasi pada suhu $450^{\circ}C$ menunjukkan efektivitas lebih tinggi dibandingkan hasil pengeringan dengan suhu $100^{\circ}C$. Selain itu, proses foto-Fenton heterogen lebih efektif daripada foto-Fenton homogen ketika dilakukan pada pH 3 dan 7.

Kata kunci: ion Pb^{2+} , limbah karat besi, foto-Feton, katalis heterogen

REMOVAL OF Pb(II) IONS FROM AQUEOUS MEDIA BY HETEROGENEOUS PHOTO-FENTON PROCESS USING RUSTY WASTE AS A CATALYST

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ABSTRACT

This research was conducted to examine the removal of Pb²⁺ ions through a heterogeneous photo-Fenton process by utilizing rusty waste as a catalyst. The iron rust waste was prepared by grinding it into a fine powder, followed by a drying treatment at 100°C and subsequent calcination at 450°C. Catalyst characterization was performed using several analytical instruments, including XRF, FT-IR, XRD, SEM, DRUV/Vis, and SAA. The photo-Fenton process was carried out in a batch system with variations in catalyst dosage, hydrogen peroxide (H₂O₂) concentration, irradiation time, and solution pH. In addition, a comparison was made between the effectiveness of using iron rust waste dried at 100°C and 450°C, as well as between heterogeneous and homogeneous photo-Fenton processes in reducing the concentration of Pb²⁺ ions. In this research, the concentration of Pb²⁺ ions in the solution were determined using AAS instrument.

The characterization results indicated that the rusty waste contained Fe₂O₃ in the forms of maghemite (γ -Fe₂O₃) and hematite (α -Fe₂O₃). Calcination at 450°C decreased the band gap energy (E_g) and enhanced the surface area of the catalyst. Optimal conditions were achieved with a catalyst dosage of 25 mmol L⁻¹ (equivalent to 45 mg of iron rust), H₂O₂ concentration of 125 mmol L⁻¹, UV irradiation for 60 minutes, and a solution pH of 7. The catalyst calcined at 450°C showed higher effectiveness compared to the catalyst subjected only to drying at 100°C. Additionally, the heterogeneous photo-Fenton process demonstrated greater effectiveness than the homogeneous system when it was conducted at pH 3 and 7.

Keywords: Pb²⁺ ion, rusty waste, photo-Fenton, heterogeneous catalyst