

TERMODINAMIKA DAN KINETIKA ADSORPSI $[\text{AuCl}_4]^-$ OLEH ASAM HUMAT TERETERIFIKASI

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INTISARI

Isolasi, pemurnian, eterifikasi dan karakterisasi asam humat serta studi tentang parameter termodinamika dan kinetika adsorpsi $[\text{AuCl}_4]^-$ telah dilakukan. Asam humat diisolasi dari tanah gambut Rawa Pening, Ambarawa, Jawa Tengah dengan cara melarutkan asam humat dalam NaOH 0,1 M kemudian diendapkan dengan HCl 1 M hingga pH 2. Asam humat hasil isolasi dimurnikan dengan 0,1 M HCl : 0,3 M HF (1:1 v/v). Asam humat murni selanjutnya dieterifikasi dengan dimetil sulfat dan K_2CO_3 dalam pelarut metanol. Penentuan model isoterm dan nilai entalpi dilakukan dengan menginteraksikan asam humat tereterifikasi dengan larutan $[\text{AuCl}_4]^-$ pada berbagai variasi konsentrasi dan temperatur. Penentuan model kinetika dan energi aktivasi dilakukan dengan menginteraksikan asam humat tereterifikasi dengan larutan $[\text{AuCl}_4]^-$ pada berbagai variasi waktu dan temperatur. Konsentrasi $[\text{AuCl}_4]^-$ sebelum dan sesudah interaksi dianalisis dengan spektrofotometer UV-visibel dan asam humat tereterifikasi sebelum dan sesudah interaksi dikarakterisasi menggunakan spektrofotometer FTIR dan XRD.

Hasil yang diperoleh menunjukkan bahwa adsorpsi $[\text{AuCl}_4]^-$ oleh asam humat tereterifikasi secara termodinamika mengikuti model isoterm Langmuir. Proses adsorpsi berlangsung semakin spontan seiring kenaikan temperatur, dan diperoleh kapasitas adsorpsi maksimum (q_{maks}) sebesar 315 mg.g^{-1} , nilai entalpi (ΔH°) sebesar $38,1 \text{ kJ.mol}^{-1}$ dan entropi (ΔS°) sebesar $195 \text{ J.mol}^{-1}.\text{K}^{-1}$. Kinetika adsorpsi $[\text{AuCl}_4]^-$ oleh asam humat tereterifikasi mengikuti model kinetika Lagergren. Nilai konstanta laju adsorpsi (k) meningkat seiring kenaikan temperatur, dan diperoleh nilai energi aktivasi (E_a) sebesar $39,8 \text{ kJ.mol}^{-1}$.

Kata kunci: asam humat tereterifikasi, termodinamika adsorpsi, kinetika adsorpsi, entalpi, energi aktivasi, $[\text{AuCl}_4]^-$

THERMODYNAMICS AND KINETICS ON THE ADSORPTION OF $[\text{AuCl}_4]^-$ BY ETHERIFIED HUMIC ACID

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ABSTRACT

Isolation, purification, etherification, and characterization of humic acid and study of thermodynamics and kinetics of the adsorption of $[\text{AuCl}_4]^-$ have been conducted. Humic acid was isolated from Rawa Pening peat soil, Ambarawa, Jawa Tengah by dissolving the humic acid in NaOH 0.1 M and precipitated with HCl 1 M to pH 2. The isolation result of humic acid was purified by 0.1 M HCl : 0.3 M HF (1:1 v/v). Etherification of humic acid was performed by reacting humic acid with dimethyl sulfate and K_2CO_3 in methanol solvent. Isotherm models and enthalpy values were determined by interacting etherified humic acid with $[\text{AuCl}_4]^-$ solution at various of concentrations and temperatures. Kinetics models and activation energy were determined by interacting etherified humic acid with $[\text{AuCl}_4]^-$ solution at various of times and temperatures. The concentration of $[\text{AuCl}_4]^-$ before and after interactions were analyzed by UV-visible spectrophotometer while that of etherified humic acid before and after interaction were characterized using FTIR and XRD spectrophotometer.

The results showed that adsorption of $[\text{AuCl}_4]^-$ by etherified humic acid thermodynamically followed Langmuir isotherm models. The adsorption process occurred more spontaneous as temperature increased, and the maximum adsorption capacity (q_{max}) obtained was 315 mg.g^{-1} , enthalpy (ΔH°) value was 38.1 kJ.mol^{-1} and entropy (ΔS°) value was $195 \text{ J.mol}^{-1}.\text{K}^{-1}$. The adsorption kinetics of $[\text{AuCl}_4]^-$ by etherified humic acid followed Lagergren kinetics model. The adsorption rate constant (k) increased as temperature increased and activation energy (E_a) value was 39.8 kJ.mol^{-1} .

Keywords: etherified humic acid, adsorption thermodynamics, adsorption kinetics, enthalpy, activation energy, $[\text{AuCl}_4]^-$