

SINTESIS KOMPOSIT MAGNETIT/SELULOSA/KITOSAN DAN APLIKASINYA SEBAGAI ADSORBEN Ni(II)

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INTISARI

Sintesis komposit magnetit/selulosa/kitosan dan aplikasinya sebagai adsorben Ni(II) telah dilakukan. Tujuan dari penelitian ini adalah mempelajari sintesis komposit magnetit/selulosa/kitosan (MSK) dengan selulosa berbahan dasar serpihan kayu *Acacia mangium* dan menentukan kondisi optimum, kinetika, isoterm, dan parameter termodinamika adsorpsi komposit MSK terhadap Ni(II). Material magnetit/selulosa disintesis secara *in situ* dengan metode kopresipitasi dengan NH_4OH sebagai agen pengendap. Larutan Fe^{2+} dan Fe^{3+} (rasio molar 1:2) dicampurkan dengan selulosa dalam akuades. Campuran ditambah larutan NH_4OH 1 M hingga pH 11. Material magnetit/selulosa dikomposisikan dengan kitosan sehingga terbentuk komposit magnetit/selulosa/kitosan yang dikarakterisasi dengan instrument FTIR, XRD, SEM-EDX, dan VSM. Kajian adsorpsi pada penelitian ini meliputi pengaruh pH, waktu kontak, konsentrasi awal Ni(II), dan energi adsorpsi. Konsentrasi Ni(II) dianalisis dengan instrumen AAS.

Hasil penelitian menunjukkan bahwa komposit MSK telah berhasil disintesis. Adsorpsi komposit MSK terhadap Ni(II) terjadi secara optimum pada pH 7 yang berada di atas pH_{pzc} (pH 5,49) dengan waktu kontak optimum 60 menit dan konsentrasi Ni(II) optimum 10 mg/L. Model kinetika adsorpsi komposit MSK terhadap Ni(II) mengikuti kinetika orde dua semu dengan nilai konstanta laju reaksi (k_2) sebesar $0,1001 \text{ g mg}^{-1} \text{ menit}^{-1}$. Model isoterm adsorpsi komposit MSK terhadap Ni(II) mengikuti isoterm Langmuir dengan nilai konstanta isoterm Langmuir (K_L) sebesar $3,820 \text{ L mg}^{-1}$ dan kapasitas adsorpsi maksimum (Q_{max}) sebesar $13,850 \text{ mg g}^{-1}$. Parameter termodinamika menunjukkan bahwa adsorpsi komposit MSK terhadap Ni(II) merupakan kemisorpsi yang berjalan secara spontan dan bersifat eksotermis dengan nilai $\Delta G < 0$, ΔH sebesar -48 kJ mol^{-1} , dan ΔS sebesar $-0,14 \text{ kJ K mol}^{-1}$.

Kata kunci: adsorpsi, kitosan, magnetit, Ni(II), selulosa

SYNTHESIS OF MAGNETITE/CELLULOSE/CHITOSAN COMPOSITES AND ITS APPLICATION AS ADSORBENT OF Ni(II)

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ABSTRACT

Synthesis of magnetite/cellulose/chitosan composites and its application as adsorbent of Ni(II) has been carried out. The purpose of this research is to study the synthesis of magnetite/cellulose/chitosan (MSK) composites with cellulose made from *Acacia mangium* wood chips and determine the optimum conditions, kinetics, isotherm, and thermodynamics adsorption of MSK composites on Ni(II). The magnetite/cellulose material was synthesized using the coprecipitation method with NH_4OH as a precipitating agent. Fe^{2+} and Fe^{3+} solutions (molar ratio 1:2) are mixed with cellulose in distilled water, then NH_4OH 1 M solution was added to pH 11. The magnetite/cellulose material was composited with chitosan to form a magnetite/cellulose/chitosan composite which was characterized using FTIR, XRD, SEM-EDX, and VSM instruments. The adsorption study in this research includes the influence of pH, contact time, initial concentration of Ni(II), and adsorption energy. The Ni(II) concentration was analyzed using the AAS instrument.

The research results show that the MSK composites has been successfully synthesized. Adsorption of MSK composites on Ni(II) occurs optimally at pH 7 which is above pH_{pzc} (pH 5.49) with an optimum contact time of 60 minutes and an optimum concentration of 10 mg/L. The adsorption kinetics model for MSK composites on Ni(II) follows pseudo second order kinetics with a reaction rate constant (k_2) of $0.1001 \text{ g mg}^{-1} \text{ min}^{-1}$ and a maximum adsorption capacity (Q_{max}) of $13,850 \text{ mg g}^{-1}$. The adsorption isotherm model for MSK composites on Ni(II) follows the Langmuir isotherm with a Langmuir isotherm constant value of 3.820 L mg^{-1} . The thermodynamic parameters show that the MSK composites adsorption on Ni(II) is a chemisorption that occurs spontaneously and exothermic with a value of $\Delta G < 0$, ΔH of -48 kJ mol^{-1} , and ΔS of $0.290 \text{ kJ K mol}^{-1}$.

Key words: adsorption, cellulose, chitosan, magnetite, Ni(II)