

**SINTESIS KOMPOSIT  
ZEOLIT-MAGNETIT-SETILTRIMETILAMONIUM BROMIDA DAN  
APLIKASINYA SEBAGAI ADSORBEN ION FOSFAT**

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**INTISARI**

Penelitian ini bertujuan untuk memodifikasi zeolit alam (ZA) dengan magnetit dan setiltrimetilamonium bromida (CTAB), uji adsorpsi adsorben terhadap ion fosfat, dan uji pemisahan adsorben-adsorbat setelah adsorpsi. Penelitian ini diawali dengan aktivasi zeolit alam Klaten dengan larutan HCl 3 M. Zeolit alam teraktivasi (ZAA) dikompositkan dengan magnetit melalui metode kopresipitasi dengan reagen  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ , dan agen pengendap  $\text{NH}_4\text{OH}$  21%. Material ZAA-Magnetit dimodifikasi CTAB dengan konsentrasi 2 kapasitas tukar kation (KTK). Material hasil sintesis dikarakterisasi dengan *Fourier Transform Infrared* (FTIR), *X-Ray Diffraction* (XRD), *Scanning Electron Microscope - Energy Dispersive X-ray Spectroscopy* (SEM-EDS), *Transmission Electron Microscope* (TEM) dan *Vibrating Sample Magnetometer* (VSM). Pada uji adsorpsi ion fosfat dilakukan variasi pH dan waktu kontak. Konsentrasi ion fosfat yang teradsorpsi diukur dengan spektrofotometer UV-Vis.

Berdasarkan hasil karakterisasi material menunjukkan bahwa komposit ZAA-Magnetit-CTAB telah berhasil disintesis. Kondisi optimum adsorpsi ion fosfat adalah pada pH 5 dan waktu kontak 45 menit. Adsorpsi ion fosfat mengikuti model kinetika orde dua semu Ho dan Mckay dengan konstanta laju adsorpsi sebesar  $4,11 \text{ g mmol}^{-1} \text{ menit}^{-1}$ . Adsorpsi ion fosfat mengikuti model isotherm adsorpsi Langmuir dengan kapasitas adsorpsi sebesar  $5,37 \times 10^{-5} \text{ mol g}^{-1}$  dan energi adsorpsi sebesar  $25,0 \text{ kJ mol}^{-1}$ . Urutan kemampuan adsorpsi berdasarkan variasi adsorben adalah ZAA-Magnet-CTAB > ZAA-Magnetit > ZAA > ZA. Proses pemisahan ZAA-Magnetit-CTAB dari adsorbat dapat dilakukan dengan magnet eksternal.

Kata kunci: adsorpsi, CTAB, fosfat, magnetit, zeolit alam.

**SYNTHESIS OF  
ZEOLITE-MAGNETITE-CETYLTRIMETHYLAMMONIUM BROMIDE  
COMPOSITE AND ITS APPLICATION AS ADSORBENT OF  
PHOSPHATE ION**

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**ABSTRACT**

The aims of this research were to modify natural zeolite (ZA) with magnetite and cetyltrimethylammonium bromide (CTAB), to determine the adsorption capacity, and recovery of adsorbent-adsorbate after adsorption. Natural zeolite was activated by 3 M HCl solution. Activated zeolite (ZAA) was composited with magnetite by coprecipitation method using  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ , and 21%  $\text{NH}_4\text{OH}$ . ZAA-Magnetite material was modified by CTAB with concentration of 2 cation exchange capacity (CEC). The synthesis materials were characterized by Fourier Transform Infrared (FTIR), X-Ray Diffraction (XRD), Scanning Electron Microscope - Energy Dispersive X-ray Spectroscopy (SEM-EDS), Transmission Electron Microscope (TEM) and Vibrating Sample Magnetometer (VSM). In the phosphate ion adsorption test, variation pH and contact time were carried out. The amount of adsorbed phosphate ion was measured by UV-Vis spectrophotometer.

The optimum condition for adsorption of phosphate ion occurred at pH 5 and a contact time of 45 minutes. Adsorption of phosphate ion followed the pseudo second order of Ho and Mckay kinetics model with adsorption rate constant of  $4.11 \text{ g mmol}^{-1} \text{ min}^{-1}$ . Adsorption of phosphate ion followed the model of Langmuir adsorption isotherm with adsorption capacity of  $5.37 \times 10^{-5} \text{ mol g}^{-1}$  and adsorption energy of  $25.0 \text{ kJ mol}^{-1}$ . The order of adsorption capacity based on the variation of the adsorbent was ZAA-Magnetite-CTAB > ZAA-Magnetite > ZAA > ZA. The separation process of ZAA-Magnetite-CTAB from the adsorbate can be carried out using external magnet.

Keywords: adsorption, CTAB, phosphate, magnetite, natural zeolite.