

## **ZEOLIT-MAGNETIT TERMODIFIKASI SETILTRIMETILAMONIUM BROMIDA DAN APLIKASINYA SEBAGAI ADSORBEN ION NITRAT**

SHAFIRA IDZNI PUTRI HARTARI

17/414644/PA/18144

### **INTISARI**

Sintesis zeolit-magnetit termodifikasi setiltrimetilamonium bromida (ZAA-Mag-CTAB) sebagai adsorben ion nitrat telah berhasil dilakukan. Penelitian ini bertujuan untuk melakukan modifikasi zeolit-magnetit (ZAA-Mag) dengan setiltrimetilamonium bromida (CTAB), mengkaji kapasitas adsorpsi ion nitrat dengan adsorben hasil sintesis, dan menguji *recovery* adsorben-adsorbat setelah adsorpsi. Penelitian diawali dengan aktivasi zeolit alam (ZA) dalam larutan HCl 3,00 M. Sintesis ZAA-Mag dilakukan dengan metode kopresipitasi antara  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ , dan larutan  $\text{NH}_4\text{OH}$  21%. Adsorben ZAA-Mag dimodifikasi dengan CTAB sebanyak 2 kapasitas tukar kation (KTK). Material hasil sintesis dikarakterisasi dengan FTIR, XRD, VSM, SEM, dan TEM. Adsorpsi ion nitrat dilakukan dengan ditentukan pH dan waktu kontak optimum. Konsentrasi ion nitrat yang teradsorpsi diukur dengan spektrofotometer UV-Vis.

Hasil yang diperoleh dari penelitian ini menunjukkan bahwa ZA berhasil diaktivasi dengan larutan asam HCl 3,00 M dengan berkurangnya kation pengotor seperti  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$ , dan  $\text{Ca}^{2+}$  serta terjadi dealuminasi. Adsorben ZAA-Mag dan ZAA-Mag-CTAB berhasil disintesis dilihat dari hasil karakterisasi FTIR, XRD, SEM, TEM, dan VSM. Adsorpsi optimum dari ion nitrat adalah pada pH 7,00 dan waktu kontak 60 menit. Adsorpsi ion nitrat mengikuti kinetika orde dua semu dengan konstanta laju adsorpsi sebesar  $3,65 \times 10^{-2} \text{ g mmol}^{-1} \text{ menit}^{-1}$ . Adsorpsi ion nitrat mengikuti isoterm adsorpsi Langmuir dan mempunyai kapasitas adsorpsi sebesar  $5,29 \times 10^{-5} \text{ mol g}^{-1}$  serta energi adsorpsi sebesar  $23,8 \text{ kJ mol}^{-1}$ . Urutan jenis adsorben dari adsorpsi yang paling optimum adalah ZAA-Mag-CTAB, ZAA-Mag, zeolit alam aktivasi (ZAA), dan ZA. Proses pemisahan ZAA-Mag-CTAB dari adsorbat lebih cepat dengan digunakan magnet eksternal.

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

***SYNTHESIS OF CETYLTRIMETHYLAMMONIUM BROMIDE MODIFIED  
ZEOLITE-MAGNETITE AND ITS APPLICATION AS ADSORBENT OF  
NITRATE ION***

SHAFIRA IDZNI PUTRI HARTARI  
17/414644/PA/18144

**ABSTRACT**

Synthesis of cetyltrimethylammonium bromide modified zeolite-magnetite (ZAA-Mag-CTAB) and its application as nitrate ion adsorbent has been carried out. This study aims are: 1. to modify natural zeolite-magnetite (ZAA-Mag) with cetyltrimethylammonium bromide (CTAB) as an adsorbent for nitrate ions; 2. to study the adsorption capacity of nitrate ions using ZAA-Mag-CTAB as adsorbent; and 3. to test the *recovery* of adsorbent-adsorbate after adsorption. First step is activation of natural zeolite (ZA) using a solution of 3.00 M HCl. Synthesis of ZAA-Mag through coprecipitation method using  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ , and solution of 21%  $\text{NH}_4\text{OH}$ . Next, adsorbent ZAA-Mag was modified with 2 cation exchange capacity (CEC) of CTAB. The synthesized materials were characterized by FTIR, XRD, VSM, SEM, and TEM. Nitrate ion adsorption was carried out by determining the optimum pH and contact time. The amount of absorbed nitrate ion was measured by UV-Vis spectrophotometer.

The results indicated that ZA was successfully activated with 3.00 M HCl acid solution. The impurity cations such as  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$  decreased and dealumination occurred. Based on the characterization of FTIR, XRD, SEM, TEM, and VSM showed that ZAA-Mag and ZAA-Mag-CTAB were successfully synthesized. The optimum adsorption of nitrate ion occurred at pH 7.00 and a contact time of 60 minutes. Adsorption followed the pseudo second order kinetics of Ho and McKay with adsorption rate constant of  $3.65 \times 10^{-2} \text{ g mmol}^{-1} \text{ min}^{-1}$ . Nitrate ions adsorption followed Langmuir adsorption isotherm with adsorption capacity of  $5.29 \times 10^{-5} \text{ mol g}^{-1}$  and adsorption energy of  $23.8 \text{ kJ mol}^{-1}$ . The order of types of adsorbent from the highest adsorption is ZAA-Mag-CTAB, ZAA-Mag, activated natural zeolite (ZAA), dan ZA. The process of separating ZAA-Mag-CTAB from the adsorbate was faster by using an external magnet.

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