

## **ADSORPSI FENOL DAN p-KLOROFENOL PADA $\text{Fe}_3\text{O}_4$ TERSALUT ASAM HUMAT (AH- $\text{Fe}_3\text{O}_4$ )**

Soerja Koesnarpadi  
11/324270/SPA/00338

### **INTISARI**

Sintesis nanopartikel  $\text{Fe}_3\text{O}_4$  tersalut asam humat (AH- $\text{Fe}_3\text{O}_4$ ) telah berhasil dilakukan dan diaplikasikan untuk adsorpsi fenol dan p-klorofenol dalam larutan. Sintesis dilakukan dengan metode kopresipitasi kimia dalam kondisi basa menggunakan ammonium hidroksida dan penambahan AH dengan perbandingan massa AH dan  $\text{Fe}_3\text{O}_4 = 1:20, 2:20, 4:20$  dan  $6:20$ . Asam humat diperoleh dari tanah gambut daerah Sambutan, Kalimantan Timur, Indonesia yang diekstraksi menggunakan larutan basa NaOH 0,1 N. Karakterisasi adsorben dilakukan dengan menggunakan *Fourier transform infrared* (FTIR), *X-ray diffraction* (XRD), *Scanning electron microscope* (SEM), *Vibrating sample magnetometer* (VSM), *Transmission electron microscope* (TEM) dan model *Brunauer-Emmett-Teller* (BET). Teknik *batch* digunakan dalam adsorpsi fenol dan p-klorofenol dengan mempelajari pengaruh pH, waktu kontak dan konsentrasi optimum serta menentukan model kinetika adsorpsi dan model isoterm adsorpsi.

Hasil karakterisasi menunjukkan bahwa  $\text{Fe}_3\text{O}_4$  tersalut AH tidak mengubah struktur kristal  $\text{Fe}_3\text{O}_4$  namun menghasilkan intensitas puncak dan sifat kemagnetan lebih rendah dibanding  $\text{Fe}_3\text{O}_4$ . Foto SEM menunjukkan bahwa ukuran partikel magnetik relatif homogen sekitar 10-18 nm. Kestabilan ion Fe pada AH- $\text{Fe}_3\text{O}_4$  terjadi pada pH 3-11 sedangkan kestabilan AH pada AH- $\text{Fe}_3\text{O}_4$  terjadi pada pH 1-11. Hasil kajian adsorpsi fenol oleh  $\text{Fe}_3\text{O}_4$  optimum pada pH 5 sedangkan pada AH- $\text{Fe}_3\text{O}_4$  optimum pada pH 5 dan 6. Adsorpsi p-klorofenol oleh  $\text{Fe}_3\text{O}_4$  optimum pada pH 5 sedangkan pada AH- $\text{Fe}_3\text{O}_4$  optimum pada pH 3. Model kinetika adsorpsi fenol dan p-klorofenol pada  $\text{Fe}_3\text{O}_4$  dan AH- $\text{Fe}_3\text{O}_4$  dapat dijelaskan dengan persamaan model kinetika adsorpsi pseudo-order dua. Model isoterm adsorpsi fenol dan p-klorofenol pada  $\text{Fe}_3\text{O}_4$  dan AH- $\text{Fe}_3\text{O}_4$  sesuai dengan model isoterm Langmuir.

**Kata kunci:** adsorpsi, fenol, p-klorofenol, isoterm, kinetika, AH- $\text{Fe}_3\text{O}_4$

## **ADSORPTION OF PHENOL AND p-CHLOROPHENOL ON MAGNETITE COATED BY HUMIC ACIDS (HA-Fe<sub>3</sub>O<sub>4</sub>)**

Soerja Koesnarpadi  
11/324270/SPA/00338

### **ABSTRACT**

The coating of Fe<sub>3</sub>O<sub>4</sub> nanoparticles using humic acid (HA) to form HA-Fe<sub>3</sub>O<sub>4</sub> has been successfully done and applied for phenol and p-chlorophenol sorption in aqueous solution. The synthesis was prepared using coprecipitation method in an alkaline condition using ammonium hydroxide and the addition of HA with mass ratios of HA and Fe<sub>3</sub>O<sub>4</sub> = 1:20, 2:20, 4:20, 6:20. The HA was taken from peat soil in Sambutan Village, East Kalimantan, Indonesia and was extracted in NaOH 0.1 M solution. The adsorbent was characterized by Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), Scanning electron microscope (SEM), Vibrating sample magnetometer (VSM), Transmission electron microscope (TEM) and Brunauer-Emmett-Teller (BET) model. The batch technique was conducted for phenol and p-chlorophenol sorption to investigate the effect of pH, contact time and optimum concentration. Kinetics and the isotherm model were also determined.

Characterization result showed that the coating of HA on the surface of Fe<sub>3</sub>O<sub>4</sub> did not change the crystal structure of Fe<sub>3</sub>O<sub>4</sub>, had lower peak intensities and saturation magnetization than Fe<sub>3</sub>O<sub>4</sub> if added with HA. The SEM image indicated the magnetic particle size was almost homogenous by 10-18 nm. Iron and HA in HA-Fe<sub>3</sub>O<sub>4</sub> materials synthesized using different mass ratios were stable in pH range of 3-11 and 1-11, respectively. The results of adsorption experiment demonstrated that phenol adsorption on Fe<sub>3</sub>O<sub>4</sub> was optimum at pH 5.0 and on HA-Fe<sub>3</sub>O<sub>4</sub> were optimum at pH 5-6. Adsorption of p-chlorophenol on Fe<sub>3</sub>O<sub>4</sub> was optimum at pH 5 and on HA-Fe<sub>3</sub>O<sub>4</sub> materials were optimum at pH 3. The kinetics model for phenol and p-chlorophenol adsorption on Fe<sub>3</sub>O<sub>4</sub> and HA-Fe<sub>3</sub>O<sub>4</sub> could be described using pseudo-second order kinetic equation. The isotherm model for phenol and p-chlorophenol adsorption on Fe<sub>3</sub>O<sub>4</sub> and HA-Fe<sub>3</sub>O<sub>4</sub> in accordance with the Langmuir isotherm model.

**Keywords:** adsorption, phenol, p-chlorophenol, isotherm, kinetic, HA-Fe<sub>3</sub>O<sub>4</sub>