ADSORPSI ZAT WARNA KATIONIK *MALACHITE GREEN* DAN ANIONIK *COOMASSIE BRILLIANT BLUE* DENGAN ABU DASAR BATUBARA TERAKTIVASI HCl

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INTISARI

Studi adsorpsi zat warna *coomassie brilliant blue* dan zat warna *malachite green* pada abu dasar batubara teraktivasi HCl telah dilakukan. Abu dasar batubara diaktivasi menggunakan larutan HCl 6 M dengan metode refluks selama 4 jam. Abu dasar batubara tanpa aktivasi dan teraktivasi HCl dikarakterisasi dengan spektrometer inframerah (FT-IR), difraktometer sinar-X (XRD), dan spektrofotometer serapan atom (AAS). Proses adsorpsi dikaji dengan parameter pengaruh pH larutan, massa adsorben, waktu kontak dan konsentrasi awal adsorbat.

Hasil karakterisasi adsorben menunjukkan bahwa komponen utama abu dasar batubara adalah SiO_2 dalam bentuk mineral kuarsa dan Al_2O_3 dalam bentuk mineral mullit. Hasil karakterisasi juga menunjukkan bahwa proses aktivasi dengan HCl dapat meningkatkan jumlah situs aktif permukaan adsorben, yang ditandai dengan naiknya intensitas relatif puncak pada difraktogram dan turunnya kadar oksida logam. Kondisi optimum proses adsorpsi zat warna *coomassie brilliant blue* dengan abu dasar batubara teraktivasi HCl berada pada pH larutan 3, massa adsorben 0,3 g, waktu kontak 90 menit; dan konsentrasi awal 125 ppm, sedangkan adsorpsi zat warna *malachite green* dengan abu dasar batubara teraktivasi HCl optimum pada pH larutan 8, massa adsorben 0,2 g, waktu kontak 90 menit; dan konsentrasi awal 125 ppm.

Kajian kinetika dan isoterm adsorpsi juga dilakukan dalam penelitian ini. Adsorpsi zat warna *coomassie brilliant blue* dan *malachite green* dengan abu dasar batubara teraktivasi HCl mengikuti kinetika orde kedua semu. Nilai konstanta laju yang dihasilkan berturut-turut sebesar $9{,}91 \times 10^{-2}$ dan $2{,}16 \times 10^{-2}$ g/mg.menit. Proses adsorpsi zat warna *coomassie brilliant blue* mengikuti model isoterm Freundlich dengan nilai konstanta Freundlich (K_F) sebesar $5{,}535 \times 10^{-4}$ mol/g, sedangkan adsorpsi zat warna *malachite green* mengikuti model isoterm Langmuir dengan nilai konstanta Langmuir (K_L) sebesar 8812 L/mol dan energi adsorpsi (E) sebesar 22,506 kJ/mol.

Kata kunci: abu dasar batubara, adsorpsi, *coomassie brilliant blue*, *malachite green*

ADSORPTION OF CATIONIC MALACHITE GREEN AND ANIONIC COOMASSIE BRILLIANT BLUE DYES USING HCl–ACTIVATED COAL BOTTOM ASH

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ABSTRACT

The adsorption study of coomassie brilliant blue and malachite green dyes using HCl-activated coal bottom ash was studied. Coal bottom ash was activated by hydrochloric acid (HCl) with reflux method for 4 hours. Raw coal bottom ash and HCl-activated coal bottom ash were characterized by infrared spectrometer (FT-IR), X-ray diffractometer (XRD) and atomic absorption spectrophotometer (AAS). Adsorption processes was examined by various parameters, such as the effects of pH, adsorbent mass, contact time and initial concentration of adsorbate.

The characterization of adsorbent showed that the main compound of coal bottom ash are SiO_2 as quartz and Al_2O_3 as mullit. The adsorbent characterization also showed that the activation process with HCl could increase the number of adsorbent active sites, which was indicated by an increase in peak relative intensity of diffractogram and a decrease in metal oxides percentage. The optimum removal efficiency of coomassie brilliant blue using HCl-activated coal bottom ash was obtained at pH 3; 0.3 g of adsorbent; 90 minutes of contact time; and 125 ppm of initial dye concentration, while the optimum adsorption of malachite green using HCl-activated coal bottom ash was obtained at pH 8; 0.2 g of adsorbent; 90 minutes of contact time; and 125 ppm of initial dye concentration.

The adsorption kinetics and isotherms were also studied in this research. The adsorption of coomassie brilliant blue and malachite green dyes by HCl-activated coal bottom ash are best described by pseudo-second order kinetics with rate constants of 9.91×10^{-2} and 2.16×10^{-2} g/mg.min, respectively. Adsorption isotherm studies indicated that Freundlich isotherm model is best fit for the adsorption of coomassie brilliant blue with the Freundlich constant for this process is 5.535×10^{-4} mol/g, while the adsorption of malachite green followed Langmuir isotherm model with the Langmuir constant and adsoption energy in this process are 8812 L/mol and 22.506 kJ/mol, respectively.

Keywords: adsorption, coal bottom ash, coomassie brilliant blue, malachite green.