

**PEMBUATAN ADSORBEN TERMAGNETISASI BERBAHAN DASAR  
ABU LAYANG BATUBARA UNTUK MENGHILANGKAN ZAT WARNA  
*MALACHITE GREEN* DAN *CONGO RED***

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**INTISARI**

Penelitian tentang pembuatan adsorben termagnetisasi berbahan dasar abu layang batubara dan kajian aplikasinya untuk adsorpsi zat warna *malachite green* (MG) dan *congo red* (CR) telah dilakukan. Abu layang diaktivasi terlebih dahulu dengan larutan HCl 6 M kemudian dilakukan magnetisasi. Proses magnetisasi abu layang batubara dilakukan dengan metode kopresipitasi dengan rasio molar  $Fe^{2+}$  dan  $Fe^{3+} = 1:2$ . Abu layang termagnetisasi (ALAM) kemudian digunakan sebagai adsorben dan hasilnya dibandingkan dengan abu layang teraktivasi (ALA). Karakterisasi material dilakukan menggunakan spektroskopi serapan atom (AAS), Spektroskopi Inframerah (FTIR), dan Difraksi Sinar-X (XRD), dan *Vibrating Sample Magnetometer* (VSM). Parameter yang mempengaruhi adsorpsi seperti pH, massa adsorben, waktu interaksi, dan konsentrasi awal zat warna telah dioptimasi. Penentuan konsentrasi zat warna sebelum dan setelah adsorpsi dilakukan dengan spektrofotometer UV-Vis. Kinetika dan isoterm adsorpsi zat warna pada abu layang teraktivasi dan abu layang termagnetisasi juga telah ditentukan.

Hasil karakterisasi AAS terhadap abu layang batubara menunjukkan komponen utama abu layang adalah  $SiO_2$  dan  $Al_2O_3$ . ALA memiliki kandungan pengotor oksida logam lebih rendah disertai peningkatan  $SiO_2$  dibandingkan abu layang tanpa aktivasi. Hasil karakterisasi dengan FTIR, XRD, VSM, dan aplikasi magnet eksternal menunjukkan ALAM telah disintesis. Hasil kajian adsorpsi menunjukkan kondisi optimum adsorpsi zat warna MG sebanyak 20 mL tercapai pada pH 7 menggunakan adsorben ALAM sebanyak 0,1gram dengan waktu kontak 45 menit dan konsentrasi awal 175 ppm. Kondisi optimum adsorpsi zat warna CR sebanyak 20 mL tercapai pada pH 5 menggunakan adsorben ALA sebanyak 0,25 gram dengan waktu kontak 75 menit dan konsentrasi awal 125 ppm. Adsorpsi kedua zat warna mengikuti kinetika orde kedua semu sedangkan model isoterm Langmuir paling sesuai untuk menggambarkan adsorpsi kedua zat warna dibandingkan model isoterm Freundlich.

Kata kunci: abu layang termagnetisasi, adsorben, *malachite green*, *congo red*.

***PREPARATION OF MAGNETIZED ADSORBEN FROM COAL FLY ASH  
AND STUDI OF ITS APPLICATION FOR THE ADSORPTION OF  
MALACHITE GREEN AND CONGO RED DYES***

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**ABSTRACT**

Research on the preparation of magnetized adsorbent from coal fly ash and its application for the adsorption of malachite green (MG) and congo red (CR) dyes have been carried out. Fly ash was first activated with 6 M HCl solution and then magnetized. The coal fly ash magnetization process was carried out using coprecipitation method with a molar ratio of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+} = 1:2$ . Magnetized fly ash (ALAM) was then used as an adsorbent and the results were compared with activated fly ash (ALA). Characterization was carried out using atomic adsorption spectroscopy (AAS), Infrared spectroscopy (FTIR), and X-Ray Diffraction (XRD), and Vibrating sample magnetometer (VSM). Parameters that affect adsorption such as the effect of pH, adsorbent mass, interaction time, and initial concentration of dyes have been optimized. Determination of dye concentration before and after adsorption was carried out using a UV-Vis spectrophotometer. The kinetics and isotherms adsorption of dyes on activated fly ash and magnetized fly ash have also been determined.

The results of AAS characterization of coal fly ash show that the components of fly ash consisted of  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ . ALA has a lower metal oxide impurity content and an increase in  $\text{SiO}_2$  content compared to fly ash without activation. The results of characterization using FTIR, XRD, VSM, and external magnet application showed ALAM has been synthesized. The optimum conditions for adsorption of 20 mL MG dye were achieved at pH 7 using 0.1 gram of ALAM adsorbent with a contact time of 45 minutes and an initial concentration of 175 ppm. The optimum conditions for 20 mL CR dye adsorption were achieved of 75 minutes and an initial concentration of 125 ppm. The adsorption of both dyes follows pseudo second order kinetics with adsorption studies showing that the Langmuir isotherm model is the most suitable for the experimental data on the adsorption of both dyes compared to the Freundlich isotherm model.

Keywords: magnetized fly ash, adsorbent, malachite green, congo red