

ADSORPSI ZAT WARNA KATIONIK MALASIT HIJAU MENGUNAKAN SILIKA GEL BERBAHAN DASAR ABU VULKANIK GUNUNG KELUD

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INTISARI

Penelitian mengenai adsorpsi zat warna kationik malasit hijau menggunakan silika gel berbahan dasar abu vulkanik gunung Kelud telah dilakukan. Abu vulkanik terlebih dahulu diaktivasi menggunakan HCl 6 M melalui metode refluks selama 4 jam. Abu vulkanik teraktivasi HCl kemudian dilebur dengan NaOH 4 M untuk menghasilkan prekursor natrium silikat. Larutan natrium silikat ditambahkan 3 M HCl tetes demi tetes hingga terbentuk silika gel. Abu vulkanik tanpa aktivasi, abu vulkanik teraktivasi HCl dan silika gel hasil sintesis kemudian dikarakterisasi menggunakan fluoresensi sinar-X (XRF), instrumen spektrofotometer inframerah (FTIR), serta difraktometer sinar-X (XRD). Pada proses adsorpsi zat warna malasit hijau, parameter adsorpsi yang dikaji meliputi pengaruh pH larutan, massa adsorben, waktu kontak, dan konsentrasi awal zat warna. Kinetika dan isoterm adsorpsi juga dipelajari pada penelitian ini. Konsentrasi malasit hijau sebelum dan sesudah adsorpsi ditentukan secara spektrofotometri pada panjang gelombang (λ_{maks}) 618 nm.

Hasil karakterisasi adsorben menunjukkan bahwa komponen utama dari abu vulkanik yaitu unsur Si dan Al, sedangkan komponen utama dari silika gel adalah unsur Si. Hasil karakterisasi juga menunjukkan bahwa silika gel hasil sintesis bersifat amorf serta memiliki situs aktif berupa gugus fungsi siloksan (Si-O-Si) dan silanol (Si-OH). Kondisi optimum adsorpsi zat warna malasit hijau menggunakan silika gel hasil sintesis berada pada pH larutan 8, massa adsorben 0,2 gram, waktu kontak 90 menit, dan konsentrasi awal larutan 200 ppm. Kajian kinetika dan isoterm adsorpsi zat warna malasit hijau menggunakan silika gel hasil sintesis mengikuti kinetika adsorpsi orde kedua semu yang menunjukkan bahwa adsorpsi terjadi dalam dua tahapan yaitu cepat dan lambat serta terjadi pada lebih dari satu sisi aktif adsorben. Nilai konstanta laju yang diperoleh yaitu sebesar $0,095 \text{ g mg}^{-1} \text{ menit}^{-1}$. Proses adsorpsi zat warna malasit hijau mengikuti model isoterm adsorpsi Langmuir dengan nilai konstanta Langmuir (K_L) sebesar $1,99 \times 10^4 \text{ L mol}^{-1}$.

Kata kunci: abu vulkanik, adsorpsi, malasit hijau, silika gel

ADSORPTION OF CATIONIC MALACHITE GREEN DYE USING SILICA GEL PREPARED FROM MOUNT KELUD VOLCANIC ASH

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ABSTRACT

Research on the adsorption of malachite green dye using silica gel prepared from mount Kelud's volcanic ash has been carried out. Volcanic ash must be activated using 6 M HCl through the reflux process for 4 hours. Activated volcanic ash was melted with 4 M NaOH to produce precursor sodium silicate. The sodium silicate solution was added with 3 M HCl drip until silica gel was formed. Raw volcanic ash activated volcanic ash, and synthesized silica gel was characterized by X-Ray fluorescence (XRF), infrared spectrometer (FTIR), and X-Ray diffractometer (XRD). The effects of pH solution, adsorbent mass, contact time, and initial dye concentration on the effectiveness of adsorption were examined. This research also conducted studies of adsorption kinetics and isotherms. Malachite green dye concentration before and after adsorption was determined by spectrophotometry at wavenumber (λ_{maks}) 618 nm.

The adsorbent characterization showed that the main components of volcanic ash were Si and Al elements, while the main components of silica gel were Si elements. The characterization results also showed that the synthesized silica gel was amorphous and had activated sites in the form of siloxane (Si-O-Si) and silanol (Si-OH) functional group. The optimum conditions for the adsorption process of malachite green dye using synthesized silica gel were obtained at pH 8, 0.2-gram adsorbent mass, 90-minute contact time, and 200 ppm of initial dye concentration. The adsorption of malachite green dye using synthesized silica gel is best described by pseudo-second-order kinetic, indicating that adsorption occurs in two steps, fast and slow. The adsorption also appears on more than one active site adsorbent. The rate constant value was $0.095 \text{ g mg}^{-1} \text{ min}^{-1}$. The adsorption process of malachite green dye followed the Langmuir isotherm model with a Langmuir constant (K_L) value of $1,99 \times 10^4 \text{ L mol}^{-1}$.

Keywords: adsorption, malachite green, silica gel, volcanic ash