

SINTESIS NANOKOMPOSIT $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -KITOSAN SEBAGAI ADSORBEN ZAT WARNA ANIONIK REMAZOL RED RB

Nisrina Sekarningrum

22/497633/PA/21437

INTISARI

Peningkatan volume limbah hasil pewarna tekstil telah menyebabkan pencemaran lingkungan yang signifikan, khususnya perairan. *Remazol Red RB* merupakan zat warna anionik yang banyak digunakan pada industri tekstil. Pada penelitian ini, telah dilakukan sintesis nanokomposit $\text{Fe}_3\text{O}_4@\text{SiO}_2$ termodifikasi kitosan sebagai adsorben zat warna *Remazol Red RB*. Partikel Fe_3O_4 disintesis melalui metode kopresipitasi kemudian dilakukan pelapisan dengan SiO_2 dari Na_2SiO_3 yang berasal dari limbah pertanian, abu sekam padi, melalui metode sol-gel. Nanokomposit $\text{Fe}_3\text{O}_4@\text{SiO}_2$ dimodifikasi lanjut dengan kitosan menggunakan glutaraldehid sebagai agen pengikat silang. Nanokomposit $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -kitosan kemudian dikarakterisasi menggunakan ATR-FTIR (*Attenuated Total Reflection-Fourier Transform Infrared*), XRD (*X-Ray Diffraction*), dan SEM-EDX (*Scanning Electron Microscope-Energy Dispersive X-Ray*). Optimasi kondisi adsorpsi yang dilakukan, yaitu optimasi pH, massa adsorben, waktu kontak, serta pengaruh konsentrasi awal larutan zat warna *Remazol Red RB* dengan pengukuran absorbansi menggunakan spektrofotometer UV-Vis.

Hasil karakterisasi nanokomposit $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -kitosan menunjukkan adanya puncak-puncak karakteristik pada spektrum ATR-FTIR dan difraktogram XRD, serta adanya perubahan morfologi permukaan pada citra SEM. Hasil karakterisasi yang didapat menunjukkan keberhasilan sintesis nanokomposit $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -kitosan. Kondisi optimum adsorpsi *Remazol Red RB* tercapai pada pH 1, menggunakan massa adsorben 0,01 g, dengan waktu kontak 90 menit dalam larutan zat warna *Remazol Red RB* 10 mg L⁻¹. Model adsorpsi yang didapat mengikuti kinetika orde kedua semu dan isoterm Freundlich dengan kapasitas adsorpsi sebesar 51,62 mg g⁻¹ dan efektif menyerap zat warna anionik sebesar 80,16%.

Kata kunci: adsorpsi, kitosan, nanokomposit, magnetit, *Remazol Red RB*

SYNTHESIS OF $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -CHITOSAN NANOCOMPOSITE AS ADSORBENTS FOR REMAZOL RED RB ANIONIC DYE

Nisrina Sekarningrum

22/497633/PA/21437

ABSTRACT

The increasing volume of textile dye waste has led to significant environmental pollution, particularly in water bodies. Remazol Red RB is an anionic dye widely used in the textile industry. In this study, chitosan-modified $\text{Fe}_3\text{O}_4@\text{SiO}_2$ nanocomposites were synthesized as adsorbents for Remazol Red RB. Fe_3O_4 particles were synthesized via the co-precipitation method, followed by SiO_2 coating using Na_2SiO_3 derived from agricultural waste, rice husk ash, through the sol-gel method. The $\text{Fe}_3\text{O}_4@\text{SiO}_2$ nanocomposites were further modified with chitosan using glutaraldehyde as a cross-linking agent. The resulting $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -chitosan nanocomposites were characterized using ATR-FTIR (Attenuated Total Reflection-Fourier Transform Infrared), XRD (X-Ray Diffraction), and SEM-EDX (Scanning Electron Microscope-Energy Dispersive X-Ray). Optimization of adsorption conditions, including pH, adsorbent mass, contact time, and the effect of initial dye concentration, was conducted by measuring absorbance using a UV-Vis spectrophotometer.

The characterization results of the $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -chitosan nanocomposites showed characteristic peaks in the ATR-FTIR spectra and XRD diffractograms, along with changes in surface morphology in SEM images. These characterization results confirm the successful synthesis of the $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -chitosan nanocomposites. The optimum adsorption conditions for Remazol Red RB were achieved at pH 1, using an adsorbent mass of 0.01 g, and a contact time of 90 mins in a 10 mg L^{-1} Remazol Red RB dye solution. The adsorption model was found to follow pseudo-second order and Freundlich isotherm, with an adsorption capacity of 51.62 mg g^{-1} and removal efficiency of 80.16% for the anionic dye.

Keywords: adsorption, chitosan, magnetite, nanocomposites, Remazol Red RB