

PEMANFAATAN FILM KITOSAN KATIONIK TERMODIFIKASI EPTAC SEBAGAI ADSORBEN UNTUK ADSORPSI ZAT WARNA ANIONIK REMAZOL BRILLIANT BLUE R (RBBR) DALAM LARUTAN

Yona Anugerah Sunia
22/497030/PA/21387

INTISARI

Telah dilakukan penelitian pemanfaatan film kitosan kationik termodifikasi EPTAC sebagai adsorben untuk adsorpsi zat warna anionik *Remazol Brilliant Blue R* (RBBR) dalam larutan. Tujuan penelitian ini, yaitu mengkaji hasil modifikasi dan karakterisasi kationisasi film kitosan dengan EPTAC untuk pemanfaatan sebagai adsorben. Penelitian ini juga bertujuan untuk mengkaji kondisi adsorpsi terkait pH, massa adsorben, waktu kontak, dan konsentrasi awal adsorbat pada proses adsorpsi zat warna anionik RBBR, serta mengkaji kinetika dan isoterm adsorpsi dari zat warna anionik RBBR dengan adsorben film kitosan kationik termodifikasi EPTAC.

Kationisasi kitosan dilakukan melalui modifikasi kitosan dengan *2,3-Epoxypropyl trimethyl ammonium chloride* (EPTAC) yang berasal dari *3-Chloro-2-hydroxypropyl trimethyl ammonium chloride* (CHPTAC) dan penambahan NaOH. Film kitosan dibentuk melalui kitosan yang diikat silang dengan glutaraldehid serta dicuci dengan air deionisasi dan larutan NaOH. Karakterisasi adsorben dilakukan dengan *Fourier Transform Infrared Spectroscopy* (FTIR) untuk analisis gugus fungsi dan *Scanning Electron Microscope–Energy Dispersive X-Ray* (SEM–EDX) untuk analisis morfologi permukaan adsorben. Setelah dilakukan uji aktivitas adsorben film kitosan termodifikasi, proses adsorpsinya dioptimalisasi dari faktor pH adsorbat, massa adsorben, waktu kontak, dan konsentrasi awal adsorbat.

Berdasarkan hasil karakterisasi dan uji aktivitas adsorben, film kitosan termodifikasi EPTAC telah berhasil dilakukan. Hasil karakterisasi FTIR film kitosan termodifikasi EPTAC menunjukkan hilangnya puncak 1589 cm^{-1} yaitu vibrasi tekuk N–H dan munculnya puncak 1473 cm^{-1} yaitu vibrasi tekuk C–H. Karakterisasi SEM–EDX juga menunjukkan perubahan morfologi permukaan lebih kasar dan berpori serta meningkatnya jumlah atom N, C, dan Cl yang membuktikan keberhasilan substitusi gugus amonium kuaterner pada struktur kitosan. Adsorben film kitosan termodifikasi EPTAC menghasilkan kemampuan adsorpsi lebih baik daripada film kitosan tanpa modifikasi dengan kapasitas adsorpsi maksimum sebesar 110 mg g^{-1} pada pH 4 dengan adsorben $0,03\text{ g}$ selama 120 menit pada konsentrasi larutan RBBR 300 mg L^{-1} . Adsorpsi penelitian ini mengikuti kinetika orde dua semu dengan nilai konstanta laju adsorpsi $0,000005\text{ g mg}^{-1}\text{ menit}^{-1}$ dan isoterm Langmuir dengan konstanta Langmuir 18.859 L mol^{-1} .

Kata kunci: adsorpsi, anionik, EPTAC, kationik, kitosan

UTILIZATION OF EPTAC MODIFIED CATIONIC CHITOSAN FILM AS ADSORBENT FOR THE ADSORPTION OF ANIONIC DYE REMAZOL BRILLIANT BLUE R (RBBR) IN SOLUTION

Yona Anugerah Sunia
22/497030/PA/21387

ABSTRACT

A study on the utilization of EPTAC modified cationic chitosan film as an adsorbent for the adsorption of the anionic dye Remazol Brilliant Blue R (RBBR) from aqueous solutions has been conducted. The objectives of this research were to evaluate the modification and characterization of chitosan cationization using EPTAC for its application as an adsorbent. This study also aimed to investigate adsorption conditions including pH, adsorbent mass, contact time, and initial adsorbate concentration in the adsorption process of anionic RBBR dye, and to examine the adsorption kinetics and isotherm of anionic RBBR using EPTAC modified cationic chitosan film.

Chitosan cationization was carried out through modification with 2,3-Epoxypropyl trimethyl ammonium chloride (EPTAC) derived from 3-Chloro-2-hydroxypropyl trimethyl ammonium chloride (CHPTAC) in the presence of NaOH. The chitosan film was prepared by crosslinking chitosan with glutaraldehyde, followed by washing with deionized water and NaOH solution. Adsorbent characterization was conducted using Fourier Transform Infrared Spectroscopy (FTIR) for functional group analysis and Scanning Electron Microscopy–Energy Dispersive X-ray (SEM–EDX) for surface morphology analysis. After evaluating the adsorption activity of the modified chitosan film, the adsorption process was optimized by factors such as adsorbate pH, adsorbent mass, contact time, and initial adsorbate concentration.

Based on the characterization and adsorption activity results, the modification of chitosan film with EPTAC was successfully synthesized. The FTIR characterization of the EPTAC modified chitosan film showed the disappearance of peak at 1589 cm^{-1} corresponding to N–H bending vibration and the appearance of peak at 1473 cm^{-1} attributed to C–H bending vibration. The SEM–EDX analysis also revealed a rougher and more porous surface morphology, along with an increased number of N, C, and Cl atoms, confirming the successful substitutions of quaternary ammonium groups onto chitosan structure. The modified chitosan film adsorbent exhibited good adsorption performance than the unmodified chitosan film with a maximum adsorption capacity of 110 mg g^{-1} at pH 4, using 0.03 g of adsorbent for 120 minutes at an initial RBBR concentration of 300 mg L^{-1} . The adsorption process followed a pseudo-second-order kinetic model with an adsorption rate constant of $0.000005\text{ g mg}^{-1}\text{ min}^{-1}$ and conformed to the Langmuir isotherm model with a Langmuir constant of $18,859\text{ L mol}^{-1}$.

Keywords: adsorption, anionic, cationic, chitosan, EPTAC