

**STUDI ADSORPSI ZAT WARNA ANIONIK
REMAZOL BRILLIANT VIOLET 5R MENGGUNAKAN SERAT KAPAS
TERKATIONISASI DENGAN 3-KLORO-2-HIDROKSIPROPIL
TRIMETILAMMONIUM KLORIDA**

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INTISARI

Penelitian ini bertujuan untuk mempelajari adsorpsi zat warna anionik *Remazol Brilliant Violet 5R* (RBV5R) menggunakan serat kapas yang dimodifikasi dengan senyawa (3-kloro-2-hidroksipropil)trimetilammonium klorida (CHPTAC). Fokus utama meliputi proses modifikasi dan karakterisasi adsorben, optimasi parameter adsorpsi, evaluasi model kinetika dan isoterm adsorpsi, serta kajian desorpsi untuk menilai potensi regenerasi adsorben. Model kinetika adsorpsi yang digunakan terdiri atas orde pertama, orde kedua, orde pertama semu, dan orde kedua semu dengan model isoterm adsorpsi Langmuir dan Freundlich.

Modifikasi serat kapas dilakukan dalam kondisi alkali menggunakan CHPTAC, kemudian dikarakterisasi dengan spektroskopi FTIR dan SEM-EDX. Proses adsorpsi dikaji terhadap pengaruh pH larutan, massa adsorben, waktu kontak, dan konsentrasi awal RBV5R. Data eksperimen digunakan untuk analisis model kinetika dan isoterm adsorpsi. Proses desorpsi dilakukan menggunakan berbagai pelarut dan variasi waktu kontak.

Hasil menunjukkan bahwa modifikasi menggunakan kapas dengan CHPTAC berhasil, ditandai dengan munculnya gugus amonium kuarterner dan peningkatan kandungan nitrogen. Adsorpsi optimum terjadi pada pH 6, massa adsorben 50 mg, waktu kontak 120 menit, dan konsentrasi awal 500 mg L⁻¹. Proses adsorpsi mengikuti model kinetika orde kedua semu ($k_2 = 0,015 \text{ g mg}^{-1} \text{ menit}^{-1}$) dan model isoterm Langmuir dengan kapasitas maksimum 163,93 mg g⁻¹. Desorpsi paling efektif dicapai dengan NaSCN 1 M sebesar 12,32% dalam 120 menit. Hasil ini menunjukkan bahwa serat kapas termodifikasi CHPTAC berpotensi sebagai adsorben ramah lingkungan yang dapat digunakan ulang untuk pengolahan limbah zat warna anionik.

Kata kunci: adsorpsi, CHPTAC, desorpsi, isoterm, kinetika, *Remazol Brilliant Violet 5R*, serat kapas.

**ADSORPTION STUDY OF ANIONIC DYE
REMAZOL BRILLIANT VIOLET 5R USING COTTON FIBER
CATIONIZED WITH 3-CHLORO-2-HYDROXYPROPYL
TRIMETHYLAMMONIUM CHLORIDE**

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ABSTRACT

The study investigates the adsorption of the anionic dye *Remazol Brilliant Violet 5R* (RBV5R) using cotton fiber modified with (3-chloro-2-hydroxypropyl) trimethylammonium chloride (CHPTAC). The objectives were to synthesize and characterize the CHPTAC-cationized cotton fiber, optimize the adsorption parameters, evaluate adsorption kinetics and isotherms, and assess the desorption behavior of the dye. The adsorption kinetics was determined using first order, second order, pseudo-first order, and pseudo-second order with the isotherms Langmuir and Freundlich models.

The modification process was carried out by treating cotton fiber with CHPTAC under alkaline conditions. The resulting adsorbent was characterized by Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy with Energy Dispersive X-ray (SEM-EDX). The adsorption experiments investigated the effects of solution pH, adsorbent dosage, contact time, and initial dye concentration. Kinetic and isotherm models were applied to the experimental data. Desorption was evaluated using different desorbing agents and contact times.

The results demonstrated that CHPTAC modification was successful, as indicated by the appearance of characteristic quaternary ammonium functional groups and increased nitrogen content. The adsorption process reached optimum conditions at pH 6, 50 mg of adsorbent, 120 minutes of contact time, and an initial dye concentration of 500 mg L⁻¹. The adsorption followed a pseudo-second-order kinetic model ($k_2 = 0.015 \text{ g mg}^{-1} \text{ min}^{-1}$) and conformed to the Langmuir isotherm model with a maximum adsorption capacity of 163.93 mg g⁻¹. Among the tested desorbing agents, 1 M NaSCN was the most effective, achieving 12.32% desorption at 120 minutes. These findings suggest that CHPTAC-cationized cotton fiber is a promising reusable adsorbent for the removal of anionic dyes from aqueous solutions.

Keywords: adsorption, CHPTAC, cotton fiber, desorption, isotherm, kinetics, *Remazol Brilliant Violet 5R*.