

**MANIK KOMPOSIT BERBASIS KARBON AKTIF DARI AMPAS KOPI  
TERMODIFIKASI KITOSAN SEBAGAI ADSORBEN  
ZAT WARNA METIL ORANYE**

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**INTISARI**

Sintesis manik komposit yang melibatkan karbon aktif dari ampas kopi yang telah dimodifikasi dengan kitosan sebagai adsorben untuk zat warna metil oranye telah berhasil dilakukan. Penelitian ini dilakukan dalam dua tahap, tahap pertama preparasi karbon aktif dari ampas kopi melalui karbonisasi dan tahap kedua modifikasi karbon aktif dengan kitosan melalui reaksi taut silang (AC-CS). Material dikarakterisasi dengan *Fourier Transform Infra-Red Spectroscopy* (FTIR) dan *X-Ray Diffraction* (XRD). Selanjutnya dilakukan kajian adsorpsi zat warna metil oranye menggunakan adsorben AC-CS. Parameter adsorpsi yang diteliti dalam penelitian ini mencakup massa adsorben, waktu kontak, konsentrasi awal adsorbat, dan pH larutan.

Hasil karakterisasi menunjukkan bahwa AC-CS telah berhasil disintesis. Data FTIR menunjukkan bahwa gugus amina dan hidroksil dari kitosan telah terikat pada AC-CS. Data XRD menunjukkan bahwa AC-CS memiliki struktur amorf dan muncul puncak khas kitosan. Adsorpsi zat warna metil oranye menggunakan adsorben AC-CS mencapai kondisi optimum pada massa adsorben 0,20 g, waktu kontak 45 menit, konsentrasi awal 80 mg L<sup>-1</sup>, dan pH 4. Adsorpsi zat warna metil oranye mengikuti model kinetika orde kedua semu dan model isoterm Langmuir. Studi aplikasi adsorpsi zat warna dari sampel limbah buatan secara bertahap menunjukkan bahwa penghilangan zat warna metil oranye membutuhkan lima kali tahapan adsorpsi agar diperoleh konsentrasi zat warna yang rendah (< 10 mg L<sup>-1</sup>).

Kata kunci: adsorpsi, ampas kopi, karbon aktif, kitosan, metil oranye

## **COMPOSITE BEADS BASED ON ACTIVATED CARBON FROM CHITOSAN-MODIFIED SPENT COFFEE GROUNDS ARE USED AS AN ADSORBENT FOR METHYL ORANGE DYE**

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### **ABSTRACT**

The synthesis of composite beads, utilizing activated carbon derived from chitosan-modified spent coffee grounds as an adsorbent for methyl orange dye, has been conducted. This research was carried out in two stages. The first stage involved preparing activated carbon from spent coffee grounds through carbonization, while the second stage involved modifying the activated carbon with chitosan through a cross-linking reaction (AC-CS). The materials were characterized using Fourier Transform Infrared Spectroscopy (FTIR) and X-Ray Diffraction (XRD). Furthermore, an adsorption study of methyl orange dye using AC-CS as the adsorbent was conducted. The adsorption parameters studied in this research included the mass of the adsorbent, contact time, initial concentration of the adsorbate, and the effect of solution pH.

The characterization results indicate the successful synthesis of AC-CS. The FTIR spectra demonstrate that the amine and hydroxyl groups of chitosan have been bound to AC-CS. The XRD diffractogram data reveals that AC-CS possesses an amorphous structure with a typical chitosan peak. The optimum conditions for adsorbing methyl orange dye using AC-CS as the adsorbent were achieved with a mass of 0.20 g, a contact time of 45 minutes, an initial concentration of 80 mg L<sup>-1</sup>, and a pH of 4. The adsorption of methyl orange dye followed both a pseudo second-order kinetic model and Langmuir isotherm models. A study involving the application of dye adsorption to man-made waste samples demonstrated that removal of methyl orange dye required five sequential adsorption steps to achieve a low dye concentration (< 10 mg L<sup>-1</sup>).

**Keywords:** activated carbon, adsorption, chitosan, coffee grounds, methyl orange