# SINTESIS DAN KARAKTERISASI NANOKOMPOSIT KARBON AKTIF TANDAN PISANG TERMODIFIKASI MAGNETIT UNTUK ADSORPSI ZAT WARNA KATION KRISTAL VIOLET

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## INTISARI

Telah dilakukan sintesis nanokomposit karbon-aktif@magnetit sebagai adsorben zat warna kation kristal violet. Karbon aktif disintesis dari tandan pisang menggunakan metode pirolisis pada suhu 800 ºC dan diaktivasi dengan KOH. Sintesis adsorben nanokomposit karbon-aktif@magnetit dilakukan dengan metode sonokopresipitasi dan memanfaatkan $NH_4OH$ sebagai agen pengendap hingga pH mencapai 11. Material hasil sintesis dikarakterisasi dengan FTIR, XRD, XRF, VSM dan SEM-EDX. Kajian adsorpsi kristal violet dilakukan dalam sistem *batch* dengan variasi pH, waktu, konsentrasi dan suhu. Adsorben dipisahkan dari larutan menggunakan medan magnet luar dan kristal violet dalam larutan dianalisis dengan menggunakan Spektrofotometer UV-vis.

Hasil penelitian menunjukkan bahwa adsorben nanokomposit karbon-aktif@magnetit telah berhasil disintesis. Hal ini dibuktikan pada adsorben nanokomposit karbon-aktif@magnetit terdapat ikatan Fe-O pada panjang gelombang 895 $cm^{-1}$, memiliki puncak difraktogram yang karakteristik untuk magnetit yaitu pada 2 theta 56,97º (511) dan 62,67º (222), nilai momen magnetik sebesar 27,42 emu $g^{-1}$, dan pada permukaan adsorben terbentuk pori-pori yang tidak serapat dengan pori-pori pada karbon aktif, hal ini dikarenakan magnetit telah berhasil terembankan pada permukaan karbon aktif dengan atom Fe sebesar 32%. Adsorben nanokomposit karbon-aktif@magnetit memiliki nilai $pH_{pzc}$ sebesar 5,6. Adsorpsi kristal violet terjadi secara optimum pada pH 6 dan mengikuti kinetika orde kedua semu dengan konstanta laju adsorpsi sebesar 0,0242 g $mg^{-1}$ $menit^{-1}$. Isoterm adsorpsi kristal violet mengikuti model Langmuir dan didapatkan kapasitas adsorpsi sebesar 22,624 mg $g^{-1}$. Parameter termodinamika menunjukkan bahwa proses adsorpsi bersifat eksotermis dan spontan dengan nilai perubahan entalpi (ΔH) sebesar -59,670 dan perubahan bebas Gibbs (ΔG) bernilai negatif.

Kata kunci: kristal violet, adsorpsi, nanokomposit karbon-aktif@magnetit

# SYNTHESIS AND CHARACTERIZATION OF MAGNETITE-MODIFIED BANANA BUNCHES ACTIVATED CARBON NANOCOMPOSITES FOR CRYSTAL VIOLET CATION DYE ADSORPTION

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## ABSTRACT

The synthesis of activated-carbon@magnetite nanocomposite as crystal violet cation dye adsorbent was conducted. Activated carbon was synthesized from banana bunches using pyrolysis method at 800 ºC and activated with KOH. The synthesis of activated-carbon@magnetite nanocomposite adsorbent was carried out by sonocoprecipitation method and utilizing $NH_4OH$ as precipitating agent until the pH reached 11. The synthesized materials was characterized by FTIR, XRD, XRF, VSM and SEM-EDX. Crystal violet adsorption studies were conducted in a batch system with variations in pH, time, concentration and temperature. The adsorbent was separated from the solution using an external magnetic field and the crystal violet in the solution was analyzed using a UV-vis Spectrophotometer.

The results showed that activated-carbon@magnetite nanocomposite adsorbent has been successfully synthesized. This is evidenced in the activated-carbon@magnetite nanocomposite adsorbent there is an Fe-O bond at a wavelength of 895 $cm^{-1}$, has a characteristic diffractogram peak for magnetite which is at 2 theta 56.97º (511) and 62.67º (222), a magnetic moment value of 27.42 emu $g^{-1}$, and on the surface of the adsorbent formed pores that are not as dense as the pores on activated carbon, this is because magnetite has successfully embraced on the surface of activated carbon with Fe atoms by 31.93%. The activated-carbon@magnetite nanocomposite adsorbent has a pHpzc value of 5.6. Adsorption of crystal violet occurred optimally at pH 6 and followed pseudo second-order kinetics with an adsorption rate constant of 0.0242 g $mg^{-1}$ $min^{-1}$. The adsorption isotherm of crystal violet followed the Langmuir model and obtained an adsorption capacity of 22.624 mg $g^{-1}$. Thermodynamic parameters showed that the adsorption process was exothermic and spontaneous with an enthalpy change (ΔH) value of -59.67 and a negative Gibbs free change (ΔG).

Keywords: cation crystal violet dye, adsorption, activated-carbon@magnetite.