SINTESIS NANOKOMPOSIT MAGNETIT/KARBON AKTIF DAN APLIKASINYA SEBAGAI ADSORBEN ZAT WARNA SAFRANIN O

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INTISARI

Telah dilakukan sintesis nanokomposit magnetit/karbon aktif sebagai adsorben zat warna kationik safranin O. Penelitian ini bertujuan untuk membuat nanokomposit magnetit/karbon aktif kulit jagung sebagai adsorben zat warna kationik safranin O dan mengetahui kondisi optimalnya. Karbon aktif disintesis dari kulit jagung yang dikarbonisasi pada suhu 350 °C selama 1 jam dan diaktivasi dengan larutan HCl. Sintesis adsorben nanokomposit magnetit/karbon aktif dilakukan dengan metode kopresipitasi dan memanfaatkan NH_4OH sebagai agen pengendap hingga pH mencapai 10. Material hasil sintesis dikarakterisasi dengan FTIR, XRD, dan SEM-EDX. Kajian adsorpsi safranin O dilakukan dalam sistem batch dengan variasi pH, waktu, massa, dan konsentrasi awal safranin O. Adsorben dipisahkan dari larutan dengan menggunakan medan magnet luar. Konsentrasi safranin O dalam larutan dianalisis menggunakan spektrofotometer UV-Vis.

Keberhasilan sintesis nanokomposit magnetit/karbon aktif ditunjukkan melalui analisis FTIR yang memperlihatkan pergeseran pita serapan gugus O–H, C–O, dan Fe–O, yang mengindikasikan adanya interaksi antara partikel Fe_3O_4 dengan gugus fungsi permukaan karbon aktif. Selain itu, hasil XRD menunjukkan puncak difraktogram khas magnetit pada 2θ 30,13° (220), 35,40° (311), 57,18° (511), dan 62,84° (440) dengan rata-rata ukuran kristalit sebesar 47,59 nm, sehingga mengonfirmasi bahwa nanokomposit berhasil terbentuk dengan baik. Adsorben nanokomposit magnetit/karbon aktif memiliki pH_{pzc} sebesar 6. Adsorpsi safranin O terjadi secara optimum pada pH 9 dan mengikuti model kinetika adsorpsi orde kedua semu. Isoterm adsorpsi safranin O mengikuti model isoterm adsorpsi Langmuir dan didapatkan kapasitas adsorpsi maksimum sebesar 46,08 mg g^{-1}.

Kata kunci: adsorpsi, magnetit, karbon aktif, safranin O

SYNTHESIS OF MAGNETITE/ACTIVATED CARBON NANOCOMPOSITE AND ITS APPLICATION AS AN ADSORBENT FOR SAFRANIN O DYES

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ABSTRACT

Magnetite/activated carbon nanocomposites were successfully synthesized as an adsorbent for the cationic dye safranin O. This study aimed to prepare magnetite/activated carbon nanocomposites derived from corn husk as an adsorbent for safranin O and to determine the optimum adsorption conditions. Activated carbon was synthesized from corn husk through carbonization at 350 °C for 1 hour, followed by activation using an HCl solution. The magnetite/activated carbon nanocomposite was prepared using a coprecipitation method, with NH_4OH employed as a precipitating agent until the pH reached 10. The synthesized materials were characterized using FTIR, XRD, and SEM-EDX. Adsorption studies of safranin O were conducted in a batch system with variations in pH, contact time, adsorbent mass, and initial dye concentration. The adsorbent was separated from the solution using an external magnetic field. The concentration of safranin O in the solution was analyzed using a UV–Vis spectrophotometer.

The successful synthesis of the magnetite/activated carbon nanocomposite was confirmed by FTIR analysis, which showed shifts in the absorption bands of O–H, C–O, and Fe–O functional groups, indicating interactions between Fe_3O_4 particles and the surface functional groups of activated carbon. Furthermore, XRD analysis revealed characteristic magnetite diffraction peaks at 2θ values of 30.13° (220), 35.40° (311), 57.18° (511), and 62.84° (440), with an average crystallite size of 47.59 nm, confirming the successful formation of the nanocomposite. The magnetite/activated carbon nanocomposite exhibited a pH_{pzc} of 6. The adsorption of safranin O was optimal at pH 9 and followed a pseudo-second-order kinetic model. The adsorption isotherm was best described by the Langmuir model, with a maximum adsorption capacity of 46.08 mg g^{-1}.

Keywords: activated carbon, adsorption, magnetite, safranin O