

## **SINTESIS KOMPOSIT ASAM HUMAT/KITOSAN/MAGNETIT DAN APLIKASINYA SEBAGAI ADSORBEN ZAT WARNA *MALACHITE GREEN***

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### **INTISARI**

Sintesis komposit asam humat/kitosan/magnetit (AHKM) sebagai adsorben zat warna *malachite green* telah dilakukan. Tujuan dari penelitian ini yaitu untuk sintesis asam humat yang dimodifikasi dengan kitosan dan magnetit guna menghasilkan adsorben dengan sifat magnetik, melakukan karakterisasi material, menentukan kondisi optimum adsorpsi, serta mempelajari kinerja adsorben. Penelitian diawali dengan ekstraksi asam humat dari tanah gambut berdasarkan kelarutan pada alkali dan asam. Komposit AHKM disintesis menggunakan metode kopresipitasi. Material komposit dikarakterisasi menggunakan FTIR, XRD, dan VSM. Kajian adsorpsi *malachite green* pada adsorben dilakukan dengan variasi pH, waktu kontak, dan konsentrasi. Kinerja adsorben dipelajari melalui penentuan kinetika dan isoterm adsorpsi *malachite green* pada komposit AHKM.

Hasil karakterisasi FTIR menunjukkan gugus-gugus fungsional khas asam humat (-COOH dan -OH), kitosan (NH<sub>2</sub>), dan magnetit (Fe-O) pada komposit. Uji kristalinitas dengan XRD menunjukkan kesesuaian pola difraksi dari asam humat, kitosan, dan magnetit serta penurunan kristalinitas karena terjadinya interaksi antar material. Kurva histeresis dari VSM menunjukkan nilai saturasi magnetik yang menurun dari magnetit (50,79 emu g<sup>-1</sup>) ke komposit (12,88 emu g<sup>-1</sup>) karena penurunan kejenuhan partikel magnetit ketika dimodifikasi dengan material lain. Uji adsorpsi *malachite green* pada AHKM menghasilkan kondisi optimum adsorpsi pada pH 7, waktu kontak 120 menit, dan konsentrasi 180 ppm. Kinetika adsorpsi mengikuti model orde dua semu (Ho – McKay) dengan nilai konstanta laju adsorpsi sebesar  $2,38 \times 10^{-3} \text{ g mg}^{-1} \text{ menit}^{-1}$  dan  $r^2$  sebesar 0,9578. Isoterm adsorpsi mengikuti model Freundlich dengan nilai kapasitas adsorpsi sebesar 17,5 L g<sup>-1</sup> dan  $R^2$  sebesar 0,9997.

Kata kunci: adsorpsi, asam humat, kitosan, magnetit, *malachite green*

## **SYNTHESIS OF HUMIC ACID/CHITOSAN/MAGNETITE COMPOSITE AND ITS APPLICATION AS MALACHITE GREEN DYE ADSORBENT**

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### **ABSTRACT**

Synthesis of humic acid/chitosan/magnetite (AHKM) composite as an adsorbent for malachite green dye has been conducted. The objectives of this study were to synthesize modified humic acid with chitosan and magnetite to produce an adsorbent with magnetic properties, characterize the material, determine optimum adsorption conditions, and investigate the performance of the adsorbent. The research began with the extraction of humic acid from peat soil based on solubility in alkali and acid. The AHKM composite was synthesized using a co-precipitation method. The composite material was characterized using FTIR, XRD, and VSM. Adsorption studies of malachite green on the adsorbent were carried out by varying pH, contact time, and concentration. The performance of the adsorbent was studied by determining the kinetics and isotherms of malachite green adsorption on the AHKM composite.

The FTIR characterization results showed the presence of characteristic functional groups of humic acid ( $-\text{COOH}$  and  $-\text{OH}$ ), chitosan ( $\text{NH}_2$ ), and magnetite ( $\text{Fe-O}$ ) in the composite. The XRD crystallinity test showed the compatibility of the diffraction patterns of humic acid, chitosan, and magnetite, as well as a decrease in crystallinity due to the interaction between the materials. The hysteresis curve from VSM showed a decrease in saturation magnetization from magnetite ( $50.79 \text{ emu g}^{-1}$ ) to the composite ( $12.88 \text{ emu g}^{-1}$ ) due to a decrease in the saturation of magnetite particles when modified with other materials. Adsorption tests of malachite green on AHKM resulted in optimum adsorption conditions at pH 7, contact time 120 minutes, and concentration 180 ppm. The adsorption kinetics followed the pseudo-second order model (Ho – McKay) with an adsorption rate constant value of  $2.38 \times 10^{-3} \text{ g mg}^{-1} \text{ min}^{-1}$  and  $r^2$  of 0.9578. The adsorption isotherm followed the Freundlich model with an adsorption capacity value of  $17.5 \text{ L g}^{-1}$  and  $R^2$  of 0.9997.

**Keywords:** adsorption, chitosan, humic acid, magnetite, malachite green