

FOTOKATALIS g-C₃N₄/Co/TiO₂-HAp UNTUK FOTODEGRADASI MALACHITE GREEN MELALUI IRADIASI SINAR TAMPAK: STUDI PENGARUH VARIASI PENAMBAHAN TiO₂

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INTISARI

Pada penelitian ini, fotokatalis g-C₃N₄/Co/TiO₂-HAp telah berhasil disintesis dan diaplikasikan dalam fotodegradasi zat warna *malachite green* (MG) melalui iradiasi sinar tampak. Penelitian ini bertujuan untuk mempelajari pengaruh penambahan TiO₂ terhadap kinerja fotokatalis g-C₃N₄/Co/TiO₂-HAp. Sintesis dilakukan secara bertahap melalui metode sol-gel yaitu pembentukan komposit TiO₂-HAp dengan rasio TiO₂:HAp 1:1, 2:1, dan 3:1, dilanjutkan dengan doping Co dan pengkompositan g-C₃N₄. Karakterisasi material dilakukan dengan analisis XRD, FTIR, SRUV, FESEM-EDX, dan TEM-SAED. Aktivitas fotokatalitik dievaluasi menggunakan spektrofotometri UV-Vis melalui studi kinetika pada kondisi optimum pH, massa fotokatalis, konsentrasi awal MG dan variasi waktu penyinaran, serta uji penggunaan ulang selama 3 siklus penggunaan.

Hasil penelitian menunjukkan bahwa variasi TiO₂-HAp 3:1 memiliki karakteristik paling unggul dalam fotodegradasi zat warna MG dengan efisiensi fotodegradasi sebesar 72,28%. Kondisi optimum fotodegradasi MG diperoleh pada pH 5, massa fotokatalis g-C₃N₄/Co/TiO₂-HAp 20 mg, dan konsentrasi awal zat warna MG 10 mg/L. Fotokatalis g-C₃N₄/Co/TiO₂-HAp dapat mendegradasi zat warna MG hingga 99,13% selama 70 menit melalui iradiasi sinar tampak. Nilai laju reaksi (k) sebesar 0,05977 menit⁻¹ menunjukkan bahwa proses fotodegradasi MG berlangsung relatif cepat. Kemampuan penggunaan ulang fotokatalis g-C₃N₄/Co/TiO₂-HAp menunjukkan stabilitas yang cukup baik dalam fotodegradasi zat warna MG selama 3 siklus penggunaan.

Kata kunci: fotodegradasi *malachite green*, grafitik karbon nitrida, hidroksiapatit, kobalt, titanium dioksida

VISIBLE-LIGHT PHOTODEGRADATION OF MALACHITE GREEN USING g-C₃N₄/Co/TiO₂-HAp PHOTOCATALYST: EFFECT OF TiO₂ CONTENT VARIATION

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ABSTRACT

In this study, the g-C₃N₄/Co/TiO₂-HAp photocatalyst was successfully synthesized and applied for the photodegradation of malachite green (MG) dye under visible-light irradiation. The objective of this study was to investigate the effect of TiO₂ addition variation on the performance of the g-C₃N₄/Co/TiO₂-HAp photocatalyst. The synthesis was carried out stepwise using the sol-gel method, beginning with the preparation of TiO₂-HAp composites at TiO₂:HAp ratios 1:1, 2:1, and 3:1, followed by Co doping and g-C₃N₄ compositing. Material characterization was conducted using XRD, FTIR, SRUV, FESEM-EDX, and TEM-SAED analyses. The photocatalytic activity was evaluated using UV-Vis spectrophotometry through kinetic studies under optimum conditions of pH, photocatalyst mass, initial MG concentration, and irradiation time variation, as well as reusability tests over three cycles.

The results showed that the TiO₂-HAp 3:1 variation demonstrated the highest performance in the photodegradation of MG dye, with a photodegradation efficiency of 72.28%. The optimum conditions for MG photodegradation were obtained at pH 5, photocatalyst mass of 20 mg, and initial MG concentration of 10 mg/L. The g-C₃N₄/Co/TiO₂-HAp photocatalyst was able to degrade MG dye up to 99.13% within 70 minutes under visible-light irradiation. The reaction rate constant (k) value of 0.05977 min⁻¹ indicated that the photodegradation process of MG proceeded relatively rapidly. In addition, the reusability performance of the g-C₃N₄/Co/TiO₂-HAp photocatalyst demonstrated relatively good stability for MG dye photodegradation over three usage cycles.

Keywords: cobalt, graphitic carbon nitride, hydroxyapatite, malachite green photodegradation, titanium dioxide