

INTISARI

Sintesis komposit $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ dan uji aktivitasnya sebagai fotokatalis pada degradasi kuning metanil telah dilakukan. Tujuan dari penelitian ini yaitu untuk mendapatkan komposit $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ dengan cara sintesis dan karakterisasi material komposit, mengkaji pengaruh dopan sulfur terhadap aktivitas fotokatalitik $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ dan menguji aktivitas fotokatalitik $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ pada degradasi zat warna kuning metanil. Tahapan pertama yang dilakukan adalah sintesis material Fe_3O_4 dengan metode kopresipitasi. Tahapan kedua yaitu pelapisan material Fe_3O_4 dengan $\text{TiO}_2\text{-S}$ dengan metode sol-gel yang diikuti dengan pelakuan termal. Variasi konsentrasi dopan sulfur yang dikaji yaitu 1, 3, 5 dan 7 (%). Hasil sintesis komposit $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ dikarakterisasi dengan menggunakan FTIR, XRD, TEM, SEM-EDX, DR-UV dan VSM. Selanjutnya, komposit $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ diuji aktivitasnya pada degradasi zat warna kuning metanil. Larutan kuning metanil yang telah dikatalisis dianalisis absorbansinya menggunakan spektrofotometer UV-Vis.

Hasil penelitian menunjukkan $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ memiliki aktivitas fotokatalitik yang responsif terhadap sinar UV dan sinar tampak serta memiliki sifat kemagnetan. Konsentrasi dopan sulfur 1, 3, 5 dan 7 (%) memiliki energi celah pita berturut-turut 2,83; 2,81; 2,76 dan 2,84 (eV). Aktivitas fotokatalitik $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ 5 % mampu mendegradasi kuning metanil tertinggi pada paparan sinar tampak sebesar 73,44 % dan pada paparan sinar UV sebesar 66,99 % dengan massa fotokatalis 20 mg, pada larutan kuning metanil pH 2, konsentrasi 5 ppm dan waktu penyinaran 180 menit. Penggunaan Fotokatalis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ 5 % sebanyak 3 kali pengulangan didapatkan persen degradasi yang cenderung sama dan struktur yang stabil. Kinetika degradasi zat warna kuning metanil mengikuti model kinetika Ho dan McKay dengan tetapan laju reaksi sebesar $0,5251 \text{ g mg}^{-1}\text{menit}^{-1}$ pada paparan sinar tampak dan $0,5834 \text{ g mg}^{-1}\text{menit}^{-1}$ pada paparan sinar UV.

Kata Kunci: Fotokatalis, $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$, kuning metanil, degradasi fotokatalitik, sinar tampak

SYNTHESIS OF $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ COMPOSITE AND ITS ACTIVITY TEST AS PHOTOCATALYST ON THE METANIL YELLOW DEGRADATION

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ABSTRACT

Synthesis of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ composite and its activity as a photocatalyst in the degradation of metanil yellow have been investigated. The aims of this study were to obtain $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ composites by synthesizing and characterizing composite materials, to examine the effect of sulfur dopants on the photocatalytic activity of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$, and to examine the photocatalytic activity of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ on the degradation of metanil yellow dye. The first step was the synthesis of Fe_3O_4 material by the precipitation method. The second stage was coating Fe_3O_4 material with $\text{TiO}_2\text{-S}$ with the sol-gel method followed by thermal treatment. The variation of sulfur dopant was 1, 3, 5, and 7 (%). The synthesized $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ composites were characterized using FTIR, XRD, TEM, SEM-EDX, DR-UV, and VSM. Furthermore, the $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ composite was tested for its photoactivity on the degradation of metanil yellow dye. The catalyzed metanil yellow solution was analyzed for absorbance using a UV-Vis spectrophotometer.

The results showed that $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ had a photocatalytic activity that was responsive to UV light and visible light and had magnetic properties. Sulfur dopant concentrations of 1, 3, 5 and 7 (%) had bandgap energies, respectively; 2.83; 2.81; 2.76 and 2.84 (eV). Photoactivity results showed that $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ 5 % photocatalyst with a mass of 20 mg, in a solution of metanil yellow 5 mg/L at pH 2, with irradiation time of 180 minutes, gave the highest percentage degradation of metanil yellow of 73.44 % and 66.99 %, under visible and UV light exposure, respectively. The use of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ 5 % photocatalyst for three repetitions obtained the almost similar percentage of degradation and a stable structure. The degradation kinetics of metanil yellow dye followed the Ho and McKay kinetic model with a reaction rate constant of $0.5251 \text{ g mg}^{-1} \text{ min}^{-1}$ on visible light exposure and $0.5834 \text{ g mg}^{-1} \text{ minute}^{-1}$ on exposure to UV light.

Keywords: Photocatalyst, $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$, metanil yellow, photocatalytic degradation, visible light