

SINTESIS $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ SEBAGAI FOTOKATALIS PADA DEGRADASI NATRIUM 3,3'-([1,1'-BIFENIL]-4,4'-DIYL)BIS(4-NAFTILAMINA-1-SULFONAT) (KONGO MERAH)

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INTISARI

Sintesis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ sebagai fotokatalis pada degradasi natrium 3,3'-([1,1'-bifenil]-4,4'-diyl)bis(4-naftilamina-1-sulfonat (kongo merah) telah dilakukan. Penelitian ini bertujuan untuk memperoleh $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ dengan cara sintesis dan melakukan karakterisasi material hasil sintesis, memahami penambahan sulfur terhadap karakter $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ sebagai fotokatalis, dan aktivitasnya sebagai fotokatalis degradasi zat warna kongo merah. Penelitian diawali dengan melakukan sintesis Fe_3O_4 . Material Fe_3O_4 dilapisi dengan TiO_2 dengan variasi rasio molar Fe/Ti 1:1, 1:3, 1:5, 1:10, 1:15, 3:1, 5:1, 10:1, dan 15:1. Material $\text{Fe}_3\text{O}_4/\text{TiO}_2$ diuji ketertarikannya terhadap magnet. Material $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ disintesis dengan menggunakan rasio molar Fe/Ti optimum. Fotokatalis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ disintesis dengan variasi rasio molar S/Ti 1, 2, 5, 10 dan 15%. Hasil sintesis dikarakterisasi dengan menggunakan spektrofotometer FT-IR, difraktometer sinar-X (XRD), spektrofotometer SR UV-Visible, *Scanning Electron Microscope* dengan *Energy Dispersive X-ray* (SEM-EDX) dan *Transmission Electron Microscope* (TEM). Aktivitas fotokatalitik TiO_2 , $\text{Fe}_3\text{O}_4/\text{TiO}_2$, dan $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ diuji dalam proses degradasi zat warna kongo merah. Proses degradasi zat warna dilakukan pada pH dan waktu optimum pada paparan sinar ultraviolet dan sinar tampak. Larutan yang telah didegradasi dianalisis absorbansinya menggunakan spektrofotometer UV-Vis.

Hasil penelitian menunjukkan bahwa $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ berhasil disintesis dengan rasio Fe/Ti optimum 1:5. Material ini dapat dipisahkan dengan mudah menggunakan magnet eksternal. Nilai energi celah pita (E_g) $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ menurun seiring dengan meningkatnya rasio molar S/Ti hingga pada titik optimumnya yaitu sebesar 3,05 eV pada rasio molar S/Ti 10%. Fotokatalis $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ memiliki persen degradasi kongo merah sebesar 98,78% di bawah sinar ultraviolet dan 98,75% di bawah sinar tampak dengan massa fotokatalis 20 mg dan rasio molar S/Ti 10% pada larutan kongo merah dengan konsentrasi 20 ppm dan pH 5 dengan waktu penyinaran 90 menit .

Kata kunci: $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$, fotokatalis, degradasi, kongo merah

SYNTHESIS OF $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ AS PHOTOCATALYST ON THE DEGRADATION OF SODIUM 3,3'-([1,1'-BIPHENYL]-4,4'-DIYL)BIS(4-AMINONAPHTALENE-1-SULFONATE) (CONGO RED)

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ABSTRACT

Synthesis of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ as photocatalyst on the degradation of sodium 3,3'-([1,1'-biphenyl]-4,4'-diyl)bis(4-aminonaphtalene-1-sulfonate) (congo red) has been done. The purposes of this research were to obtain $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ by synthesizing and characterize the synthesized material, study the effect of addition of sulfur to the character of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ as photocatalyst, and the activity of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ on congo red dye degradation. This research was initiated by synthesis of Fe_3O_4 . The Fe_3O_4 was then coated by TiO_2 with various Fe/Ti molar ratio of 1:1, 1:3, 1:5, 1:10, 1:15, 3:1, 5:1, 10:1, and 15:1. Attraction of $\text{Fe}_3\text{O}_4/\text{TiO}_2$ to magnetic field was then examined. The optimum molar ratio of Fe/Ti was utilized for synthesizing $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$. The $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ was synthesized with various S/Ti molar ratio of 1, 2, 5, 10 and 15%. The synthesized materials were characterized using FT-IR spectrophotometer, X-ray Diffractometer (XRD), SR UV-Visible spectrophotometer, Scanning Electron Microscope with Energy Dispersive X-ray (SEM-EDX) and Transmission Electron Microscope (TEM). Photocatalytic activity of TiO_2 , $\text{Fe}_3\text{O}_4/\text{TiO}_2$, and $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ were examined in degradation of congo red. The degradation was conducted at optimum pH and irradiated by ultraviolet and visible ray. Absorbances of degraded solutions were analyzed using UV-Vis spectrophotometer.

Results showed that $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ was successfully synthesized at optimum Fe/Ti molar ratio 1:5. This material could be separated easily using external magnet. Band gap energy (E_g) of $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ decreased as S/Ti molar ratio increased to its optimum point 3.05 eV on molar ratio of S/Ti 10%. The $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$ had degradation percentage 98.78% under ultraviolet radiaton and 98.75% under visible radiation using 20 mg of photocatalyst, molar ratio of S/Ti 10% in 20 ppm congo red solution with pH 5 for 90 minutes reaction time.

Key words: $\text{Fe}_3\text{O}_4/\text{TiO}_2\text{-S}$, photocatalyst, degradation, congo red.