EFFECT OF ANIONS ON PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE USING ZINC OXIDE POWDER

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Lihat Sebelah

EFFECT OF ANIONS ON PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE USING ZINC OXIDE POWDER

By
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A PITA research report submitted in partial fulfilment of
the requirements for the award of the degree of
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VERIFICATION AND APPROVAL FORM

This PITA research report entitled *Effect of Anions on Photocatalytic Degradation of Methylene Blue Dye using Zinc Oxide Powder* prepared and submitted by Nor'ain Bt Ismail @ Awang, Matric No. UK29500 in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology (Environment) has been examined and is recommended for approval of acceptance.

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DECLARATION

I hereby declare that this PITA research report entitled *Effect of Anions on Photocatalytic Degradation of Methylene Blue Dye using Zinc Oxide Powder* is the result of my own research except as cited in the references.

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ABSTRACT

Photocatalytic degradation process has been widely implemented in wastewater remediation and ZnO is extensively researched as the catalyst for the treatment. Photocatalytic degradation rate of organic pollutants is greatly influenced by impurity ions. Many studies revealed that certain anions have significant effects on the overall performance of photocatalysis system. Some of them can either enhance the rate of photocatalyst reaction or act as inhibitor that causes significant reduction in photodegradation rate. This study was conducted to investigate the effect of inorganic anions (chloride, Cl^-, carbonate, CO_3^{2-} and sulphate, SO_4^{2-}) on photocatalytic degradation of methylene blue (MB) dye using ZnO powder. The degradation process of 10 mg/L of MB was carried out in a batch, bench-scaled slurry photoreactor operating at ambient temperature under illumination of UV light (λ=254 nm) for 30 – 150 minutes. The ZnO loading content was set to 1 g/L. 200 mg/L of concentration of Cl^-, CO_3^{2-} and SO_4^{2-} in sodium salt was prepared. Photodegradation of MB dye was performed in the photocatalytic reactor at temperature 30°C in the presence of selected anion or its combinations. UV-Visible spectrophotometer was used for the measurement of MB concentration before and after photodegradation process. X-ray powder diffraction (XRD) was used for characterising the photocatalyst. The findings shows inorganic anions (CO_3^{2-}, SO_4^{2-}, Cl^-) caused variation in the rate of MB removal using ZnO as the photocatalyst. MB removal rate was increased in the presence of rate enhancer, SO_4^{2-} and Cl^- and it was marginally decreased in the presence of inhibitor, CO_3^{2-}. All studied combination of anions (CO_3^{2-} + SO_4^{2-}, SO_4^{2-} + Cl^- , CO_3^{2-} + SO_4^{2-} + Cl^-) served as inhibitors except for Cl^- + CO_3^{2-} combination. The inhibitors impeded photodegradation process, thus caused reduction in the rate of MB removal. Combination of Cl^-+CO_3^{2-} combination has slightly enhanced the rate of reaction. The highest MB removal rate achieved was 99.89 % in the presence of 200 mg/L of SO_4^{2-}.

KESAN ANION TERHADAP PEMEROSOTAN BERMANGKIN FOTO PEWARNA BIRU METILENA MENGGUNAKAN SERBUK ZINK OKSIDA

ABSTRAK

Proses pemerosotan pemangkin foto telah dilaksanakan secara meluas dalam pemulihan air sisa dan Zink Oksida (ZnO) dikaji secara meluas sebagai pemangkin untuk sesuatu rawatan. Kadar kemerosotan pemangkin foto bahan pencemar organik banyak dipengaruhi oleh ion bendasing. Banyak kajian menunjukkan bahawa anion tertentu mempunyai kesan yang ketara ke atas prestasi keseluruhan sistem pemangkin foto. Sebahagian daripadanya boleh sama ada meningkatkan kadar tindak balas pemangkin foto atau bertindak sebagai perencat yang menyebabkan pengurangan ketara dalam kadar pemerosotan. Kajian ini dilakukan untuk mengkaji kesan anion bukan organik (klorida, Cl^-, karbonat, CO_3^{2-} dan sulfat, SO_4^{2-}) terhadap pemerosotan bermangkin foto pewarna biru metilena (MB) menggunakan serbuk ZnO. Proses pemerosotan 10 mg/L MB dijalankan menggunakan alatan yang sedia ada pada suhu bilik di bawah pencahayaan cahaya Ultra Ungu (UV) (λ = 254 nm) untuk 30-150 minit. Kandungan muatan ZnO ditetapkan sebanyak 1 g/L. Cl^-, CO_3^{2-} dan SO_4^{2-} di dalam garam natrium disediakan pada kepekatan 200 mg/L. Pemerosotan-foto pewarna MB dilaksanakan dalam reaktor bermangkin foto pada suhu 30°C dalam kehadiran anion yang terpilih serta kombinasinya. Spektrofotometer Ultra-ungu Nampak digunakan untuk mengukur kepekatan MB sebelum dan selepas proses pemerosotan. XRD digunakan untuk mencirikan pemangkin foto. Hasil kajian menunjukkan anion tak organik (CO_3^{2-}, SO_4^{2-}, Cl^-) menyebabkan variasi pada kadar penyingkiran MB dengan menggunakan ZnO sebagai fotokatalis. Kadar penyingkiran MB telah meningkat dengan kehadiran peningkat kadar iaitu SO_4^{2-} and Cl^- dan ianya telah sedikit menurun dengan kehadiran perencat, CO_3^{2-}. Kajian yang melibatkan semua gabungan anion (CO_3^{2-}+ SO_4^{2-}, SO_4^{2-} +Cl^- , CO_3^{2-}+ SO_4^{2-}+ Cl^-) bertindak sebagai perencat kecuali gabungan Cl^-+CO_3^{2-}. Perencat telah menghalang proses pemerosotan pemangkin foto, sekali gus menyebabkan pengurangan dalam kadar penyingkiran MB. Gabungan Cl^-+ CO_3^{2-} telah menunjukkan sedikit peningkatan dalam kadar tindak balas. Kadar penyingkiran MB tertinggi yang telah dicapai adalah 99.89 % dengan kehadiran 200 mg/L SO_4^{2-}.