PHOTODEGRADATION MECHANISM OF METHYLENE BLUE IN HIGH SALINITY USING ZINC OXIDE PHOTOCATALYST

FARAHANA ATIKAH BINTI DZULKARNAIN

SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU

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By
FARAHANA ATIKAH BINTI DZULKARNAIN

A PITA report submitted in partial fulfilment of
the requirements for the award of the degree of
Bachelor of Technology (Environment)

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UNIVERSITI MALAYSIA TERENGGANU
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VERIFICATION AND APPROVAL FORM

This PITA research report entitled *Photodegradation Mechanism of Methylene Blue in High Salinity using Zinc Oxide Photocatalyst* prepared and submitted by Farahana Atikah Bt Dzulkarnain, Matric No UK29495 in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (Environment) has been examined and is recommended for approval of acceptance.

Approved by:

.....
Supervisor
Name: Dr Wan Rafizah binti Wan Abdullah @ Wan Abd. Rahman
Official Stamp: Date: 7/6/2016

DR. WAN RAFIZAH BT WAN ABDULLAH @ WAN ABD. RAHMAN
Pensyarah
Pusat Pengajian Kejuruteraan Kelautan
Universiti Malaysia Terengganu

.....
Head of Environmental Technology Program
Name: Prof. Dr. Ir. Ahmad bin Jusoh
Official Stamp PROF. IR. DR. AHMAD BIN JUSOH
Dean
School Of Ocean Engineering
Universiti Malaysia Terengganu
Date: 7/6/2016

DECLARATION

I hereby declare that this PITA research report entitled *Photodegradation Mechanism of Methylene Blue in High Salinity using Zinc Oxide Photocatalyst* is the result of my own research except as cited in the references.

Signature	: atikah
Name	: FARAHANA ATIKAH BT DZULKARNAIN
Matric No.	: UK29495
Date	: 7/6/2016

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PHOTODEGRADATION MECHANISM OF METHYLENE BLUE IN HIGH SALINITY USING ZINC OXIDE PHOTOCATALYST

ABSTRACT

Nowadays, the presence of toxic dyes in industrial wastewater is of great concern as they bring significant harm towards human health, aquatic lives and the environment in general. Photoassisted catalytic decomposition of organic pollutants using semiconductors as photocatalysts, has been a promising method for dyeing wastewater treatment, due to its ability of not producing any secondary toxic materials. There are several factors that can influence dye removal efficiency such as salinity, photocatalyst loading, initial concentration of dye and light irradiation time. Therefore, this study was conducted to evaluate the photocatalytic properties of ZnO under various processing conditions, mainly in high salinity condition. The degradation mechanism of methylene blue (MB) dye in high salinity condition by ZnO photocatalyst was investigated. 7.7 mg/L of MB dye solution was photodegraded under illumination of UV light for up to 150 min in the presence of 1 g/L of ZnO. The salinity of the solution was set at 64.7 g/L NaCl. The treated MB solution was characterized using UV-Visible spectrophotometer and FTIR analyses. XRD was used for carrying out the phase analysis on ZnO powder before and after photocatalytic degradation. Photodegradation of MB in high salinity condition using 1 g/L ZnO photocatalyst increased with increasing UV irradiation time. The presence of 64.7 g/L of Cl^- reduced the efficiency of ZnO to induce removal of MB by 4.21%. The removal rate, R of MB after 150 min in the salinity of 64.7 g/L was 91%. Decolourization of MB under UV light irradiation in the presence of ZnO and salinity was caused by the breaking of MB molecules into intermediate compounds. XRD analysis confirmed that no leaching of ZnO occurred even in such high Cl^- concentration. The outcomes from this study will definitely help to contribute towards the development of photocatalytic treatment system for industrial dyeing wastewater in terms of efficiency and cost.

MEKANISME PEMEROSOTAN FOTO PEWARNA BIRU METILENA DALAM KEMASINAN TINGGI MENGGUNAKAN PEMANGKIN FOTO ZINK OKSIDA

ABSTRAK

Pada masa kini, kehadiran pewarna toksik dalam sisa air industri adalah membimbangkan kerana mereka membawa kerosakan besar terhadap kesihatan manusia, kehidupan akuatik dan alam sekitar secara umum. Penguraian pencemar organik bermangkin berbantukan cahaya menggunakan semikonduktor sebagai fotokatalis, telah menjadi kaedah yang berkesan untuk rawatan air sisa pencelupan kerana kemampuannya untuk tidak menghasilkan sebarang bahan toksik sekunder. Terdapat beberapa faktor yang boleh mempengaruhi kecekapan penyingkiran pewarna seperti kemasinan, muatan pemangkin foto, kepekatan awal pewarna dan masa penyinaran cahaya. Oleh itu, kajian ini dijalankan untuk menilai sifat-sifat pemangkin foto ZnO dalam pelbagai keadaan pemprosesan, terutamanya dalam keadaan kemasinan tinggi. Mekanisme pemerosotan pewarna biru metilena (MB) dalam keadaan kemasinan yang tinggi oleh pemangkin foto ZnO telah disiasat. 7.7 mg/L larutan pewarna MB telah difoto-rosotkan di bawah pencahayaan cahaya UV sehingga 150 min dengan kehadiran 1 g/L ZnO. Kemasinan larutan telah ditetapkan pada 64.7 g/L NaCl. Larutan MB yang telah dirawat dicirikan menggunakan analisis spektrofotometer UV-boleh nampak dan FTIR. XRD telah digunakan untuk menjalankan analisis fasa pada serbuk ZnO sebelum dan selepas pemerosotan bermangkin foto. Pemerosotan foto bagi MB dalam keadaan kemasinan tinggi menggunakan 1 g/L pemangkin foto ZnO meningkat dengan peningkatan masa penyinaran UV. Kehadiran 64.7 g/L Cl^- mengurangkan kecekapan ZnO untuk mendorong penyingkiran MB sebanyak 4.21%. Kadar penyingkiran MB selepas 150 minit dalam kemasinan 64.7 g/L adalah 91%. Penyahwarnaan MB di bawah sinaran cahaya UV dengan kehadiran ZnO dan kemasinan disebabkan oleh pemecahan molekul MB kepada sebatian perantaraan. Analisis XRD mengesahkan tiada larut lesap ZnO berlaku walaupun dalam kepekatan Cl^- tinggi. Hasil daripada kajian ini pasti akan membantu untuk menyumbang ke arah pembangunan sistem rawatan pemangkin foto untuk air sisa industri pewarna dari segi kecekapan dan kos.