



UNIVERSITI PUTRA MALAYSIA

**DECOLORIZATION AND DECOMPOSITION OF TEXTILE WASTEWATER
USING A COMBINATION OF ELECTRON BEAM IRRADIATION AND
ACTIVATED SLUDGE PROCESSES**

NORLIRUBAYAH BINTI MOHD NASIR

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NORLIRUBAYAH BINTI MOHD NASIR

**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA**

2010

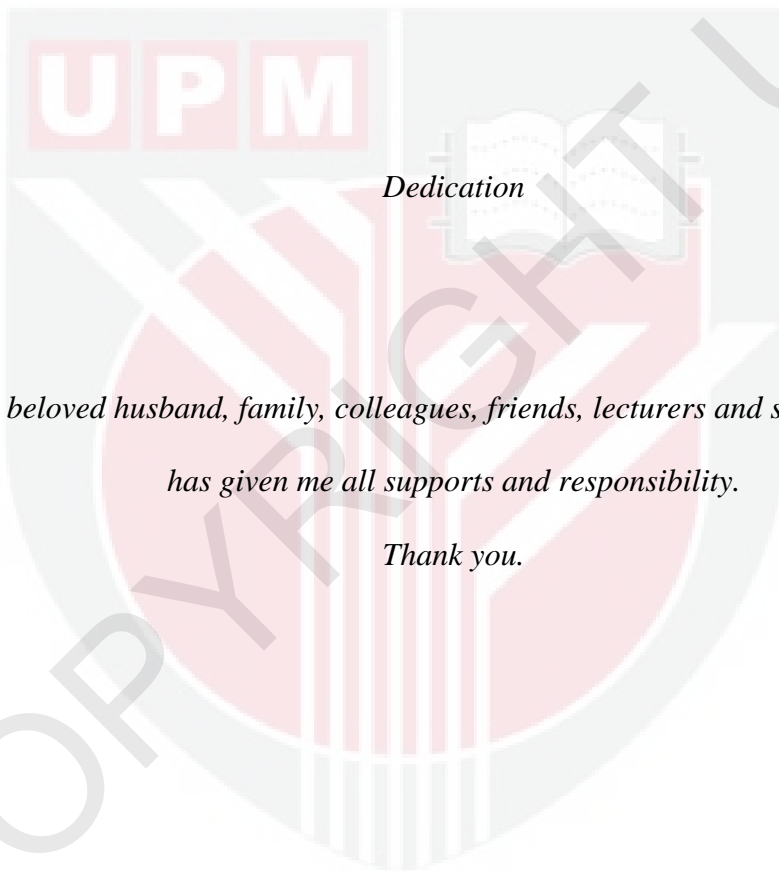
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By

NORLIRUBAYAH BINTI MOHD NASIR

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

December 2010



Dedication

*To my beloved husband, family, colleagues, friends, lecturers and supervisors, who
has given me all supports and responsibility.*

Thank you.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Chairman : Professor Fakhru'l-Razi Ahmadun, PhD

Faculty : Engineering

Treatment of industrial-organic wastewater using radiation has resulted into partial and full decompositions. This study is focused on textile wastewater. The ratio between partial and full decompositions depends on the dosage of irradiation and also the initial concentration of pollutants present. Textile wastewater contains strong color, pH, high temperature, high chemical oxygen demand (COD) concentration, high 5 day's biochemical oxygen demand (BOD₅) and high suspended solid contents. In this study, the decolorization and decomposition of textile wastewater using a combination of electron beam irradiation and activated sludge processes were investigated. The objectives of this study were to investigate the performance of a combined process of electron beam irradiation and activated sludge in decolorization and decomposition of textile wastewater which complies with Standards A and B of the Environmental Quality Act Regulation 1974 and also to investigate the influence of irradiation on the biodegradability of textile wastewater. This study involved two successive methods namely electron beam irradiation technology and activated

sludge process. The electron beam irradiation was effective in reducing the pH, the COD and the color of textile wastewater, while the application of an activated sludge process was efficient in decreasing the concentrations of COD and BOD₅. This study was conducted in three stages. At the primary treatment, the biodegradability ratio of influent calculated was between 0.38 and 0.4, while the value of biodegradability ratio of irradiated wastewater increased up to 0.51 and 0.55. At the secondary treatment, the average of the COD removal efficiencies of irradiated diluted and biologically treated effluents calculated were between 70% and 72%, and 88% and 90%, respectively. Meanwhile, the average values of the BOD₅ removal efficiency of irradiated diluted and biologically treated effluents were stated between 60% to 62%, and 94% to 95%, respectively. The average of the color removal efficiencies were higher for biologically treated compared to irradiated diluted for the HRTs of 5 days, 3 days and 2 days. The color removal efficiency of irradiated diluted achieved were between 60% and 61%, while for irradiated wastewater, the improvement of color removal efficiency increased up to 79% and 81%. At the tertiary treatment, the application of the technology of electron beam irradiation was to enhance the reduction of the COD and the color of biologically treated effluent. The doses varied at 25 kGy, 50 kGy and 100 kGy. The average of the COD removal efficiencies at 25 kGy, 50 kGy and 100 kGy obtained were between 90% to 91%, 91% to 92%, and 92% to 94%, respectively. Meanwhile, the increase of the color removal at 25 kGy, 50 kGy and 100 kGy were achieved up to 90% to 95%, 95% to 96%, and 97% to 98%, respectively. In conclusion, the application of electron beam radiation and activated sludge processes hold the greatest application of removing pollutants, reducing the color and also on enhancing the biodegradability of textile wastewater.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENYAHWARNAAN DAN PENGURAIAN AIR SISA TEKSTIL DENGAN
MENGUNAKAN KAEDAH GABUNGAN PENYINARAN ALUR
ELEKTRON DAN PROSES ENAPCEMAR TERAKTIF**

Oleh

NORLIRUBAYAH BINTI MOHD NASIR

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Penggunaan sinaran terhadap olahan air sisa industri organik akan menyebabkan penguraian separa dan penuh. Penyelidikan ini tertumpu kepada air sisa tekstil. Nisbah antara penguraian separa dan penuh bergantung kepada dos penyinaran dan kepekatan awal bahan pencemar yang hadir. Air sisa tekstil tersebut mengandungi tahap kepekatan warna, pH, keperluan oksigen kimia (COD), keperluan oksigen biokimia pada hari ke-5 (BOD₅) dan jumlah pepejal terampai yang tinggi. Dalam penyelidikan ini, penggunaan kombinasi kaedah penyinaran alur elektron dan proses enapcemar teraktif untuk olahan penyahwarnaan dan penguraian air sisa tekstil telah dikaji. Tujuan projek ini adalah untuk mengkaji gabungan kaedah penyinaran alur elektron dan proses enapcemar teraktif melalui penyahwarnaan dan penguraian air sisa tekstil sehingga mencapai tahap A and B Peraturan Akta Kualiti Alam Sekitar 1974 dan juga untuk mengkaji nisbah keterbiodegradan air sisa tekstil. Penyelidikan ini melibatkan dua kaedah iaitu teknologi penyinaran alur elektron dan proses enapcemar teraktif. Penyinaran alur elektron adalah berkesan untuk mengurangkan

pH, keperluan oksigen kimia (COD) dan warna air sisa tekstil, manakala, penggunaan proses enapcemar teraktif pula berkesan untuk pengurangan kepekatan keperluan oksigen kimia (COD) dan keperluan oksigen biokimia (BOD₅). Penyelidikan ini dijalankan dalam tiga peringkat. Pada rawatan pertama, nisbah keterbiodegradan air sisa permulaan adalah dikira antara 0.38 dan 0.4, manakala, nisbah keterbiodegradan sisa air yang telah disinarkan meningkat kepada 0.51 dan 0.55. Pada rawatan kedua, purata peratusan penyingkiran keperluan oksigen kimia (COD) air sisa pencairan tersinar dan air sisa terolah adalah antara 70% ke 72%, dan 88% ke 90% masing-masing. Manakala, bacaan purata peratusan penyingkiran keperluan oksigen biokimia (BOD₅) adalah direkodkan antara 60% ke 62% untuk air sisa pencairan tersinar dan air sisa terolah adalah dicatatkan antara 94% ke 95%. Purata peratusan penyingkiran warna air sisa terolah telah mencatatkan bacaan yang lebih tinggi jika dibandingkan dengan air sisa pencairan tersinar pada masa tahanan hidraulik 5 hari, 3 hari dan 2 hari. Purata peratusan penyingkiran warna air sisa pencairan tersinar adalah antara 60% ke 61%, manakala peningkatan peratusan penyingkiran warna air sisa terolah telah meningkat sehingga 79% ke 81%. Pada rawatan ketiga, penggunaan teknologi penyinaran alur elektron pada peringkat ketiga telah membuktikan peningkatan terhadap pengurangan keperluan oksigen kimia (COD) dan warna air sisa terolah. Dos yang telah dipilih adalah 25 kGy, 50 kGy dan 100 kGy. Purata peratusan penyingkiran keperluan oksigen kimia (COD) pada 25 kGy, 50 kGy dan 100 kGy adalah dicatatkan antara 90% ke 91%, 91% ke 92%, dan 92% ke 94% masing-masing. Manakala, purata peratusan peningkatan penyingkiran warna pada 25 kGy, 50 kGy dan 100 kGy, adalah antara 90% ke 95%, 95% ke 96%, dan 97% ke 98% masing-masing. Kesimpulannya, penggunaan penyinaran alur elektron dan proses enapcemar telah membuktikan keberkesanan terhadap

penyingkiran bahan pencemar, pengurangan warna dan juga peningkatan tahap keterbiodegradan air sisa tekstil.



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I certify that a Thesis Examination Committee has met on **13 December 2010** to conduct the final examination of Norlirubayah binti Mohd Nasir on her thesis entitled “**Decolorization and Decomposition of Textile Wastewater using a Combination of Electron Beam Irradiation and Activated Sludge Processes**” in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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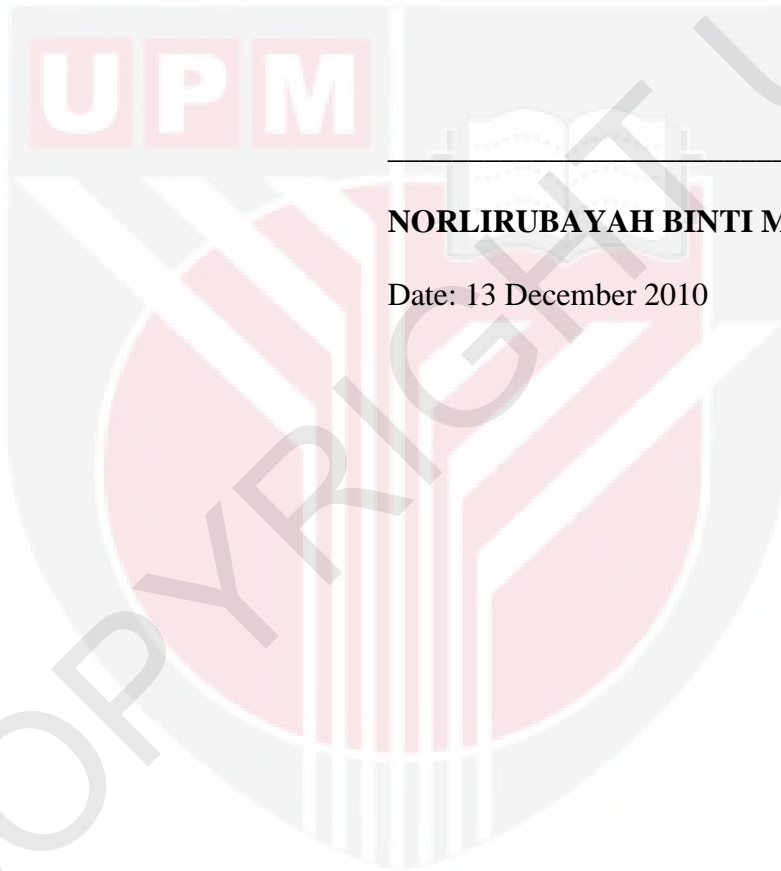
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



NORLIRUBAYAH BINTI MOHD NASIR

Date: 13 December 2010

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