



UNIVERSITI PUTRA MALAYSIA

**REMOVAL OF COLOUR AND ORGANIC POLLUTANTS FROM TEXTILE
WASTEWATER USING INTEGRATED BIOLOGICAL AND ADVANCED OXIDATION
PROCESS**

ADEL MOHAMED AHMED

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TEXTILE WASTEWATER USING INTEGRATED BIOLOGICAL
AND ADVANCED OXIDATION PROCESS**

By

ADEL MOHAMED AHMED

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

June 2007



*To the soul of my father.
A father who shows me his support from the day of
my cradle till the day he dies.
And to all faithful Muslims in the world.*



Abstract of the thesis presented to the Senate of Universiti Putra
Malaysia in fulfilment of requirement for the degree of Doctor of
Philosophy

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Chairman: Professor Azni Idris, PhD

Faculty : Engineering

Textile industrial wastewater effluent varies greatly in characteristics within a plant and even from the same process from time to time. Removal of pollutants such as colour and organics by conventional techniques has been difficult and could not reach the level of required discharge. In this study, colour and organic removals from textile wastewater in a continuous process using an integrated system of activated sludge and advanced oxidation process was studied. The primary objective was to reduce colour to 50 PtCo; the total organic carbon (TOC), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and total suspended solid (TSS) to less than 20, 50, 20 and 20 mg/l, respectively; and to remove oil and grease (O&G). Activated sludge was satisfactory in terms of removing TOC, COD, BOD, O&G and TSS. At 36 h



retention time, the removal of TOC, COD, BOD, O&G and TSS were 80, 78, 79, 53 and 61%, respectively. However, the colour removal was only 37%.

With equalization tank, combining of 50 mg/l O₃ with 1 ml/l H₂O₂ and UV was proven capable of reducing the colour, TOC, COD, BOD, O&G and TSS after 60 min by 97, 60, 64, 62, 90 and 36%, respectively.

Without equalization tank, activated sludge treatment was efficient in terms of removing TOC, COD, BOD, O&G and TSS from the different strengths of textile wastewater samples. Removals of TOC, COD, BOD, O&G and TSS were 76-86, 77-84, 78-82, 34-61 and 65-74%, respectively. However, colour removal was from 17 to 34%. This means that activated sludge was satisfactory in removing only organics pollutants.

Having different, easy control and successful processes that treat different strengths of textile wastewater is the best formulation of process treatment options to ensure appreciable removals of colour and organic pollutants from any strength of textile wastewater.

A software called TexTreat was successfully developed. It can determine the required process treatment option of AOP_s for any existing textile treatment plant and predict the characteristics of the final discharge using different retention times. The validation of the process treatment options using TexTreat shows their applicability with different textile wastewater plants.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra
Malaysia sebagai memenuhi keperluan untuk ijazah Doktor
Falsafah

**PENYINGKIRAN WARNA DAN BAHAN PENCEMAR ORGANIK
DARIPADA AIR SISA BUANGAN TEKSTIL MELALUL PROSES
BERSEPADU BIOLOGIKAL DAN PENGOKSIDAAN TERMAJU**

Oleh

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Januari 2007

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Ciri-ciri air sisa buangan industri tekstil adalah berbeza bagi setiap kilang malah juga berbeza walaupun ia melalui proses yang sama dari semasa ke semasa.

Penyingkiran bahan cemar seperti warna dan organik melalui teknik konvensional adalah sukar dan tidak dapat mencapai tahap pembuangan. Oleh itu, kajian penyingkiran warna dan organik daripada sisa buangan tekstil sebenar melalui proses berterusan menggunakan sistem bersepadu enapcemar teraktif dan proses pengoksidaan termaju dijalankan. Objektif utama kajian adalah untuk mengurangkan bahan cemar warna kepada 50 PtCo dan Jumlah Karbon Organik (TOC), Keperluan Oksigen Kimia (COD), Keperluan Oksigen Biokimia (BOD), dan Jumlah Pepejal Terampai (TSS) kepada nilai kurang daripada 50 mg/l serta penyingkiran Minyak dan Lemak (O&G).

Enapcemar teraktif berkesan dalam menyingkirkan TOC, COD, BOD, O&G dan TSS. Selepas 36 jam masa penahanan, penyingkiran TOC, BOD, O&G dan TSS adalah sebanyak 80, 78, 79, 53 dan 61%. Walaubagaimanapun, penyingkiran warna hanya sekadar 37% yang berkemungkinan disebabkan oleh kehadiran bahan organik tak berwarna dalam air sisa buangan tekstil dan kadar larut pewarna biodegradasi yang rendah.

Kombinasi 50mg/l O_3 dengan 1ml/l H_2O_2 dan UV dalam tangki penyamaan berupaya mengurangkan kadar warna TOC, COD, BOD, O&G dan TSS kepada 97, 60, 64, 62, 90 dan 36 %. Tanpa tangki penyamaan, rawatan ke atas enapcemar teraktif sangat berkesan dalam menyingkirkan TOC, COD, BOD, O&G dan TSS daripada sampel air sisa buangan tekstil yang mempunyai keupayaan yang berbeza. Nilai penyingkiran TOC, COD, BOD, O&G dan TSS adalah sebanyak 76-86, 77-84, 78-82, 34-61 dan 65-74%. Walaubagaimanapun, penyingkiran warna adalah dari 17 kepada 34%. Ini bermakna enapcemar teraktif hanya berkesan dalam menyingkirkan bahan cemar organik sahaja.

Oleh yang demikian, kawalan yang mudah dan proses yang berjaya dalam kepelbagaian keupayaan air sisa buangan tekstil merupakan strategi rawatan terbaik dalam memastikan penyingkiran lebih berkesan terhadap bahan cemar warna dan organik daripada semua jenis keupayaan air sisa buangan tekstil.

Proses regressi yang berkaitan dengan formulasi rawatan telah dibangunkan dalam kod perisian (TexTreat). Penilaian terhadap strategi rawatan dan juga TexTreat menunjukkan keupayaannya terhadap kepelbagaian air sisa buangan kilang tekstil.

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I certify that an Examination Committee has met on 21 June 2007 to conduct the final examination of Adel Mohamed Ahmed on his Doctor of Philosophy thesis entitled “Removal of Colour and Organic Pollutants From Textile Wastewater Using Integrated Biological and Advanced Oxidation Process” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

ADEL MOHAMED AHMED

Date: 25 September 2007

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