UNIVERSITI PUTRA MALAYSIA

CONCENTRATION AND DISTRIBUTION OF LINEAR ALKYLBENZENE IN SEDIMENTS OF SELECTED MALAYSIAN RIVERS AS MOLECULAR MARKERS OF SEWAGE TREATMENT EFFICIENCY

SAMI MUHSEN SLEMAN MAGAM

FPAS 2012 11

CONCENTRATION AND DISTRIBUTION OF LINEAR ALKYLBENZENE IN SEDIMENTS OF SELECTED MALAYSIAN RIVERS AS MOLECULAR MARKERS OF SEWAGE TREATMENT EFFICIENCY

By

SAMI MUHSEN SLEMAN MAGAM

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirement for the Degree of Master of Science in the Faculty of Environmental Studies

March 2012

DEDICATION

To my dear wife, close friends, my family, and my supervisor who have been the most important reasons of hopefulness during my study.

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfillment of the requirement of the degree of Master of Science

CONCENTRATION AND DISTRIBUTION OF LINEAR ALKYLBENZENE IN SEDIMENTS OF SELECTED MALAYSIAN RIVERS AS MOLECULAR MARKERS OF SEWAGE TREATMENT EFFICIENCY

By

SAMI MUHSEN SLEMAN MAGAM

March 2012

Chairman : Associate Professor Mohamad Pauzi Zakaria, PhD

Faculty : Environmental Studies

The present study investigates the distribution of linear alkylbenzenes (LABs) in sediment samples collected from selected locations in Sarawak, Sembulan, and Kuantan rivers in Peninsular Malaysia. Batch studies were conducted to assess the current status of domestic wastes and synthetic detergent pollution in sediments in these three rivers. Twenty three sampling stations have been selected for sediment collection. Analysis and quantification of LABs was carried out using gas chromatography-mass spectrometry (GC-MS). Concentrations of total LABs in ng/g on a dry weight basis (dw) in the sediment samples of Sarawak River, Sembulan River, and Kuantan River ranged from 156.5 to 7386.2; 643.2 to 5567.1; and 772.8 to 7517.6 ng/g dw, respectively. The *I/E* ratio (ratio of internal to external isomers of LABs) is employed to estimate the degree of degradation of LABs in aquatic environments, making it a powerful, though simple, tool for monitoring biodegradation of LABs in the environment. The *I/E* ratios for Sarawak, Sembulan, and Kuantan rivers fell in the ranges 0.52 to 1.24; 0.81 to 1.79; and 0.50 to 1.28, respectively. The *I/E* ratio at station two in Kuantan River was much lower than those

at the other stations, indicating that the sewage discharged into Kuantan River was poorly treated.

Anthropogenic activities may contribute to high levels of LABs in sediment samples. In addition to anthropogenic activities, natural features of the sampling location may contribute significant amounts of LAB discharges to the aquatic systems. In sum, the study results demonstrate that the LABs are useful as indicators of pollutants originating from domestic wastes and synthetic detergents.

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

KEPEKATAN DAN PENGAGIHAN LINEAR ALKYLBENZENE DALAM ENAPAN SUNGAI TERPILIH MALAYSIA SEBAGAI PENANDA MOLEKUL KECEKAPAN PENGOLAHAN KUMBAHAN

Oleh

SAMI MUHSEN SLEMAN MAGAM

Mac 2012

Pengerusi : Profesor Madya Mohamad Pauzi Zakaria, PhD

Fakulti : Pengajian Alam Sekitar

Kajian ini dijalankan bagi menyiasat tabiran linear alkil benzen (LAB) di dalam sampel sedimen yang diambil dari beberapa lokasi terpilih di sungai Sarawak, Sembulan dan Kuantan di Semenanjung Malaysia. Kajian sacara berkelompok telah dijalankan untuk menilai status terkini bagi pencemaran detergen sintetik dan sisa domestic di dalam sedimen dari tiga sungai tersebut. Dua puluh tiga stesen telah dipilih untuk penyampelan sedimen. Analisis dan kuantifikasi LAB telah dijalankan dengan menggunakan Kromatografi gas-spektometri jisim (GC-MS). Kepekatan jumlah LAB dalam unit ng/g berasaskan berat kering (dw) di dalam sampel sedimen sungai Sarawak, sungai Sembulan dan sungai Kuantan berjulat dari 156.5 hingga 7386.2; 643.2 hingga 5567.1; dan 772.8 hingga 7517.6 ng/g dw. Nisbah I/E (nisbah isomer LAB dalaman kepada luaran) diaplikasikan untuk menganggarkan darjah degradasi LAB di persekitaran akuatik, menjadikan ia suatu alat yang mudah lagi berkesan dalam pengawasan biodegradasi LAB di dalam alam sekitar. Nisbah I/E

bagi sungai Sarawak, Sembulan dan Kuantan berjulat dari 0.52 hingga 1.24; 0.81 hingga 1.79; dan 0.50 hingga1.28. Nisbah I/E di stesen dua di sungai Kuantan adalah sangat rendah dari stesen lain, menunjukkan bahawa pembuangan sisa kumbahan ke dalam sungai Kuantan adalah tidak dirawat dengan sempurna. Aktiviti antropogenik mungkin menyumbang kepada tahap kepekatan LAB yang tinggi di dalam sampel sedimen. Merujuk kepada aktiviti antropogenik, ciri-ciri semulajadi yang terdapat di stesen penyampelan mungkin telah menyumbang amaun LAB yang signifikan di dalam sistem akuatik. Kesimpulannya, hasil kajian menunjukkan bahawa LAB adalah berkesan sebagai penunjuk aras bagi bahan pencemar yang berasal dari sisa domestik dan detergen sintetik.

ACKNOWLEDGEMENTS

First of all, all Praise be to Allah, the Cherisher and the Sustainer of the world. This thesis would not have come into existence without the valuable help and support of great people. I am extremely grateful to Professor Dr. Mohamad Pauzi Zakaria, my supervisor for his keen supervision, continuous support and encouragement throughout my research study. His discussions and suggestions significantly improved the outcomes of this research. His sharp critical reading and comments on the manuscript did enhance the quality of my study. Special thanks and respect are also due to Dr.Normala Halimoon, the Co-supervisor, for his constructive comments, valuable pieces of advice and the continuous support.

I would like also to express my deep gratitude to Mr. Mohd Reza, Ms. Norliza Ismail, Mr. Abdalah Bakhet, Mr. Shaz'an bin Jamhari and Ms. Norazida Manan who helped and encouraged me from the initial stages of my study. Truly speaking I have been so much lucky to have such supportive research group at our laboratory. I would like also to thank Dr. Najat Al-odini, Dr.Anwar Al-shamiry, Dr. khaled Al-kodimi, Mr. Murad Al-salahi, Mr. Mohammed Gazaz and Mr. Esam for their kind assistance.

I would like to express my appreciation to Dr. Ahmad Homadi, Assistant President of Hodeidah University and Hodeidah University in general for granting me the scholarship to pursue my studies in UPM.

I wish to express my unlimited and eternal appreciation to my father, deceased mother, brothers and sisters for their endless support and encouragement. A special thank goes to my dear wife Najat Masood and my kids for their relentless support

throughout my study .They have been the source of strength and inspiration in times of hardships throughout the period of my study.

Finally, I would like to thank everyone who helped me in one way or another.

APROVAL

I certify that a Thesis Examination Committee has met on 1st April 2012 to conduct the final examination of Sami Muhsen Sleman Magam on his thesis entitled ³Concentration And Distribution Of Linear Alkylbenzene In Sediments Of Selected Malaysian Rivers as Molecular Markers of Sewage Treatment Efficiency´ L Q accordance with the Universities and University Colleges 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.

Members of the Thesis Examination Committee were as follows:

Ahmad Makmom Abdullah, Ph.D.
Associate Professor
Department of Environmental Science
Faculty of Environmental Studies
Universiti Putra Malaysia
(Chairman)

Karen Anne Crouse, Ph.D.
Y. Bhg. Professor
Department of Chemistry
Faculty of Science
Universiti Putra Malaysia
(Internal Examiner 1)

Mansor b Hj Ahmad, Ph.D.
Associate Professor
Department of Chemistry
Faculty of Science
Universiti Putra Malaysia
(Internal Examiner 2)

Mohd Talib Latif, Ph.D.
Associate Professor
Environmental and Natural Resource Sciences
Faculty of Science and Technology
Universiti Kebangsaan Malaysia (UKM)
(External Examiner)

Zulkarnain Zainal, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 24 April 2012

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Mohamed Pauzi Zakaria, PhD
Associate Professor
Faculty of Environmental Studies
Universiti Putra Malaysia
(Chairman)

Normala Halimoon, PhD
Lecturer
Faculty of Environmental Studies
Universiti Putra Malaysia
(Member)

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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.

SAMI MUHSEN SLEMAN MAGAM

Date

TABLE OF CONTENTS