UNIVERSITI PUTRA MALAYSIA

DETERMINATION OF PERFLUOROOCTANOIC ACID AND PERFLUOROOCTANE SULFONATE IN WATER SAMPLES FROM SUNGAI LANGAT, MALAYSIA

KHAIRUNNISA BINTI ZAINUDDIN

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By

KHAIRUNNISA BINTI ZAINUDDIN

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

October 2010

DEDICATION

To my father and mother who have been the most important reasons of anticipation during my study and my family who is my daily reminder of all that is good in this world.

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

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Chairman: Associate Professor Mohamad Pauzi Zakaria, PhD

Faculty: Environmental Studies

Perfluorinated compounds (PFCs) are non-degradable and persistent compounds, bioacculumative and possess toxic characterictics. The compounds are produced in large quantities, applied and disposed without proper monitoring and regulation within the last half-century. If the PFCs productions are to end today, the compounds would continue to persist in the environment for many years to come. Currently in Malaysia there are no studies concerning Perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonate (PFOS) and no regulations has been developed to control these compounds. The method used in this study involves solid phase extraction together with liquid

chromatography coupled with mass spectrometry (LC/MS/MS). Results from the water samples taken from Langat River, Malaysia indicated that relatively high concentration of PFOS can be found in the eastern of the river; one of the most populated areas within the basin (station S16 – station S35) with the highest concentration in station S35 (43.5 ng/mL). Reason for this is that the compound was highly used in industry as well as in manufacturing processes and consumer products. Relatively high concentration of PFOA can be found in station S6 (5.94 ng/mL) since station S6 is the station receiving effluent from landfill site. Continuous studies on the PFCs compounds could provide more data set and larger view of current state of PFCs contamination in Malaysian aquatic environments.

Keywords: Perfluorinated compounds (PFCs), Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulfonate (PFOS), Langat River and LC/MS/MS

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

MENENTUKAN ASID PERFLUOROOKTANOIK DAN SULFONAT PERFLUOROOKTAN DI SAMPEL AIR DARIPADA SUNGAI LANGAT, MALAYSIA

Oleh

KHAIRUNNISA BINTI ZAINUDDIN

Oktober 2010

Pengerusi: Profesor Madya Mohamad Pauzi Zakaria, PhD

Fakulti: Pengajian Alam Sekitar

Sebatian berfluorida (PFCs) adalah sangat tidak terurai, bioakumulasi, dan bersifat toksik. Sejak separuh abad yang lalu, PFCs telah dihasilkan, digunakan dan telah dibuang tanpa mengikut undang-undang. Walaupun sekiranya penghasilan PFC dihentikan pada masa ini, kadar pencemarannya di alam sekitar tetap tidak akan berubah untuk jangka masa panjang. Buat pengetahuan kami, tiada kajian yang di lakukan tentang asid perfluorooktanoik (PFOA) dan sulfonat perfluorooktan (PFOS) di Malaysia. Tiada undang-undang yang dibangunkan untuk mengawalselia sebatian-sebatian ini. Dalam kajian ini, kaedah kajian yang digunakan melibatkan pengekstrak fasa pepejal

(SPE) dan kromatografi cecair dengan spektrometri berjisim (LC/MS/MS). Keputusan yang diperolehi daripada sampel air Sungai Langat, Malaysia menunjukkan bahawa terdapat kepekatan PFOS yang tinggi di hulu sungai iaitu antara kawasan yang kepadatannya tinggi di lembah Sungai Langat (S16 – S35) dengan kepekatan yang tertinggi di S35 (43.5 ng/mL).. Ini adalah disebabkan oleh penggunaan sebatian ini di dalam industri dan sebagai salah satu sebatian di dalam produk pengguna. Kepekatan PFOA yang tinggi turut dilihat di S6 (5.94 ng/mL) menandakan stesyen ini berkemungkinan menjadi penyebab utama pencemaran PFOA di Sungai Langat. Stesyen ini menerima hasil buangan daripada pusat pembuangan sisa pepejal. Kajian tentang PFCs yang berterusan akan menghasilkan lebih banyak data dan pandangan luas tentang situasi semasa pencemaran PFCs di air sungai Malaysia.

Kata kunci: Sebatian berfluorida (PFC), asid perfluorooktanoik (PFOA), sulfonat perfluorooktan (PFOS), Sungai Langat dan LC/MS/MS

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I certify that a Thesis Examination Committee has met on 8 October 2010 to conduct the final examination of Khairunnisa binti Zainuddin on her thesis entitled "Determination of Perfluorooctanoic Acid and Perfluorooctane Sulfonate in Water Samples from Sungai Langat, Malaysia" 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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This thesis was submitted to Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follow:

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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 published previously and is not concurrently for any other degree at Universiti Putra Malaysia or any other institutions.

KHAIRUNNISA BINTI ZAINUDDIN

Date: 8 October 2010

TABLE OF CONTENTS