

DETERMINATION OF SELECTED TRACE METALS IN NETUS RIVER,
TERENGGANU

CHEM 30301111

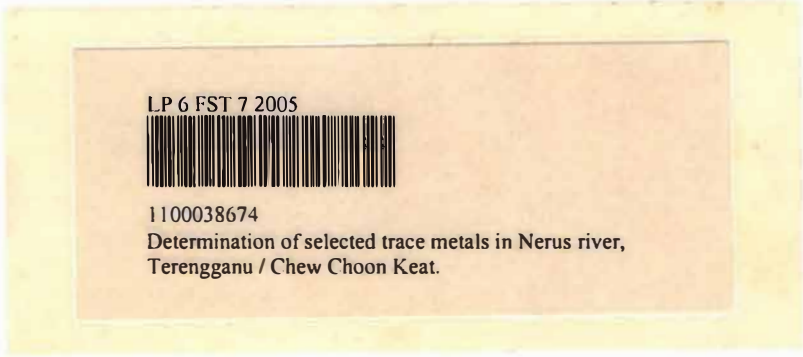
FACULTY OF SCIENCE AND TECHNOLOGY
UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA

2005

(NO/2182

1100038674

Perpustakaan
Kolej Universiti Sains Dan Teknologi Malaysia (KUSTEM)



PERPUSTAKAAN
KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA
21030 KUALA TERENGGANU

1100038674		

Lihat sebelah

LP
6
FST
23
3915

HAK MILIK
PERPUSTAKAAN KUSTEM

DETERMINATION OF SELECTED TRACE METALS IN NERUS RIVER,
TERENGGANU.

By

Chew Choon Keat

Research Report submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Science (Analytical and Environmental Chemistry)

Department of Chemical Science
Faculty of Science and Technology
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA
2005

1100038674



**JABATAN SAINS KIMIA
FAKULTI SAINS DAN TEKNOLOGI
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA**

**BORANG PENGESAHAN DAN KELULUSAN SARANAN
PROJEK PENYELIDIKAN I DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

Determination of Selected Trace Metals in Nerus River, Terengganu oleh **Chew Choon Keat**, No.Matrik **UK6755** telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Kimia sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah **Sarjana Muda Sains (Kimia Analisis dan Persekitaran)** Fakulti sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

Disahkan oleh:


.....

Penyelia Utama

Nama: **Prof. Madya Dr. Norhayati Mohd Tahir**

Cop Rasmi:

MORHAYATI MOHD TAHIR (Ph. D . PROF MADYA)
PENSYARAH
JABATAN SAINS KIMIA
FAKULTI SAINS DAN TEKNOLOGI
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA
MENGABANG TELIPOT, 21030 KUALA TERENGGANU

Tarikh:


.....

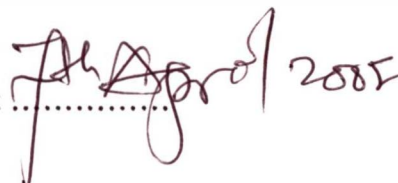
Ketua Jabatan Sains Kimia

Nama: **Prof. Madya Dr. Ku Halim Ku Bulat**

Cop Rasmi:

PROF. MADYA DR. KU HALIM KU BULAT
Ketua
Jabatan Sains Kimia
Fakulti Sains dan Teknologi
Kolej Universiti Sains dan Teknologi Malaysia
21030 Kuala Terengganu.
Tel: 09-6683257

Tarikh:


2005

ACKNOWLEDGEMENT

I would like to express my gratitude to my supervisor, Prof. Madya Dr. Norhayati Mohd Tahir for her advice, guidance, constructive comment and many valuable suggestions that greatly improved this thesis writing.

Next, I also extend deepest appreciation to the lab assistants especially Mr. Ruzeman, who have been great help in carrying out and completing my lab works. Besides that, I wish to thank to KUSTEM's librarians too. Thank you for their help to find me information needed to complete this mini project.

Not forgetting here to thank my project – mate (Jeswin, Noraini and Bee Bee) and my friend in KUSTEM. Thanks for their helps and unforgettable memories throughout these three years.

Last but not least, thank to my beloved parents who provided a good education for me and my whole families who always support me.

TABLE OF CONTENTS

	Page
APPROVAL FORM	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xiii
ABSTRACT	xv
ABSTRAK	xvi
1.0 INTRODUCTION	1
1.1 Background of Study	1
1.2 Objectives of Study	2
2.0 LITERATURE REVIEW	3
2.1 The Important of Rivers	3
2.2 Water Pollution	3
2.3 Metals in Water System	4
2.4 Effects of Metal Pollutions in River	6
2.5 Sources of Metals in Rivers	8
2.5.1 Rock and Soil	8

2.5.2	Precipitation and Atmospheric Fallout	9
2.5.3	Pollution – Contamination	10
2.5.3a	Agricultural	10
2.5.3b	Runoff from Highway and Street Surface	11
2.5.3c	Mining and Land Clearing	11
2.5.3d	Industrial Discharges	13
2.6	Factors Affecting the Concentration of Metals in Aquatic Environment	13
2.6.1	pH	14
2.6.2	Salinity	14
2.6.3	Temperature (T) and Dissolved Oxygen (DO)	14
2.6.4	Season	14
2.7	ICP – OES	15
3.0	METHODOLOGY	16
3.1	Location of Sampling Stations	16
3.2	Equipment and Chemicals	24
3.2.1	Equipment	24
3.2.2	Chemicals	25
3.3	Cleaning Procedures	26
3.4	Collection and Preservation of Samples	26
3.5	Analyses of Samples	27
3.5.1	Preparation of Reagents for Extraction	27
3.5.1a	Nitric Acid (2M)	27

3.5.1b	APDC Solution 1%	27
3.5.2	Solvent Extraction	27
3.5.3	Digestion for Particulate Trace Metals	28
3.6	Recovery Test for Cd, Cu, Pb, Fe and Zn	28
3.6.1	Recovery Test for Method	28
3.6.2	Recovery Test for Instrument	28
3.7	Calibration Curve for Cd, Cu, Pb, Fe and Zn	29
4.0	RESULT AND DISCUSSION	32
4.1	Calibration curve for dissolved Cd, Fe, Cu, Zn and Pb	32
4.2	Recovery Test for Cd, Fe, Cu, Zn and Pb	38
4.3	Suitable pH range for APDC - MIBK extraction	40
4.4	Dissolved Cadmium (Cd)	42
4.5	Particulate Cadmium (Cd)	47
4.6	Dissolved Lead (Pb)	50
4.7	Particulate Lead (Pb)	56
4.8	Dissolved Copper (Cu)	60
4.9	Particulate Copper (Cu)	66
4.10	Dissolved Zinc (Zn)	70
4.11	Particulate Zinc (Zn)	75
4.12	Dissolved Iron (Fe)	79
4.13	Particulate Iron (Fe)	84

5.0	CONCLUSION AND SUGGESTIONS	87
5.1	Conclusions	87
5.2	Suggestions	88
	WORK SCHEDULE	89
	REFERENCES	90
	APPENDICES	96
	CURRICULUM VITAE	112

LIST OF TABLES

Table		Page
2.1	National Guidelines for Drinking Water Quality in Malaysia.	5
2.2	Effects of metals pollution of Cu, Cd, Zn and Pb on human body.	7
2.3	Concentration of metals in sediments.	8
2.4	Results of metals concentration in surface water due to agricultural soils.	10
3.1	Location of sampling stations	17
3.2	Chemicals used in this study	25
4.1	Limit of quantification and limit of detection for both particulate and dissolved metals.	37
4.2	The result of method recovery tests and instrument recovery tests	38
4.3	Comparison of the accuracy and precision of method recovery tests	39
4.4	Comparison of the accuracy and precision of instrument recovery tests	39
4.5	Concentration of dissolved Cd (ppb)	42
4.6	Average concentration of dissolved Cd (ppb)	44
4.7	Classification of dissolved cadmium according INWQS (ppm)	46
4.8	Concentration of particulate Cd (ppb)	47
4.9	Average concentration of particulate Cd (ppb)	48
4.10	Concentration of dissolved Pb (ppb)	50
4.11	Average concentration of dissolved Pb (ppb)	52
4.12	Classification of dissolved lead according INWQS (ppm)	55

4.13	Concentration of particulate Pb (ppb)	56
4.14	Average concentration of particulate Pb (ppb)	58
4.15	Concentration of dissolved Cu (ppb)	60
4.16	Dissolved copper concentration in the fresh surface waters of World River	62
4.17	Average concentration of dissolved Cu (ppb)	63
4.18	Classification of dissolved copper according INWQS (ppm)	65
4.19	Concentration of particulate Cu (ppb)	66
4.20	Average concentration of particulate Cu (ppb)	68
4.21	Concentration of dissolved Zn (ppb)	70
4.22	Average concentration of dissolved Zn (ppb)	72
4.23	Classification of dissolved zinc according INWQS (ppm)	74
4.24	Concentration of particulate Zn (ppb)	75
4.25	Average concentration of particulate Zn (ppb)	76
4.26	Concentration of dissolved Fe (ppb)	79
4.27	Average concentration of dissolved Fe (ppb)	81
4.28	Classification of dissolved iron according INWQS (ppm)	83
4.29	Concentration of particulate Fe (ppb)	84
4.30	Average concentration of particulate Fe (ppb)	85
5.1	The range of concentration for Cd, Cu, Fe, Pb and Zn levels in Nerus River	87

LIST OF FIGURES

Figures	Page
2.1 The results of research done in mining area, Lean River, China.	12
3.1 Kampung Payung (Station S1)	18
3.2 Kampung Langkap (Station S2)	18
3.3 Kampung Merbau Menyusup (Station S3)	19
3.4 Kampung Banggul Nyiur (Station S4)	19
3.5 Kampung Pangkalan Merbau (Station S5)	20
3.6 Kampung Bukit Nenas (Station S6)	20
3.7 Tekah (Station S7)	21
3.8 Kampung Banggul Peradung (Station S8)	21
3.9 Kampung Buluh Gading (Station S9)	22
3.10 Map of Nerus River	23
3.11 Flowchart of the APDC –MIBK solvent extraction method	30
3.12 Digestion for particulate samples	31
4.1 Calibration Curve during dissolved Pb analysis	32
4.2 Calibration Curve during dissolved Fe analysis	33
4.3 Calibration Curve during dissolved Cu analysis	33
4.4 Calibration Curve during dissolved Zn analysis	34
4.5 Calibration Curve during dissolved Cd analysis	34
4.6 Calibration Curve during particulate Pb analysis	35

4.7	Calibration Curve during particulate Fe analysis	35
4.8	Calibration Curve during particulate Cu analysis	36
4.9	Calibration Curve during particulate Zn analysis	36
4.10	Calibration Curve during particulate Cd analysis	37
4.11	Suitable pH range for APDC- MIBK extraction	40
4.12	Concentration of dissolved Cd (ppb)	42
4.13	Average concentration of dissolved Cd (ppb) for nine stations	44
4.14	Concentration of particulate Cd (ppb)	47
4.15	Average concentration of particulate Cd (ppb) for nine stations	49
4.16	Concentration of dissolved Pb (ppb)	50
4.17	Average concentration of dissolved Pb (ppb) for nine stations	53
4.18	Concentration of particulate Pb (ppb)	56
4.19	Average concentration of particulate Pb (ppb) for nine stations	58
4.20	Concentration of dissolved Cu (ppb)	60
4.21	Average concentration of dissolved Cu (ppb) for nine stations	63
4.22	Concentration of particulate Cu (ppb)	66
4.23	Average concentration of particulate Cu (ppb) for nine stations	68
4.24	Concentration of dissolved Zn (ppb)	70
4.25	Average concentration of dissolved Zn (ppb) for nine stations	72
4.26	Concentration of particulate Zn (ppb)	75
4.27	Average concentration of particulate Zn (ppb) for nine stations	77
4.28	Concentration of dissolved Fe (ppb)	79
4.29	Average concentration of dissolved Fe (ppb) for nine stations	81

4.30	Concentration of particulate Fe (ppb)	84
4.31	Average concentration of particulate Fe (ppb) for nine stations	86

LIST OF ABBREVIATIONS

Al	Aluminum
APDC	Ammonium Pyrrolidine Dithiocarbamate
As	Arsenic
Ba	Barium
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
DO	Dissolved oxygen
Fe	Iron
HCL	Hydrochloric acid
HF	Hydrofluoric acid
HNO ₃	Nitric acid
ICP –OES	Inductive Coupled Plasma –Optical Emission Spectrometer
INWQS	Malaysia Interim National Water Quality Standards
Mn	Manganese
MIBK	Methyl Iso- Buthyl Keton
NH ₃	Ammonia
Ni	Nickel
Pb	Lead
PE	Polyethylene

Sn Stanum

Zn Zinc

ABSTRACT

Dissolve and particulate trace metals (Pb, Cd, Cu, Fe and Zn) were determined in the Nerus River, Terengganu. In this study, sampling was carried out six times at nine stations and water samples were collected with Van Dorn water sampling equipment. Dissolved metals were pre-concentrated by APDC-MIBK solvent extraction and back extracted into dilute nitric acid. Particulate metals were digested in a microwave lab station and both of the dissolve and particulate metals were analyzed using ICP-OES. The result showed that the metals concentration range as follow: dissolved Cd (0.03-0.13 ppb), particulate Cd (0.13-0.97 ppb), dissolved Pb (0.23-1.59 ppb), particulate Pb (0.21-1.85 ppb), dissolved Cu (0.36-2.45 ppb), particulate Cu (0.53-5.29 ppb), dissolved Zn (1.54-20.99 ppb), particulate Zn (0.84- 12.87 ppb), dissolved Fe (4.79-89.26 ppb) and particulate Fe (27-4670 ppb). According to Interim National Water Quality Standards (INWQS) in Malaysia, the concentration of all the dissolved metals studied in Nerus River, Terengganu were classified in Class I indicating a clean status. However, the concentration of dissolved iron, copper and zinc shows increasing trend when compare with previous study. In general, the concentrations of metals studied are affected by anthropogenic input such as runoff from road, domestic waste and also agricultural runoff.

ABSTRAK

Logam surih terlarut dan partikulat (Pb, Cd, Cu, Fe dan Zn) telah ditentukan di Sungai Nerus, Terengganu. Dalam kajian ini, persampelan telah dijalankan sebanyak enam kali di sembilan stesen persampelan dan sampel air diambil dengan alat persampel Van- Dorn. Logam terlarut telah dipekatkan dengan kaedah pengekstrakan pelarut APDC –MIBK dan diekstrak kembali ke dalam asid nitrik cair. Logam partikulat telah dihadamkan menggunakan ‘microwave lab station’ dan kedua-dua logam terlarut dan partikulat dianalisis menggunakan ICP –OES. Keputusan kajian menunjukkan julat kepekatan logam seperti berikut: Cd terlarut (0.03-0.13 ppb), Cd partikulat (0.13-0.97 ppb), Pb terlarut (0.23-1.59 ppb), Pb partikulat (0.21-1.85 ppb), Cu terlarut (0.36-2.45 ppb), Cu partikulat (0.53-5.29 ppb), Zn terlarut (1.54-20.99 ppb), Zn partikulat (0.84- 12.87 ppb), Fe terlarut (4.79-89.26 ppb) and Fe partikulat (27-4670 ppb). Berdasarkan Piawaian Interim Kualiti Air Kebangsaan (INWQS) dalam Malaysia menunjukkan semua logam terlarut berada dalam Kelas I iaitu status bersih. Tetapi, kepekatan bagi Zn, Cu dan Fe menunjukkan peningkatan jika dibandingkan dengan kajian dahulu. Secara keseluruhan, didapati kepekatan bagi logam dalam kajian ini dipengaruhi oleh sumber anthropogenik seperti hakisan dari jalan, pembuangan domestik dan juga sumber pertanian.