

STUDY ON THE CARBON AND DEHYDRATE OF THE CARBON IN  
THE SOIL AND SEDIMENT OF CEMERAN, CENTRAL JAWA,  
SOUTH ISLAND, INDONESIA

2006


MINISTRY OF SCIENCE AND TECHNOLOGY  
INSTITUTIONAL OF SCIENCE AND TECHNOLOGY MALAYSIA

2006

001100042312

1100042312

LP 5 FST 4 2006



1100042312  
Total organic carbon and degradable organic carbon in water an  
sediment of Setiu Lagoon, Terengganu, South China Sea / Chua  
Seong Seng.



**PERPUSTAKAAN**  
KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA  
21030 KUALA TERENGGANU

1100042312		

Lihat sebelah

**HAK MILIK  
PERPUSTAKAAN KUSTEM**

**TOTAL ORGANIC CARBON AND DEGRADABLE ORGANIC  
CARBON IN WATER AND SEDIMENT OF SETIU LAGOON,  
TERENGGANU, SOUTH CHINA SEA**

**By**

**CHUAH SEONG SENG**

**Research Report submitted in partial fulfillment of the requirements for  
the degree of Bachelor of Science (Marine Science)**

**Department of Marine Sciences  
Faculty of Science and Technology  
2006**

**This project report should be cited as:**

**Chuah, S.S., 2006. Total Organic Carbon (TOC) and degradable organic carbon in water and sediment of Setiu Lagoon, Terengganu, South China Sea. Bachelor of Science in Marine Science. Faculty Science and Technology. University College of Science and Technology Malaysia, Terengganu. 124p.**

**No part of this project report may be reproduce by any mechanical, photography, or electronic process, or in the form of phonographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without written permission from the author and the supervisor(s) of the project.**



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

**PENGAKUAN DAN PENGESAHAN LAPORAN PROJEK PENYELIDIKAN I  
DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

*Total Organic Carbon And Degradable Organic Carbon In Water And Sediment Of Setiu Lagoon, Terengganu, South China Sea* oleh *Chuah Seong Seng*, No. Matrik *UK8207* telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Samudera sebagai memenuhi sebahagian daripada keperluan memperoleh *Ijazah Sarjana Muda Sains Sains Samudera*, Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

**Disahkan oleh:**

**Penyelia Utama** **PROF. DR. LAW AH THEEM**  
Nama: **PENSYARAH**  
Cop Rasmi: **Jabatan Sains Samudera**  
**Fakulti Sains dan Teknologi**  
**Kolej Universiti Sains dan Teknologi Malaysia**  
**21030 Kuala Terengganu.**

Tarikh: **24/04/2006**

**Ketua Jabatan Sains Samudera**  
Nama: **PROF. MADYA DR. HJ. ROSNAN HJ. YAACOB**  
Cop Rasmi: **Ketua**  
**Jabatan Sains Samudera**  
**Fakulti Sains dan Teknologi**  
**Kolej Universiti Sains dan Teknologi Malaysia**  
**21030 Kuala Terengganu.**

Tarikh: **24/04/2006**

## ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest thankful to my supervisor, Prof. Dr. Law Ah Theem. Thanks Prof for his gratefulness in supervising me throughout the whole study both in the laboratory analysis as well as in the project paper writing. Besides, thanks for advises and also the useful comments that Prof. gave out in order to make my final year project paper more prefect. Besides that, all the master students of Prof. Dr. Law Ah Theem also I wish to attach my sincere thankfulness.

In addition, I would like to express my greatest gratitude to Dr. Nor Antonina Binti Abdullah who as our final year project coordinator for her arrangement for all of the thesis presentation and the thesis evaluation process. Furthermore, thanks Dr. for her help and assistants during the study.

Besides, I would like to thank to the Dean of Faculty Science and Technology KUSTEM as well as Head of Marine Science Department, Prof Madya Dr. Rosnan bin Yaacob who had approved all the documentation for the sampling as well as the laboratory usage.

On the other hand, I want to express my gratitude to my family members and my friends who gave me full support in accomplishing this study. Last but not least, my course mate under the same Prof. for thesis, deepest thanks I expressed. Thanks for giving out full cooperation during the sampling conducted together as well as the help lend out during the laboratory analysis. Other party which related to this study also I would like to thanks all of them.

# CONTENTS

INDEX	PAGE
TITLE PAGE	i
APPROVAL FORM	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF MAP	xii
LIST OF ABBREVIATIONS	xiii
LIST OF APPENDICES	xiv
ABSTRAK	xv
ABSTRACT	xvi

<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
1.1	Introduction	1
1.2	Objectives	6
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	
2.1	Organic Matter	7
2.2	Total Organic Carbon (TOC)	8
2.3	Biodegradation and Bioremediation	10
2.4	Biological Oxygen Demand (BOD)	13
2.5	Sources of organic pollutants in the ocean	15
<b>CHAPTER 3</b>	<b>MATERIALS AND METHODOLOGY</b>	
3.1	Study Area	19
3.2	Sampling Schedule	22
3.3	Hydrological Parameters	22
3.4	Glassware Cleaning	22
3.5	Sampling Techniques and Sample Preservation	23
3.6	Analytical Techniques	24



3.6.1	Determination of Organic Carbon (TOC) In Sediment, Wet-combustion method (Manually).	26
3.6.2	Determination of Organic Carbon in Water Sample Dry Combustion Method – TOC analyzer	32
3.6.3	Determination of biological oxygen demand (BOD <sub>5</sub> ) in water sample	36
3.6.4	Determination of degradable organic carbon in sediments	41
3.6.5	Data Compilation and Statistical Analysis	46

## **CHAPTER 4      RESULT**

4.1	Sampling Site's Location	47
4.2	Hydrological Parameters	47
4.3.1	Organic carbon in water samples	51
4.3.2	BOD <sub>5</sub> in water samples	53
4.3.3	Degradable organic carbon in water samples	55
4.3.4	Non-degradable organic carbon in water samples	57
4.3.5	Organic carbon in sediment samples	60
4.3.6	BOD <sub>5</sub> utilization by sediment samples	62
4.3.7	Degradable organic carbon in sediment samples	64
4.3.8	Non-degradable organic carbon in sediment samples	66

<b>CHAPTER 5</b>	<b>DISCUSSION</b>	<b>69</b>
<b>CHAPTER 6</b>	<b>CONCLUSION</b>	<b>91</b>
<b>LITERATURE CITED</b>		<b>93</b>
<b>CURICULUM VITAE</b>		<b>124</b>

## **LIST OF TABLES**

<b>No. Table</b>		<b>Page</b>
Table 3.1	Sampling stations with their longitude and latitude position.	20
Table 3.2	Date and season of Setiu Lagoon sampling.	22
Table 3.3	Analytical techniques for TOC and BOD analysis.	24
Table 4.1	Mean and range of hydrological parameter readings during the first, second and third sampling periods.	48
Table 4.2	The average values of organic carbon, BOD and degradable as well as non-degradable organic carbon also percent of degradable organic carbon in lagoon water and sediment during the first, second and third sampling periods.	50
Table 5.1	Total Organic Carbon (TOC) concentration ( $\mu\text{M}$ ) in the surface water of different water medium.	87
Table 5.2	Total Organic Carbon (TOC) percent (%) in the sediment of different region.	88

## LIST OF FIGURES

No. Figure		Page
Figure 3.1	Analytical Techniques	25
Figure 3.2	Analysis Method for Organic Carbon (TOC) in Sediments	30
Figure 3.3	Analysis Method for Organic Carbon in Water Samples	35
Figure 3.4	Picture of Total Organic Carbon analyzer (model Shimadzu, TC 5000)	35
Figure 3.5	Analysis Method for BOD <sub>5</sub> (mg/l) in Water Sample	39
Figure 3.6	Flow chart for BOD <sub>5</sub> analysis	40
Figure 3.7	Analysis Method for biodegradable organic carbon (mg/l) in sediment	44
Figure 4.1.1	Distribution of organic carbon level in middle layer water at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	52
Figure 4.1.2	Surfer plot of organic carbon level (mg C/L) in the middle layer water during first, second and third sampling periods.	53

Figure 4.2.1	Distribution of BOD <sub>5</sub> levels in middle water layer at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	54
Figure 4.3.1	Distribution of degradable organic carbon in middle water layer at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	56
Figure 4.3.2	Surfer plot of degradable organic carbon (mg C/g) in the middle layer water during first, second and third sampling periods.	57
Figure 4.4.1	Distribution of non-degradable organic carbon in middle layer water at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	58
Figure 4.4.2	Surfer plot of non-biodegradable organic carbon level (mg C/g) in the middle layer water during first, second and third sampling periods.	59
Figure 4.5.1	Distribution of organic carbon level in sediment at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	61
Figure 4.5.2	Surfer plot of organic carbon level (mg C/g) in the sediment during first, second and third sampling periods.	62
Figure 4.6.1	Distribution of BOD <sub>5</sub> utilization by sediment at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	63
Figure 4.7.1	Distribution of degradable organic carbon in sediment at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	65
Figure 4.7.2	Surfer plot of degradable organic carbon (mg C/g) in the sediment during first, second and third sampling periods.	66

Figure 4.8.1	Distribution of non-degradable organic carbon in sediment at Setiu Lagoon, Terengganu for first, second and third sampling periods as well as the average.	67
Figure 4.8.2	Surfer plot of non-degradable organic carbon (mg C/g) in the sediment during first, second and third sampling periods.	68
Figure 5.1	Monthly rainfall and evaporation in Kuala Terengganu in different monsoon season for year 2005.	72
Figure 5.2	Distribution of organic carbon at mid-depth water at Setiu Lagoon.	75
Figure 5.3	Distribution of BOD <sub>5</sub> at the mid-depth water at Setiu Lagoon.	77
Figure 5.4	Distribution of degradable organic carbon at mid-depth water in Setiu Lagoon.	79
Figure 5.5	Distribution of organic carbon in sediment samples at Setiu Lagoon.	82
Figure 5.6	Percentage of degradable organic carbon in sediment samples at Setiu Lagoon.	86

## **LIST OF MAP**

<b>No. Map</b>		<b>Page</b>
Map 3.1	Study's Sampling Stations in Setiu Lagoon, Terengganu.	21

## LIST OF ABBREATIONS

$\mu\text{m}$	-	Micrometer
$\text{‰}$	-	Part per thousand
ALPHA	-	American Publish Health Association
BOD	-	Biological Oxygen Demand
$\text{C}_6\text{H}_{12}\text{O}_6$	-	Carbohydrate
$\text{CH}_4$	-	Methane
Cl	-	Chlorine
$\text{CO}_2$	-	Carbon Dioxide
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
DOC	-	Dissolved organic carbon
DOE	-	Department of Environment
FW	-	Formula Weight
GFC	-	Glass Microfibre Filters
HCl	-	hydrochloride acid
M	-	Molar
Max	-	Maximum
mg C/g	-	Milligram carbon per gram
mg/L	-	Milligram per liter
Min	-	Minimum
ml	-	Milliliter
MW	-	Molecular weight
N	-	Normality
$\text{NO}_2^-$	-	Nitrite
$\text{NO}_3^-$	-	Nitrate
NPOC	-	Non-purgeable organic carbon
$\text{O}_2$	-	Oxygen
$^{\circ}\text{C}$	-	Degree Celsius
OM	-	Organic matter
p	-	Probability
POC	-	Purgeable organic carbon
S	-	Sulphur
SS	-	Suspended Solid
St	-	Station
Std. Dev.	-	Standard Deviation
TC	-	Total carbon
TIC	-	Total inorganic carbon
TOC	-	Total Organic Carbon
WQS	-	Water Quality Standard
$\mu\text{M}$	-	Micromole



## **LIST OF APPENDICES**

<b>No. appendix</b>		<b>Page</b>
<b>APPENDIX I</b>	<b>Standard Curve Of and total inorganic Carbon for the water samples.</b>	<b>97</b>
<b>APPENDIX II</b>	<b>Recovery test for Total Organic Carbon in sediment.</b>	<b>98</b>
<b>APPENDIX III</b>	<b>Tidal condition of Setiu Lagoon, Terengganu.</b>	<b>100</b>
<b>APPENDIX IV</b>	<b>Data Collected during first, second and third sampling in Setiu Lagoon, Terengganu.</b>	<b>101</b>
<b>APPENDIX V</b>	<b>Statistic Analysis ( Two - Way Anova Analysis Of Organic carbon and BOD<sub>5</sub> In Setiu Lagoon).</b>	<b>107</b>
<b>APPENDIX VI</b>	<b>Daily observation rainfall and evaporation data of Kuala Terengganu in 2005.</b>	<b>122</b>

## ABSTRAK

Bahan organan dan organan biodegradasi dalam air dan sediment di Setiu Lagoon telah dikaji. Tiga lawatan dilakukan ke atas empat belas stesen telah ditentukan. Sampling pertama, kedua dan ketiga dilakukan pada 25 Ogos, 6 Oktober dan 14 Disember 2005. Purata nilai bagi bahan organan, BOD<sub>5</sub>, organan biodegradasi, organan tak biodegradasi dan peratus organan biodegradasi dalam sample air semasa sampling pertama ialah 11.42mg C/L, 1.61mg/L, 0.19mg C/g, 11.23mg C/g, and 1.85%; untuk sampling kedua, bacaan ialah 10.04mg C/L, 3.77mg /L, 4.53mg/g, 9.13mg C/g, and 11.46%; dan untuk sampling ketiga, bacaan ialah 32.11mg C/L, 1.19mg/ L, 0.13mg/g, 31.97mg C/g, 0.46%. Bagi sample sediment, semasa sampling pertama, bacaan ialah 6.13mg C/g, 1.27mg/L, 0.79mg C/g, 5.33mg C/g, 18.48%; bagi sampling kedua, bacaan ialah 8.13mg C/g, 1.27mg/L, 1.43mg C/g, 6.70mg C/g, 19.54%; serta untuk sampling ketiga, bacaan ialah 9.46mg C/g, 0.94mg /L, 1.06mg C/g, 8.40mg C/g, 17.73%. Dalam sample air, bahan organan, BOD<sub>5</sub>, organan biodegradasi, organan tak biodegradasi dan peratus organan biodegradasi menunjukkan tiada perbezaan ketara ( $p>0.05$ ) antara kesemua stesen. Bahan organan, BOD<sub>5</sub>, organan biodegradasi, organan tak biodegradasi dan peratus organan biodegradasi sample air menunjukkan perbezaan yang ketara ( $p<0.05$ ) antara sampling pertama, kedua dan ketiga tetapi keadaan sebaliknya berlaku bage sample sediment. Tambahan pula, bagi sample sediment, bahan organan, BOD<sub>5</sub>, organan biodegradasi menunjukkan perbezaan ketara ( $p<0.05$ ) antara stesen sebaliknya, organan tak biodegradasi dan peratus organan biodegradasi menunjukkan tiada perbezaan yang ketara ( $p>0.05$ ) antara stesen.

## ABSTRACT

The distribution of organic carbon and degradable organic carbon in water and sediment of Setiu Lagoon were studied. Three trips were conducted on the established fourteen stations. The first, second and third sampling was carried out on 25 August, 6 October and 14 December 2005 respectively. The average values of organic carbon, BOD<sub>5</sub>, degradable organic, non-degradable organic and percent of degradable organic carbon in water samples during first sampling were 11.42mg C/L, 1.61mg/L, 0.19mg C/g, 11.23mg C/g, and 1.85% respectively; for the second sampling, the values were 10.04mg C/L, 3.77mg /L, 4.53mg/g, 9.13mg C/g, and 11.46%; for third sampling the values were 32.11mg C/L, 1.19mg/ L, 0.13mg/g, 31.97mg C/g, 0.46% respectively. For sediment samples, for first sampling, the values were 6.13mg C/g, 1.27mg/L, 0.79mg C/g, 5.33mg C/g, 18.48% respectively; for second sampling, the values were 8.13mg C/g, 1.27mg/L, 1.43mg C/g, 6.70mg C/g, 19.54%; for the third sampling, the values were 9.46mg C/g, 0.94mg /L, 1.06mg C/g, 8.40mg C/g, 17.73% respectively. In water samples, organic carbon, BOD<sub>5</sub>, degradable organic, non-degradable organic and percent of degradable organic carbon have shown no significant difference ( $p>0.05$ ) among all the stations. Organic carbon, BOD<sub>5</sub>, degradable organic, non-degradable organic and percent of degradable organic carbon in water samples indicated a significant difference ( $p<0.05$ ) between the first, second and third samplings but sediment samples in the other way round. In addition, in sediment samples, organic matters, BOD<sub>5</sub>, degradable organic showed a significant difference ( $p<0.05$ ) between stations while non-degradable organic and percent of degradable organic matters showed no significant difference ( $p>0.05$ ) between stations.