

ASSESSMENT OF WATER QUALITY IN TASIK SST: DEPTH  
PROFILE OF TEMPERATURE, DISSOLVED  
OXYGEN AND BIOCHEMICAL  
OXYGEN DEMAND

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## DECLARATION

I declare that this dissertation is the result of my own independent work, except where otherwise stated.

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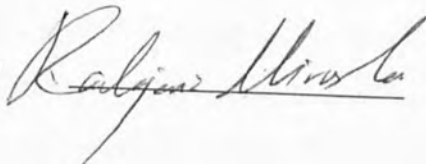
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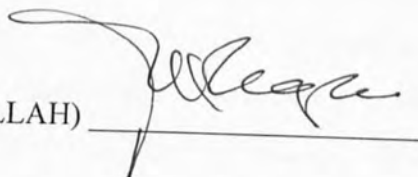
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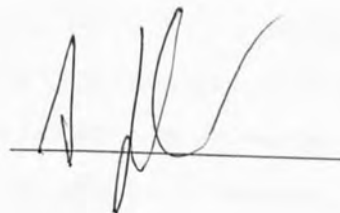
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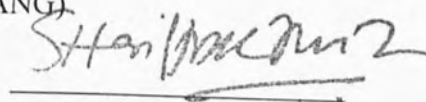
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## ABSTRACT

This study was carried out to determine the water quality in Tasik SST, UMS. YSI Multiparameter Detection Systems and standard method from APHA, 1995 had been used to obtain the data. Sampling was done twice such at 21 January 2006 for first sampling and 23 February 2006 for the second sampling. Three stations were chosen and the sample taken from the bottom until the surface which is take from 0.5m to 2.0m. The samples were analyzed for Temperature, pH, Dissolved Oxygen (DO) and Biochemical Demand Oxygen (BOD). Temperature, pH and Dissolved Oxygen (DO) were measured *in situ* while Biochemical Oxygen Demand (BOD) was measured *ex- situ*. DO was measured initially and after incubation for five days. The BOD<sub>5</sub> was computed from the difference between DO<sub>1</sub> and DO<sub>5</sub>. Result for the selected parameters are T (29.95-31.33 °C), pH (6.73-6.95), DO (3.3- 6.3 mg l<sup>-1</sup>) and BOD (0.1-3.6mg l<sup>-1</sup>).



## ABSTRAK

Kajian mengenai kualiti air telah dijalankan di Tasik SST,UMS. YSI Multiparameter Detection System dan Standard Method merupakan kaedah yang digunakan bagi mendapatkan data-data. Persampelan telah dilakukan sebanyak dua kali iaitu pada 21 Januari 2006 dan 23 Februari 2006. sebanyak tiga stesen telah dipilih dan sample air yang diambil adalah mengikut kedalaman iaitu 0.5m hingga 2.0m. pengukuran bagi suhu dan nilai pH telah dilakukan di kawasan kajian manakala pengukuran oksigen terlarut (DO) dan permintaan oksigen biokomia (BOD) pula dilakukan dengan menggunakan kaedah Winkler dan dilakukan di dalam makmal. Nilai DO diukur pada awal kajian dan selepas inkubasi selama lima hari BOD<sub>5</sub> pula akan dikira iaitu dengan melihat perbezaan di antara DO<sub>1</sub> dan DO<sub>5</sub>. Hasil kajian yang diperolehi iaitu T (29.95-31.33 °C), pH (6.73-6.95), Oksigen Terlarut (DO) (3.3- 6.3 mg l<sup>-1</sup>) dan Permintaan Oksigen Biokimia (BOD) (0.1- 3.6mg l<sup>-1</sup>).



## CONTENTS

	PAGES
DECLARATION	i
AFFIRMATATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
ABSTRAK	v
LIST OF CONTENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF PHOTOS	xi
LIST OF SYMBOLS AND ABBREVIATIONS	xii
LIST OF APPENDIX	xiii
 <b>CHAPTER 1 INTRODUCTION</b>	 <b>1</b>
1.1 Introduction	1
1.1.1 Water Use	2
1.1.2 Water Pollution	4
1.2 Research Objective	5
 <b>CHAPTER 2 LITERATURE REVIEW</b>	 <b>6</b>
2.1 Introduction	6





2.2	Stabilization Ponds	9
2.2.1	Facultative Ponds	13
2.2.2	Anaerobic Ponds	14
2.2.3	Aerated Ponds	16
2.2.4	Aerobic Ponds	17
2.3	Advantages and Disadvantages of Stabilization Ponds	18
2.4	Water Quality Index	19
2.5	Physical Characteristic Water	21
2.5.1	Temperature	21
2.6	Chemical Characteristic Water	22
2.6.1	pH	22
2.6.2	Dissolved Oxygen	24
2.6.3	Biochemical Demand Oxygen	30
<b>CHAPTER 3 RESEARCH METHODOLOGY</b>		<b>34</b>
3.1	Research Location	34
3.1.1	Tasik SST	34
3.2	Sampling	38
3.2.1	<i>In-Situ</i>	38
3.2.2	<i>Ex- Situ</i>	38
3.3	Laboratory Analysis Test	38
3.3.1	Biochemical Demand Oxygen	38
3.4	Statistical Analysis	40



<b>CHAPTER 4 RESULTS AND DISCUSSION</b>	<b>41</b>
4.1 Introduction	41
4.2 Results and Discussion of <i>In Situ</i> Analysis	42
4.2.1 Temperature	42
4.2.2 pH	46
4.2.3 Dissolved Oxygen (DO)	49
4.2.4 Dissolved Oxygen % Saturation	53
4.3 Results and Discussion of <i>Ex-Situ</i> Analysis	54
4.3.1 Biochemical Oxygen Demand (BOD)	54
 <b>CHAPTER 5 CONCLUSION</b>	 <b>58</b>
<b>REFERENCES</b>	<b>61</b>
<b>APPENDICES</b>	<b>65</b>



## LIST OF TABLES

Tables Number	Page
Table 1.1 Categories of Water Pollutants	4
Table 2.1 Types and applications of stabilization ponds in common use.	11
Table 2.2 Interim National Water Quality Standards for Malaysia (INWQS)	20
Table 4.1 Result from the analysis on the parameter at Tasik SST, UMS.	41
Table 4.2 Compatible Temperature for Species of Fish in the Lake	46
Table 4.4 Result of dissolved oxygen percent saturation from concentration	53
Table 1 The data from each station for selected parameter in the First Sampling (January,2006)	69
Table 2 The data from each station for selected parameter in the Second Sampling (February,2006)	69
Table 3 The data of temperature in the First Sampling (January, 2006)	70
Table 4 The data of temperature in the Second Sampling (February, 2006)	70
Table 5 The data of pH in the First Sampling (January, 2006)	70
Table 6 The data of pH in the Second Sampling (February, 2006)	70
Table 7 The data of Dissolved Oxygen (DO) in the First Sampling (January, 2006)	71
Table 8 The data of Dissolved Oxygen (DO) in the Second Sampling (February, 2006)	71
Table 9 The data of Biochemical Oxygen Demand (BOD) in the First Sampling (January, 2006)	71
Table10 The data of Biochemical Oxygen Demand (BOD) in the Second Sampling (February, 2006)	71
Table 11 Calculation of dissolved oxygen percent saturation from concentration	72



## LIST OF FIGURES

Figures Number	Page
Figure 2.1 Diagrammatic Representations of Processes in a Facultative Pond	18
Figure 3.1 Location of study area at Bandaraya Kota Kinabalu, Sabah	36
Figure 3.2 Location of study area, Tasik SST, University Malaysia Sabah	37
Figure 4.1 Graph temperatures in Sampling 1(January, 2006) according to depth profile.	43
Figure 4.2 Graph temperatures in Sampling 2 (February, 2006) according to depth profile.	43
Figure 4.3 Graph pH in Sampling 1(January, 2006) according to depth profile.	47
Figure 4.4 Graph pH in Sampling 2 (February, 2006) according to depth profile	48
Figure 4.5 Concentration of DO in Sampling 1(January, 2006) according to depth profile.	51
Figure 4.6 Concentration of DO in Sampling 2 (February,2006) according to depth profile.	51
Figure 4.7 BOD concentrations in Sampling 1(January, 2006) according to depth profile.	53
Figure 4.8 BOD concentrations in Sampling 2(February, 2006) according to depth profile.	54





**LIST OF PHOTOS**

Photos number	Page
Photo 1 Station 1	65
Photo 2 Station 2	65
Photo 3 Station 3	66
Photo 4 YSI 650 Multiparameters Detection Systems	66
Photo 5 pH Meter	67
Photo 6 Water Sampler	67
Photo 7 The Equipment for BOD <sub>5</sub>	68
Photo 8 BOD Bottles	68



## LIST OF SYMBOL AND ABBREVIATION

$^{\circ}\text{C}$	degrees celcius
M	meter
l	liter
$\text{mg l}^{-1}$	milligram per liter
pH	unit of acidic and bes
$\text{MnSO}_4\cdot\text{H}_2\text{O}$	Manganous sulfate powder
$\text{Na}_2\text{S}_2\text{O}_3$	Sodium Thiosulfate
KI	Potassium Iodide
NaOH	Sodium Hydroxide
NaI	Sodium Iodide
$\text{Na}_2\text{S}_2\text{O}_3$	Sodium Thiosulfate
$\text{DO}_1$	Dissolved Oxygen for 1 <sup>st</sup> day
$\text{DO}_5$	Dissolved Oxygen for 5 <sup>th</sup> day
BOD	Biochemical Demand Oxygen
S1	Station 1
S2	Station 2
S3	Station 3
$^{\circ}\text{F}$	Fahrenheit
SST	School of Science & Technology
UMS	University Malaysia Sabah
WQI	Water Quality Index



LIST OF APPENDIX

	Page
Appendix A	65
Appendix B	69
Appendix C	72
Appendix D	75



## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

Water is the universal solvent. Because many natural waters are slightly acidic, they can dissolve a great variety of compounds, from simple salts to minerals, including sodium chloride (common table salt) and calcium carbonate (calcite) in limestone rock. Water also reacts with complex organic compounds, including many amino acid found in human body (Botkin *et.al.*, 2003).

Compared with other common liquids water has a high surface tension, a property that is extremely important in many physical and biological processes that involve moving water through, or storing water in, small opening or pore spaces. Compare with most other common liquids, water has a high capacity to absorb and store heat. The capacity of water to hold heat has important climate significance (James *et.al.*, 1992).

Among the common compounds, water is the only one whose solid form is lighter than its liquid form (it expands by about 8% when it freezes, becoming less dense). That is why ice floats. If ice were heavier than liquid water, it would sink to the bottom of the





oceans, lakes and rivers. If water froze from the bottom up, shallows seas, lakes and rivers would freeze solid. All life in the water would die, because cells of living organisms are mostly water, and as water freezes and expands, cell membrane and walls rupture. If ice were heavier than water, the biosphere would be vastly different from what it is, and life, if it existed at all, would be greatly altered (James *et.al.*, 1992). Sunlight penetrates water to variables depths, permitting photosynthetic organism to live below the surface (Botkin *et.al.*, 2003).

### 1.1.1 Water Use

In discussing water use, it is important to distinguish between off-stream and in-stream uses. Off-stream uses refer to water removed from its sources (such as river or reservoir) for use. Much of this water is returned to the sources after use; for example, the water used to cool industrial processes may go to cooling ponds and then be discharged to a river, lake or reservoir (Botkin *et.al.*, 2003).

In-stream use includes the use of rivers for navigations, hydroelectric power generation, fish and wildlife habitats and recreation. These multiple uses usually create controversy, because each requires different condition to prevent damage or detrimental effects.

Improved irrigation could reduce agricultural withdrawals by between 20 and 30%. Because agriculture is the biggest water user, this would be a tremendous savings.



Agricultural conservation include price agricultural water to encourage conservation (subsidizing water will encourage overuse) and encourage the development of crops that require less water or are more salt tolerant so that less periodic flooding of irrigated land is necessary to remove accumulated salts in the soil (Botkin *et.al.*, 2003).

Domestic use of water accounts for only about 10% of total national water withdrawals. However, because domestic water use is concentrated in urban areas, it may pose major local problems in areas where water is periodically or often in short supply. Most water in homes is used in the bathroom and for washing clothing and dishes. Water use for domestic purposes can be substantially reduced at a relatively small cost by implementing the following measures; turn off water when not absolutely needed for washing, brushing teeth, shaving and so on. Use drip irrigation and place water-holding mulch around garden plants.

Water conservation measures taken by industry can be improved. For instance, water removal for steam generation of electricity could be reduced 25% to 30% by using cooling towers that use less or no water. Manufacturing and industry could curb water withdrawals by increasing in-plant treatment and recycling of water and by developing new equipment and processes that require less water (Botkin *et.al.*, 2003).



### 1.1.2 Water Pollution.

Water pollution refers to degradation of water quality. From a public health or ecological view, a pollutant is any biological, physical or chemical substance that, in and identifiable excess, is known to be harmful to other desirable living organism. Water pollution include heavy metals, sediment, certain radioactive isotopes, heat, fecal coliform bacteria, phosphorus, nitrogen, sodium and other useful elements, as well as certain pathogenic bacteria and viruses.

**Table 1.1** Categories of Water Pollutants

Pollutant category	Examples of sources	Comments
Dead organic matter	Raw sewage, agricultural waste, urban garbage	Produces biochemical oxygen demand and diseases
Organic chemicals	Agricultural use of pesticides and herbicides; industrial processes that produce dioxin	Potential to cause significant ecological damage and human health problems. Many of these chemicals pose hazardous waste problems
Heavy metals	Agricultural, urban, and industrial use of mercury, lead, selenium, aluminum, chloride and so n	Example: mercury from industrial processes that is discharged into water. Heavy metals can cause significant ecosystem damage and human health problems



Sediment	Runoff from construction sites, agricultural runoff, and natural erosion	Reduces water quality and results in loss of soil resources
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## 1.2 Research Objective

The main objectives of this research are:

1. To measure the value of pH, dissolved oxygen, and biochemical oxygen demand in Tasik SST, University Malaysia Sabah.
2. To investigate the effects of depth on temperature, pH, dissolved oxygen, and biochemical oxygen demand in Tasik SST.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Although water quality and water quantity are inextricably linked, water quality deserves special attention because of its implications for affecting the public health and the quality of life. Even with the large federal investment in pollution control since 1972, the President's Council on Environmental Quality reports that the nation's waters continue to be damaged by pollution and misuse (Viessman *et.al.*, 1993).

Water quality refers to the quantity of suspended and dissolved solids, dissolved gases; heat and microorganism in a given quantity of water in nature, a myriad of impurities enter and leave water throughout the hydrologic cycle. Human activities add and remove pollutants superimposed with naturally occurring water quality constituents.

Water quality characteristics and the parameters used to measure them, are commonly categorized as a physical, chemical, and biological. Water quality measurement involves field sampling and analysis, laboratory analysis and in situ monitoring. Temperature, pH, dissolved oxygen and other parameters with short sample holding times are measured in the field.



The most important reason for studying water quality is the increasing worldwide demand for potable water. Surface water is the source most easily contaminated by human activity. It is the surface water systems, then, that must be carefully protected from contamination (Waite, 1984). The purpose of the water quality standards is to multiply locally-initiated achievements and to obviate the need for enforcement action as much as possible.

The primary causes of deterioration of surface-water quality are municipal and domestic wastewater, industrial and agricultural wastes (organic, inorganic, heat), and solid and semisolid refuse. A municipality obtaining its water supply from a surface body may find its source so fouled by wastes and toxic chemicals that it is unsuitable or too costly to treat for use as a water supply. Fortunately, waste products discharged by cities and industry are being controlled at the point of initiation (Viessman *et.al.*, 1993) .

The higher the concentration of dissolved oxygen, the better the water quality. However, since oxygen is only slightly soluble in water, the saturation is low and varies significantly with temperature, dropping substantially as water warms. At 0°C (32°F), the saturation concentration of oxygen in water is 14.6 mg/l. At 30°C (80°F), the saturation concentration is 7.6 mg/l (Ralph *et. al.*, 2002).

When running water is stored, either in lake or reservoirs, quality changes occur; such changes are dependent on inflow regimes, climate and basin morphometry. Velocity changes in such standing water environments will result in sedimentation of particulates,



the reservoir or lake becoming a sink for a number of related materials, such as sorbet nutrients, metals, bacteria and viruses. A decrease in particulates increases light penetration, and if other factors are suitable, a concomitant increase in phytoplankton will occur. Such algal development can have a major impact on water quality. In most climates thermal stratification will occur in deep lakes and reservoirs and this may be accompanied by chemical stratification as well (Barnes *et. al.*, 1983).

In temperate zone deep lakes and reservoir will exhibit stratification, such that poor vertical mixing takes place and two or more discrete layers are formed during part of the year. In warm temperature zones the warming of surface water in spring decreases the density of these waters; the light warm water termed the epilimnion lies over the viscous, cold deep water termed the hypolimnion. Between these zones a layer of rapid temperature change occurs and this is referred to as the thermocline.

As winter approaches, the surface waters cool and the temperature difference with the bottom declines; ultimately, little difference with the bottom exist and with isothermal conditions the phenomenon of complete mixing taking place. Such lakes with one mixing period per year are termed monomictic. In colder climates than those described above; the condition where water is heaviest at 4° C and becomes lighter as it cools is important.

Present problems while others, when properly understood and monitored, can be used to advantage in optimizing water quality. The phenomenon of stratification will ensure a choice of different quality water for abstraction. Surface water may be rich in



algae when sufficient light can penetrate; however they will normally have high oxygen and low iron levels. If the hypolimnion is reasonably well oxygenated, say above 3 mg liter<sup>-1</sup>, then multilevel draw-off option should be used to abstract from this zone (Barnes *et. al.*, 1983).

In eutrophic lakes and reservoirs with a deoxygenated hypolimnion, artificial overturn or hypolimnion aeration may be beneficial. Reservoirs or lakes, apart from algal development and hypolimnion problems, generally result in improved water quality for supply. If reservoirs are run in series, in a manner akin to pond treatment of effluents, then management can improve water quality (Barnes *et. al.*, 1983).

## 2.2 Stabilization Ponds

A waste stabilizations pond system is a basin or a set of connecting basins of varying area and depth inside which biological processes break down the wastewater at a natural rate. For ponds with no artificial aeration (unassisted ponds), process control is at the outset by precise design and planning; after that, the performance is subject to the forces of nature such as temperature, wind, sunlight and the biological interactions of micro-organisms. Although waste stabilization ponds are simply constructed, their effectiveness depends upon a complex interaction of physical, chemical and biological processes (Freeze, 1979).

Stabilization ponds have been in use in the United States since 1901. Presently, there are approximately 7,500 stabilization ponds being used to treat wastewater and



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