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

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THIS DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE BACHELOR OF SCIENCE (HONOURS)

ENVIRONMENTAL SCIENCE
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITY MALAYSIA SABAH

March 2006

DECLARATION

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

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ACKNOWLEDGEMENT

This dissertation has accumulated many debts of gratitude throughout its completion. Thus, I would like to extend my hearties appreciation to a great number of people who have contributed in my conquest of completing this dissertation. Although that is an inadequate recompense for their contribution, this dissertation would not have been successful without their full commitment. Firstly, I would like to thank to my family, where they give the financial support and love to finish my dissertation and courageous that I needed along my study journey, until I was able to complete this project. Firstly, my heartiest appreciation goes to my supervisor Assoc.Dr. Miroslav Radojevic, who has been a great help in constructive advices on my work, valuable suggestion, continuous encouragement at various stages throughout the completion of dissertation and providing me a wide range of references, also for his expert guidance and for his patience, without which this work could not have been accomplished. I am also greatly in debt to the UMS Technical Lab, Pn. Dayang Janiah Abdul Sami and En. Muhin Haji for always providing all the equipments in the laboratory. Last but not least, my grateful thanks go to my colleagues especially to my course mate of Environmental Science who helped me in preparation of the project and committed in giving maximum effort while working in groups to complete this task.

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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_5 was computed from the difference between DO_1 and DO_5. Result for the selected parameters are T (29.95-31.33 °C), pH (6.73-6.95), DO (3.3- 6.3 mgl^{-1}) and BOD (0.1-3.6mg l^{-1}).

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_5 pula akan dikira iaitu dengan melihat perbezaan di antara DO_1 dan DO_5. Hasil kajian yang diperolehi iaitu T (29.95-31.33 °C), pH (6.73-6.95), Oksigen Terlarut (DO) (3.3- 6.3 mgl^{-1}) dan Permintaan Oksigen Biokimia (BOD) (0.1-3.6mgl^{-1}).

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LIST OF SYMBOL AND ABBREVIATION

° C	degrees celcius
M	meter
l	liter
mgl^{-1}	milligram per liter
pH	unit of acidic and bes
$MnSO_44H_2O$	Manganous sulfate powder
$Na_2S_2O_3$	Sodium Thiosulfate
KI	Potassium Iodide
NaOH	Sodium Hydroxide
NaI	Sodium Iodide
$Na_2S_2O_3$	Sodium Thiosulfate
DO_1	Dissolved Oxygen for 1st day
DO_5	Dissolved Oxygen for 5th day
BOD	Biochemical Demand Oxygen
S1	Station 1
S2	Station 2
S3	Station 3
° F	Fahrenheit
SST	School of Science & Technology
UMS	University Malaysia Sabah
WQI	Water Quality Index

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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

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 decease 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 changed 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 or 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 us reasonably well oxygenated, say above 3 mg liter $^{-1}$, 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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