

EFFECT OF AERATION SYSTEM IN RECREATIONAL LAKE  
IN UTeM MAIN CAMPUS

MUHAMMAD FAEZ BIN ABD RAHMAN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MUHAMMAD FAEZ BIN ABD RAHMAN BACH. OF MECHANICAL ENG. (PLANT & MAINTENANCE) 2015 UTeM

## **SUPERVISOR VERIFICATION**

“I hereby declare that I have read this thesis and in my opinion this report is  
sufficient in terms of scope and quality for the award of the degree of  
Bachelor of Mechanical Engineering (Plant and Maintenance) with Honours”

**Signature** : .....

**Name of Supervisor** : .....

**Date** : .....

**EFFECT OF AERATION SYSTEM IN RECREATIONAL LAKE  
IN UTeM MAIN CAMPUS**

**MUHAMMAD FAEZ BIN ABD RAHMAN**

**This report is submitted in  
fulfillment of requirements for the awards  
Bachelor of Mechanical Engineering (Plant & Maintenance)**

**Faculty of Mechanical Engineering  
Universiti Teknikal Malaysia Melaka**

**JUNE 2015**

**DECLARATION**

“I hereby declare this report is resulted from my own research except from my own summaries and as cited in references”

**Signature** : .....

**Authors Name** : .....

**Date** : .....

Special for  
My Beloved Parents

## ACKNOWLEDGEMENT

The author is extremely grateful and thankful to Allah S.W.T. in finishing this final year project. Furthermore, the author would like to thanks my supervisor, Puan Nurul Hanim binti Razak whose input and advice that has helped me solve the problems occurred during conducting experiments in this final year project.

Besides that, the author feels indebted to the staffs of Syarikat Air Melaka Berhad (SAMB) and Faculty of Mechanical Engineering that provide knowledge and equipments in order to obtain the required data in completing this final year project.

Lastly, the author would like to thank all of his friends for the encouragement and cooperation during the whole periods during this final year project.

## ABSTRACT

Aeration system is used to increase Dissolved Oxygen (DO) in water content and remove any excess chemical substances such as ammonia is commonly used in water treatment process or recreational lake. The purpose of this research is to distinguish between aerated lake system and non-aerated lake system in recreational lakes at Universiti Teknikal Malaysia Melaka (UTeM) Main Campus. This research has determined that the aeration system installed in recreational lake has increase the rate of DO in water content. The sampling process was conducted at both lakes in different points. The samples were tested on different parameters which are Turbidity, pH value, Ammonia content, DO and Total Dissolved Solids (TDS). The data obtain from both lakes was compared to determine the advantages of aeration system. The implication of this research is to reopen the recreational lakes for recreational activities although been suspected containing Leptospirosis few years ago. Since the lake has suspected contaminated, the recreational activities at the lake are prohibited. Besides that, this research will provide a scientific databank or main reference for UTeM Administration and Development Centre about the contents of the lakes.



## ABSTRAK

Sistem pengudaraan digunakan untuk meningkatkan kadar oksigen terlarut dalam kandungan air dan membuang bahan kimia seperti ammonia selalu digunakan dalam proses rawatan air ataupun di tasik rekreasi. Tujuan kajian ini dilakukan adalah untuk membezakan antara tasik yang menggunakan sistem pengudaraan dan tasik yang tidak menggunakan sistem pengudaraan di tasik rekreasi di Kampus Induk Universiti Teknikal Malaysia Melaka (UTeM). Kajian ini telah membuktikan sistem pengudaraan berjaya meningkatkan kadar oksigen terlarut di dalam kandungan air. Proses pengambilan sampel air telah dilakukan di dua buah tasik dan di titik lokasi yang berbeza. Contoh sampel air dikaji mengikut parameter yang berbeza. Antara parameter yang dikaji adalah kadar kekeruhan air, nilai pH, nilai ammonia, kadar oksigen terlarut dan Jumlah Pepejal Terlarut. Maklumat yang diperolehi dari ujian di kedua tasik telah dibandingkan untuk menentukan kelebihan sistem pengudaraan. Kesan dari kajian ini adalah untuk membuka semula tasik riadah untuk aktiviti riadah walaupun telah disuspek mengandungi virus Leptospirosis beberapa tahun yang lepas. Sejak tasik tersebut disyaki tercemar, sebarang aktiviti rekreasi adalah dilarang sama sekali. Selain itu, kajian ini akan menjadi maklumat ataupun rujukan untuk pihak UTeM dan Pusat Pembangunan UTeM mengenai kandungan air di tasik riadah UTeM.

## TABLE OF CONTENTS

<b>CHAPTER</b>	<b>CONTENT</b>	<b>PAGE</b>
	<b>DECLARATION</b>	ii
	<b>DEDICATION</b>	iii
	<b>ACKNOWLEDGEMENT</b>	iv
	<b>ABSTRACT</b>	v
	<b>ABSTRAK</b>	vi
	<b>LIST OF TABLES</b>	xi
	<b>LIST OF FIGURES</b>	xii
	<b>LIST OF SYMBOLS</b>	xiii
	<b>LIST OF ABBREVIATION</b>	xiv
	<b>LIST OF APPENDIX</b>	xv
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	1
	1.1 BACKGROUND OF THE PROJECT	1
	1.2 PROBLEM STATEMENT	2
	1.3 OBJECTIVES	3
	1.4 SCOPES	3

<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	4
2.1	RECREATIONAL LAKE AT UTeM	4
2.1.1	Physical of UTeM Lakes	5
2.1.2	Challenge on maintaining recreational lakes	6
2.2	LEPTOSPIROSIS VIRUS	6
2.2.1	Rate of death caused by Leptospirosis virus	7
2.3	WATER QUALITY ANALYSIS	9
2.3.1	Water Quality Testing	9
2.3.1.1	Turbidity	10
2.3.1.2	Total Dissolved Solids (TDS)	11
2.3.1.3	Dissolved Oxygen (DO)	11
2.3.1.4	pH Value	11
2.3.1.5	Ammonia	12
2.4	AERATION SYSTEM	12
2.4.1	Challenges with aeration	14
2.4.2	Chemicals removed and oxidized by aeration	14
2.4.2.1	Carbon Dioxide	15
2.4.2.2	Hydrogen Sulfide	15
2.4.2.3	Methane	16
2.4.2.4	Iron and Manganese	16
2.4.3	Types of Aerator	16
2.4.3.1	Water-in-air	17
2.4.3.2	Air-in-water	20
2.5	THE ADVANTAGES OF THE RESEARCH	22

<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	23
3.1	INTRODUCTION	23
3.2	WATER QUALITY ANALYSIS	25
3.2.1	Turbidity	25
3.2.2	pH Value	26
3.2.3	Dissolved Oxygen (DO)	27
3.2.4	Ammonia Content	28
3.2.5	Total Dissolved Solids (TDS)	29
3.3	DATA SAMPLING	30
3.3.1	Safety Precaution	32
3.3.2	Apparatus set up	32
<b>CHAPTER 4</b>	<b>DATA AND RESULTS</b>	34
4.1	INTRODUCTION	34
4.2	AERATED LAKE SYSTEM	35
4.2.1	pH Value	35
4.2.2	Turbidity	36
4.2.3	Ammonia Content	37
4.2.4	Dissolved Oxygen (DO)	37
4.2.5	Total Dissolved Solids (TDS)	38
4.3	NON-AERATED LAKE SYSTEM	39
4.3.1	pH Value	39
4.3.2	Turbidity	40
4.3.3	Ammonia Content	41
4.3.4	Dissolved Oxygen (DO)	41
4.3.5	Total Dissolved Solids (TDS)	42

<b>CHAPTER 5</b>	<b>DISCUSSION AND ANALYSIS</b>	43
5.1	INTRODUCTION	43
5.2	WATER QUALITY ANALYSIS	44
5.2.1	pH Value	44
5.2.2	Turbidity	45
5.2.3	Ammonia Content	46
5.2.4	Dissolved Oxygen (DO)	46
5.2.5	Total Dissolved Solids (TDS)	47
5.3	EFFECT OF AERATION SYSTEM	48
5.3.1	Location of Aerator	48
5.3.2	Type of Aerator	49
<b>CHAPTER 6</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	50
6.1	CONCLUSION	50
6.2	RECOMMENDATION	52
REFERENCES		53
APPENDIX A		55
APPENDIX B		56
APPENDIX C		57
APPENDIX D		58

## LIST OF TABLES

NO	CONTENT	PAGE
2.1	Leptospirosis Cases Statistics	8
4.1	pH value for Lake 1	36
4.2	Turbidity Reading for Lake 1	36
4.3	Ammonia Content for Lake 1	37
4.4	Dissolved Oxygen reading for Lake 1	38
4.5	Total Dissolved Solids reading for Lake 1	38
4.6	pH value for Lake 2	40
4.7	Turbidity reading for Lake 2	40
4.8	Ammonia Content for Lake 2	41
4.9	Dissolved Oxygen data for Lake 2	41
4.10	Total Dissolved Solids for Lake 2	41
5.1	pH value for Lake 1 and Lake 2	45
5.2	Turbidity reading for Lake 1 and Lake 2	45
5.3	Ammonia content for Lake 1 and Lake 2	46
5.4	Dissolved Oxygen reading for Lake 1 and Lake 2	47
5.5	Total Dissolved Solids for Lake 1 and Lake 2	47

## LIST OF FIGURES

NO	CONTENT	PAGE
2.1	Lake Plan Layout	5
2.2	Turbidity Scale	10
2.3	Water Aerator	13
2.4	Cascade Aerator	17
2.5	Cone Aerator	18
2.6	Slat and Coke Aerator	19
2.7	Draft Aerator	20
2.8	Pressure Aerator	21
3.1	Flow Process Chart	24
3.2	Turbidity meter	26
3.3	pH meter	27
3.4	Portable Water Analyzer	28
3.5	Portable Water Analyzer	29
3.6	Portable Water Analyzer	30
3.7	Parameters Testing	31
3.8	SAMB officer gave an instruction	33
4.1	Lake 1 with aerated lake system	35
4.2	Lake with non-aerated lake system	39

**LIST OF SYMBOLS**

$\text{km}^2$	=	kilometer square
$\text{m}^2$	=	Meter square
$\text{O}_2$	=	Gaseous Oxygen
$\text{CO}_2$	=	Carbon Dioxide
$\text{H}_2\text{S}$	=	Hydrogen Sulfide
$\text{CH}_4$	=	Methane
Fe	=	Iron
Mn	=	Manganese
mg	=	Milligram
L	=	Litre
ppm	=	Part per million
$\text{NH}_4$	=	Ammonia
$\text{H}_2\text{CO}_3$	=	Carbonic Acid



**LIST OF ABBREVIATION**

SAMB	=	Syarikat Air Melaka Berhad
PBAPP	=	Perbadanan Air Pulau Pinang
LAP	=	Lembaga Air Perak
SYABAS	=	Syarikat Bekalan Air Selangor
UTeM	=	Universiti Teknikal Malaysia Melaka
DO	=	Dissolved Oxygen
TDS	=	Total Dissolved Solids
NTU	=	Nephelometric Turbidity Unit
COD	=	Chemical Oxygen Demand
BOD	=	Biochemical Oxygen Demand
ASTM	=	American Society for Testing and Materials

**LIST OF APPENDIX**

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
A	PSM 1 Poster	55
B	Gantt Chart for PSM 1	56
C	Gantt Chart for PSM 2	57
D	Formal Letter to SAMB	58

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 BACKGROUND OF THE PROJECT**

Nowadays, water is one of the needed sources by humans in their daily life. In our country, Malaysia, the sources of the water came from the river and human build water dam. There are several agencies in Malaysia that manage the water supplies and supply it to homes. For example the agencies that manage water supplies in Malaysia are Syarikat Air Melaka Berhad (SAMB), Perbadanan Air Pulau Pinang (PBAPP), Lembaga Air Perak (LAP), and Syarikat Bekalan Air Selangor (SYABAS). Each state has different agencies that manage water treatment and distribution. These agencies are responsible to treat the water from the sources before been distributed to users. There are several water sources in Malaysia such as sources from river, dam, lake and underground water. Human build dam usually is located near the river or waterfall. Besides that, dam is used as rain catchment to store the water. The raw water is not safe to be use before being treated. This is because there are many unwanted contents in raw

water such as unhealthy bacteria. Lake is a fresh water pond that produced by the water flow from the river. Hence, lake at Malaysia are been used to do recreational activities.

People nowadays like to do water activities such as swimming, fishing, canoeing, and kayak. These activities usually be conducted at recreational lake because the facilities produced by Ministry of Sport at certain lake. But certain lake produced unpleasant smell from time to time because of the living organism. Due to unpleasant smell, people are not comfortable to conduct activities near the lake. The increasing of impurities in the lake is the main factor that cause the unpleasant smell produced by the lake. The decreasing of dissolved oxygen will cause the increasing impurities. To increase dissolved oxygen in the lake is by aeration system. This study focuses on the effect of aeration system in recreational lake in Universiti Teknikal Malaysia Melaka (UTeM) Main Campus.

There are many type of aerators currently been used in recreational lake. For example type of aerators been used are cascade aerator, cone tray aerator, spray aerator, surface aerator, submerge aerator and other else.

## **1.2 PROBLEM STATEMENT**

Water quality in lake in UTeM Main Campus has been a major issue recently and been closed for students and public used. This matter happened because the lake has been suspected contained the Leptospirosis virus. Consequently, peoples and students have been prohibited to conduct any activities around the lake. In addition, peoples are uncomfortable to get near to the lake because the unpleasant smell produced by the lake that caused by organism that live in the lake such as fish and planter. The dissolved oxygen in lake is low and enhances the impurities in the lake. Dissolved oxygen is one of the content in the water that against impurities produced by living organism in the lake. The installation of the aerator is required to increase the dissolved oxygen in the lake.

### 1.3 OBJECTIVES

- a) To determine the effect of aeration system of lake in UTeM Main Campus.
- b) To distinguish between aerated lake system and non-aerated lake system.
- c) To develop water quality study for recreational lakes in UTeM Main Campus.

### 1.4 SCOPES

This case study describes an experimental approach to distinguish between aerated lake system and non-aerated lake system in lake at UTeM Main Campus. To conduct this experiment, the apparatus are been setup based on the data needed. For this study, data needed are contents of the lake at UTeM Main Campus. By using Aqua Chem software to analyze the sample data taken from the lake, will obtained the dissolved oxygen between two lakes.

The water samples are been sent to Chemistry Department to be analyzed. The result of the water samples are being compared between two lakes. The purpose of this comparison is to determine the effect of aeration installed in the lake. Besides that, to prove the lake is safe for recreational used.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 RECREATIONAL LAKE AT UTeM

Universiti Teknikal Malaysia Melaka (UTeM) is among the public universities in Malaysia. UTeM are basically is the technical institutes which offer an engineering courses. UTeM was established on 1<sup>st</sup> December 2000. It was formerly known as Kolej Universiti Teknikal Kebangsaan Melaka before being rebranded to university status on 2<sup>nd</sup> February 2007. The main campus was started being built after earth work was completed on 25<sup>th</sup> June 2003. The main campus start been used in 2009.

UTeM Main Campus has an area of 725 acres, equal to 2.93 km<sup>2</sup>, which included two lakes that located near the back entrance of the main campus. The lakes are located in different level in purpose to ease the water flow from the first lake until the second lake before entering the river. The second lake was used as recreational lake because the storage for keeping the water activities equipment such as canoe and kayak is beside the

lake. UTeM students are able to do an activities at the lake everyday for free because it's part of university mission, to create a active students beside produce well learned technical graduate.

There are many water activities can be done at the lake such as kayak, canoe and rowing. The lake also had been used training place for UTeM Rowing team. The location of the recreational lake is behind the Development Centre and next to the UTeM orchard.

### 2.1.1 Physical of UTeM lakes

The purpose of these lakes been built in campus is to manage the irrigation system in the campus. These lakes are solutions to overcome flood if heavy rain occurred beside drainage system around the campus. The drainage system is directly flow to the lake before the water flow into the river. The area of the first lake is 26148.1m<sup>2</sup>. This lake is located at in front of the UTeM Main Hall. The second lake which is used as recreational lake is 48076.8m<sup>2</sup>. Figure 2.1 shows the plan layout of the lakes.



Figure 2.1: Lake Plan Layout

Source: (UTeM Development Centre, 2014)

Basically, the first and second lakes are used for recreational activities but the activities are likely being conducted on the second lake because the facilities are near the lakeside. The first lake is been used in triathlon activity. The depth of these lakes is the same, which 1 meter, not include the mud on the bottom of the lake. Among these lakes, the second lake has been installed a water spray system to act as aeration system for the lake. Between the first and second lake, waterwheel has been built.

### **2.1.2 Challenge on Maintaining Recreational Lake**

Recreational lake is the place people conducted water activities and hang around the lake. There are many challenges in order to keep the lake clean and safe to use. To keep the lake surrounding clean without trash is easy but to ensure the lake is safe to use is the main challenge to maintaining the lake. This is because the lake is nearby the orchard and parasite or bacteria can affected the content of the lake.

Nowadays, there are many virus and bacteria can cause the lake to be contaminated. Although Development Centre has try to keep the lake clean, the biological factor from the organism surrounding and inside the lake can caused the lake to be contaminated. This matter has worried the management because it will affect the safety and health the lake users.

## **2.2 LEPTOSPIROSIS VIRUS**

Leptospirosis Virus is also known as rat catcher's yellow. Leptospirosis Virus is a type of bacterial infection spread by animals. This bacterial infection is caused by a species of pathogenic leptospira genus called Spirochaetes (Paul, 2001). The pathogenic bacteria are generally from the leptospira interrogans genomospecies and there are eleven detected species of leptospira while thirty-seven serovars are found from wildlife