



POTENTIAL STUDY OF ELIMINATING THE GROWTH OF GREEN ALGAE IN
FISH PONDS.

NURUL ASHILA BINTI KHALID

Thesis submitted in fulfillment of the requirements for the award of the degree of
B.ENG (HONS.) CIVIL ENGINEERING

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2014

ABSTRACT

The main cause for excessive algae and aquatic plant growth in a pond or lake is an abundance of nutrients. Phosphorus and nitrogen combined with carbon dioxide are the main suppliers that can turn your pond from clean to green very quickly. All aquatic plants and algae make their own energy through photosynthesis, which uses sunlight and carbon dioxide to create energy and oxygen as the by products. The other key ingredient to plant growth and health is nutrients, the main two being phosphorus and nitrogen. Algae growth advantages and disadvantages. The objective of this study is to determine the factors that influence the growth of algae in the water. In this study also to formulate a material inhibits growth of algae in the fishponds. Parameters that are looking like COD, TSS and NH_3 . Other parameters such as pH is to be determined as well. A total of 3 samples was taken for each week were conducted in this study. From the results of this study, the content of the algae grew when acquiring these three factors, namely, sunlight, oxygen and nutrient content enough. The results showed that the COD is decreased in every week. TSS values decreased as the content of the algae grows and cannot pass through the filter. Although the results of NH_3 shows that the increase and decrease in the last 3 weeks. The NH_3 should increase with the increase due to the growth of algae in the water. From experiment the water increase alkaline water and the highest value is 6.82. Generally, the algae increase in the water if the factors that influence of the growth sufficient and enough.

ABSTRAK

Punca utama alga yang berlebihan dan pertumbuhan tumbuhan akuatik di dalam kolam atau tasik adalah kelimpahan nutrien. Fosforus dan nitrogen digabungkan dengan karbon dioksida adalah bekalan utama yang boleh bertukar kolam anda dari bersih kepada hijau dengan cepat. Semua tumbuh-tumbuhan akuatik dan alga membuat tenaga mereka sendiri melalui fotosintesis yang menggunakan cahaya matahari dan karbon dioksida untuk mewujudkan tenaga dan oksigen sebagai produk oleh. Bahan utama lain untuk pertumbuhan tumbuhan dan kesihatan adalah nutrien, kedua-dua utama ialah fosforus dan nitrogen. Pertumbuhan alga ada kebaikan dan keburukannya. Objektif kajian ini adalah untuk menentukan faktor-faktor yang mempengaruhi pertumbuhan algae didalam air. Kajian ini juga bertujuan untuk mengkaji kebolehan bahan untuk menghalang pertumbuhan alga didalam air kolam ikan. Parameter yang diperhatikan adalah seperti COD, TSS and NH_3 . Parameter lain seperti PH hendak ditentukan juga. Sebanyak 3 kali sampel telah diambil untuk setiap minggu telah dijalankan dalam kajian ini. Dari hasil kajian ini, kandungan algae semakin bertambah apabila memperoleh ketiga-tiga faktor iaitu, cahaya matahari, oksigen dan kandungan nutrient yang mencukupi. Keputusan menunjukkan bahawa nilai COD adalah menurun dalam setiap minggu. Nilai TSS menurun memandangkan kandungan algae bertambah dan tidak boleh melalui penapis. Walaupun keputusan NH_3 menunjukkan bahawa nilai menaik dan menurun dalam tempoh 3 minggu. Nilai NH_3 sepatutnya meningkat dengan masa meningkat disebabkan oleh pertumbuhan algae di dalam air. pH air semakin alkali dan yang paling alkali ialah 6.82. Secara umumnya, semakin banyak alga di dalam air sekiranya faktor-faktor yang mempengaruhi pertumbuhannya mencukupi.

TABLES OF CONTENTS

		Page
SUPERVISOR'S DECLARATION		ii
STUDENT'S DECLARATION		iii
DEDICATION		iv
ACKNOWLEDGEMENTS		v
ABSTRACT		vi
ABSTRAK		vii
TABLE OF CONTENTS		viii
LIST OF TABLES		x
LIST OF FIGURES		xi
LIST OF ABBREVIATIONS		xii
CHAPTER 1	INTRODUCTION	
1.1	Introduction	1
1.2	Background of study	2
1.3	Statement of the problem	3
1.4	Objective of study	3
1.5	Scope of study	3
1.6	Expected outcome	4
1.7	Significance of study	4
CHAPTER 2	LITERATURE REVIEW	
2.1	Introduction	5
2.2	Algae	5
2.3	Fertilizer	6
2.4	Types of fertilizer	7
2.5	Nutrients	7

	2.5.1 Nutrient as Energy Pollutants	8
	2.5.2 Sources of Nutrients	9
	2.5.3 Effects of Nutrients Enrichment	9
2.6	Limestone as Filter	10
2.7	Limestone characteristic	10
CHAPTER 3	METHODOLOGY	
3.1	Introduction	12
3.2	Flow Chart	12
3.3	Aquarium System Diagram	14
3.4	Procedures	14
3.5	Laboratory Testing	15
	3.5.1 Chemical Oxygen Demand (COD)	15
	3.5.2 Ammonia Nitrate (NH ₃)	16
	3.5.3 Total Suspended Solid (TSS)	16
	3.5.4 pH	17
CHAPTER 4	RESULT AND DISCUSSIONS	
4.1	Introduction	18
4.2	Parameter Analysis	18
	4.2.1 Result Parametet Analysis	19
	4.2.2 Chemical Oxygen Demand (COD) Analysis	20
	4.2.3 Total Suspended Solid (TSS) Analysis	23
	4.2.4 Ammonia Nitrate (NH ₃)	26
CHAPTER 5	CONCLUSION AND RECOMMENDATION	
5.1	Introduction	29
5.2	Conclusion	29
5.3	Recommendations	30
REFERENCE		

LIST OF TABLES

Table No.	Title	Page
4.1	Results of Parameter Analysis	19

LIST OF FIGURES

Figures No.	Title	Page
3.1	Methodology process flowchart	13
3.2	COD Testing	15
3.3	Reagent for Ammonia Nitrate Testing	16
3.4	TSS Testing	17
4.1	COD vs HRT (week 1)	20
4.2	COD vs HRT (week 2)	21
4.3	COD vs HRT (week 3)	21
4.4	COD vs WEEK	22
4.5	TSS vs HRT (week 1)	23
4.6	TSS vs HRT (week 2)	23
4.7	TSS vs HRT (week 3)	24
4.8	TSS vs WEEK	24
4.9	NH ₃ vs HRT (week 1)	26
4.10	NH ₃ vs HRT (week 2)	26
4.11	NH ₃ vs HRT (week 3)	27
4.12	NH ₃ vs WEEK	27

LIST OF ABBREVIATIONS

COD	Chemical Oxygen Demand
NH ₃	Ammonia Nitrate
HRT	Hydraulic Retention Time
TSS	Total Suspended Solid

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Water is an important element to every living things including human. The water are use for many activities. Water also could be an agent to transport particles either physical, chemicals and biochemical from one place to another.

Algae is commonly found in the water system. It including waster water pollution. The presence of algae in water can bring many disadvantages related to the environment. An algae bloom can cause water pollution as well as Eutrofication.

Algae is a type of microorganism similar to protozoa. In short, algae is called a microscopic mobile organism. The only thing that makes algae different from protozoa is the ability of algae to undergo photo-synthesis process. By nature, algae exist in our water system, it can be found especially in river water or fish ponds.

Nutrients are present in many forms in aquatic systems such as dissolved inorganic, dissolved organic, particulate organic and biotic forms. However, only dissolved forms are directly useful for algal growth. The main dissolved forms of nutrients include nitrogen and phosphorus, which present in ammonia, nitrate, nitrite and orthophosphate. Excess nitrogen and phophorus cause significant water quality problem, including harmful algal blooms, hypoxia and declines in wildlife and wildlife habitat.

Ammonium nitrate is one of the most elements of fertilizers used in most agricultural purpose. Excessively usage of nitrates as fertilizer has led to some serious environmental problems. All nitrates are soluble, so amount of nitrates is not taken up by plants in a field is washed away into groundwater, rivers, streams, ponds and lakes. In these bodies of water, the nitrates become main sources of food for algae and other plant life. As a consequence, formation of algal blooms is happening is the first step in the eutrophication of a pond or lake. Hence, a pond or lake slowly evolves into a marsh or swamp, then into a bog, and transformed into a meadow in the end.

The addition of phosphates by the activities of human can accelerate the eutrophication process of nutrient enrichment which fastening ecological of lakes and rivers. Especially in inland waters, phosphorus is the nutrient that limits growth of aquatic plants. If large amount phosphorus is added into a body of water, plant growth will be increased then gradually fills in the lake.

Algae growth may be due to many factors. The most common factor is due to the nutrients in the water. The nutrients that contribute to the growth of algae are ammonical nitrogen, nitrite nitrate and phosphorus.

1.2 BACKGROUND OF STUDY

Many recreational activities such as canoeing, fish pond and so on will be disturbed by the growth of algae. Algae is commonly found in the fishponds. The presence of algae in water can bring many disadvantages to the environment in the fish pond. The concentration of nutrients in the water makes algae to grow quickly. Phosphorus and nitrogen combined with carbon dioxide are the main suppliers that can turn your pond from cleaners to green very quickly. All aquatic plants and algae make their own energy through photosynthesis, which uses sunlight and carbon dioxide to create energy and oxygen as the byproducts. The other key ingredient to plant growth and health is nutrients, the main two being phosphorus and nitrogen. Nutrient removal is essential for fish pond to protect water from eutrophication and for potential to reduce algae in water.

1.3 STATEMENTS OF THE PROBLEM

Nutrient concentration in water fishponds will cause the unwanted algae growth. Algae growth will reduce the quality of water and at the same time affect the aquatic living. Fish also will die due to lack of oxygen supply. Besides, the aesthetical value will decrease due to algae growth. The purpose of this study is to remove the nutrients in the water. This material is to reduce nutrients in the water. These are the same nutrients that algae need to survive. Also, help decrease algae production by keeping them from having enough nutrients to live.

1.4 OBJECTIVES OF THE STUDY

The objectives of this research are :

1. To determine the factor of growing algae.
2. To formulate a material inhibits growth algae

1.5 SCOPE OF STUDY

The area to be covered is the fish ponds at Gallery Universiti Malaysia Pahang. Samples of water are taken at these ponds. This required to analyze the concentration of nutrient in the water, which are ammoniacal nitrogen, phosphorus, nitrite and nitrate I determine the factor of grow algae in the fish pond. Besides, I formulate a material inhibit growth algae that rapid presence in the water. Fish species are an important material in my research and I will use catfish as fish species to run my experiment. In my experimental design, I have build a mini aquarium system. I preserve the algae in fish pond. After that, collect the water sample from that once a week for water quality determination. The parameters that will be observed are , Chemical Oxygen Demand

(COD), Total Suspended Solids (TSS), Ammonia Nitrogen (NH) and pH. The experiment will be conducted in the Environmental Engineering Laboratory, Faculty of Civil Engineering, (UMP).

1.6 EXPECTED OUTCOME.

The findings of this study are important to determine the factors of growing algae. By this study, the conditions and factors of algae growth can be identified to control the nutrient concentration in water fish ponds. By the way, the algae growth can be decreased that will not spoil the aesthetic value of fish ponds by using a material to inhibit growth algae.

1.7 SIGNIFICANCE OF THE STUDY

Roughing filtration is to protect slow sand filters by reducing influent turbidity and suspended solids to a level that is effective for operation. Roughing filtration presents a promising method for improving raw water quality without using any chemicals. Filtration is one of the oldest and simplest methods of removing those contaminants. Generally, filtration methods include slow sand and rapid sand filtration. Limestone is used as the filter because the cost is very cheap compared to other filtration's material and also is inexpensive to construct.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The literature review is about searched the related and relevant literature for a research project that had been chosen. It is also, summarize the literature and find the evidences which can answer the research objectives and research questions. Based on the literature that had been found, further research is made in eliminating the growth of green algae in fish ponds

2.2 ALGAE

Algae are a group of simple organism and belong to the members of the Protista Kingdom. Basically, algae is not categorized under plant kingdom. However, algae are able to use the energy from sunlight to produce their own food through photosynthesis process.

Algae does not have roots, leaves, and other structures that a normal plant has. A type of algae, phytoplankton can float and swim in the water body. Normally, algae is

found in many natural waters, but are usually not a health concern. Some species of algae is toxic, for example, *Anabaena flos-aquae*, *Microcystic aeruginosa*, and *Alphanizomenon*. During the algae bloom, toxin concentration in river many causes illness and death in fish. According to AWWA, 1990, human exposure to drinking polluted toxin water has caused irritation and gastroenteritis.

Algae is basically photosynthesis, plants which can produce oxygen, just like many living plants in the earth. In short quantity, algae is beneficial to the water system because they release oxygen and can oxygenate water around them. Algae also serve as a main food sources for many aquatic species, especially the zooplankton and small fish. Algae is the most important member of the food chain supply in a river.

For example, a river with a lot of green means the river is clean. Whereby too much of blue-green algae indicates the river is polluted. Most species of algae are not harmful but there are certain types of algae which can produce toxins in the water system.

2.3 FERTILIZER

Fertilizers can be defined as any material, organic or inorganic, natural or synthetic that supplies plants with the necessary nutrients for plant growth and optimum yield. Fertilizer adds nutrients and texture to soil that needs to support trees, vegetables, herbs and flowers.

Like other living organisms, plants also are made up from cells. Within these cells, occur numerous metabolic chemical reactions that are responsible for growth and reproduction of the plants. Since plants do not eat food like animals, they depends on nutrients in the soil to provide the basic chemicals for these metabolic reactions. The supply of these components in soil is limited, and if plant did not get enough amounts of these nutrients it will reduce the quality and yield of the plants (Pimentel, 1997)

Fertilizers are composed from nitrogen, phosphorus, and potassium compounds. Fertilizers also contain with trace elements that improve the growth of plants.(Pimentel, 1997).

2.4 TYPES OF FERTILIZER

Two different types of fertilizer are inorganic and organic fertilizer. Inorganic fertilizers are fertilizers that add with chemical additives that are designed for plants to directly absorb, such as nitrogen, phosphorus and potassium. These three essential elemental nutrients should naturally occur in healthy soil, but some plants require more of them (Lowrison,1989)

Granulated materials are N-P or N-P-K grades of fertilizers. Each uniform size fertilizers particles contains all of the nutrients in the grade. For example, each particle in a 10-20-10 granulated fertilizers theoretically contains 10 percent nitrogen, 20 percent phosphate and 10 percent potassium. The principle advantages of granulated materials is this uniform distribution of nutrients. Granulated fertilizers generally have good handling properties, with little tendency to cake or dust (Beegle,1995).

2.5 NUTRIENTS

There are at least 19 elements which are essential for life, and these basic elements are collectively called nutrients. Every living organism needs nutrients to sustain growth and life function. Five of these nutrients are required in large amounts: Carbon, hydrogen, oxygen, nitrogen and phosphorus. The first three (C, H, O) are readily available in either water or dissolved carbon dioxide and are never a long-term limiting factor for aquatic plant growth. Nutrients are chemicals, such as nitrogen, phosphorus carbon, calcium, potassium, iron, manganese, boron and cobalt which are essential of living organism.

Some nutrients are termed as macronutrients and some are termed as micronutrient. Macronutrients are nutrients that are required by large quantities while micronutrients are nutrients that are only needed in trace quantities in the river ecosystem. Nitrogen and phosphorus are examples of micronutrients. The concentration of nitrogen and phosphorus dissolved in natural water are much lower, and it is usually one of these two elements that provide the limiting factor for the aquatic plant growth and the algae growth (Rubin and Atkinson, 2001).

2.5.1 Nutrient as Energy Pollutants

There are many types of pollutants in the water system, some is extremely dangerous to the river aquatic life, some pollutants are neutral to the aquatic system, and some are good in nature. The pollutants are categorized as toxic pollutants and energy pollutants. According to Kupchella and Hyland (1992), some chemical agents are toxic in practically any amount, while some small amounts of certain chemicals that cause pollution can actually be beneficial to water quality and aquatic ecosystem. This kind of pollution components is known as nutrient. This research only focuses on nutrient like phosphorus, ammonical nitrogen, nitrite and nitrate.

Nutrients is basically good for the water system in a low quantity. However, if the concentration of nutrient is too high, or exceeded the required amount, the river quality will start to decrease. There are several factors that cause the decrease of water quality due to the input of excessive nutrients which will be explained during this research.

From the perspective of water quality, nutrients can be considered as pollutants when their concentration is too large to allow excessive growth of aquatic plants like algae.

2.5.2 Sources of Nutrients

The nutrients may be polluted in the water body by many factors and causes. The nutrients may be polluted naturally also manmade. Natural source of nutrients in water bodies is caused by the natural eutrophication process of lake. The cycle of algae growth and decaying process will accumulate the nutrient concentration in the lake. The manmade factors are discussed as below (Srinivasan, 2009).

2.5.3 Effects of Nutrients Enrichment.

Excessive plant growth associated with over-enrichment of nutrients caused oxygen depletion, which causes increased stress on aquatic organism such fish. Rich nutrient runoff can cause algae bloom. When nutrients stimulate the growth of algae, the habitat for other living organism and drinking water supply will be affected. According to Chin (2006), phosphorus is the limiting nutrients in freshwater aquatic system while nitrogen is the limiting nutrient in the seaward portions of estuarine system.

When the presence of algae exceeded the usual amount, it will cause damage to the river. The rapid production of algae in water is called "bloom". Algae bloom requires light, nutrients and oxygen. The bloom will use up most of the oxygen in the river in a fast rate and the photosynthesis process of algae will not be able to replenish the oxygen in the water. The aquatic life of water will lack of oxygen and endanger many species in the river. Algae bloom may block the direct sunlight from penetrating into the river bed and affect other aquatic plants in the river. Other aquatic plants will not be able to do photosynthesis due to lack of sunlight and eventually dies. Besides, algae bloom also use up the nutrients supply in the river. So, algae bloom is a dangerous phenomenon in the river system.

2.6 LIMESTONE AS FILTER

It has been proving by many researches that limestone is effective in neutralizing acid and removing metals from wastewater. It also can try in fish pond. A variety of passive treatment systems have been developed that do not require continuous chemical inputs and that take advantage of naturally occurring chemical and biological processes to cleanse contaminated fresh water (Nadiyah Mokhtar,2006).

While the contaminated water passes through the filter, microbes and other particles are removed. Although the removal mechanisms are not well understood, they are believed to be a combination of biological, physical and chemical mechanisms. Specific mechanisms may include biological action, attachment of microbes to filter media by electrochemical force and physical straining (WHO, 2004).

Roughing filters could achieve peak turbidity removal ranging from 60% to 90%.

Generally, the more turbid the water, the greater in reduction could be achieved (WHO,2004).

2.7 LIMESTONE CHARACTERISTICS

Limestone is usually classified as igneous rocks derived from molten masses or magmas. However, there is also some evidence that the origin of some limestone may be attributed to the occurrence of regional metamorphism or preexisting rocks, rearrangement and recrystallization without liquid or molten stage. The rock will display in much variation in composition, appearance, colour, texture, porosity and hardness.

The essential constituent of limestone is calcite or calcium carbonate. Pure limestone may comprise of 98 or 99 % of calcite along with other substances. Pure limestone are nearly white or cream coloured. Much carbonaceous matter causes the rock to be grey or even black. The texture, porosity and toughness of the limestone will depend largely upon the nature of the sediment from the consolidation of which it has been formed (Nadiyah Mokhtar,2006).

Several investigators have studied on limestone treatment to treat water and wastewater, Pearson and McDonnell (1957) developed design models for the use of limestone in open channel for remediation.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter is explain about flow chart about process of reserch, experimental study, experimental model design, equipment used , sample preparation and procedure of experiment.

3.2 FLOW CHART

The methodology process flow chart for eliminating the growth of green algae in fish ponds as illustrated in Figure 3.1. The flow chart is including selection of material, equipment, experimental design, preparation of sample and testing method.

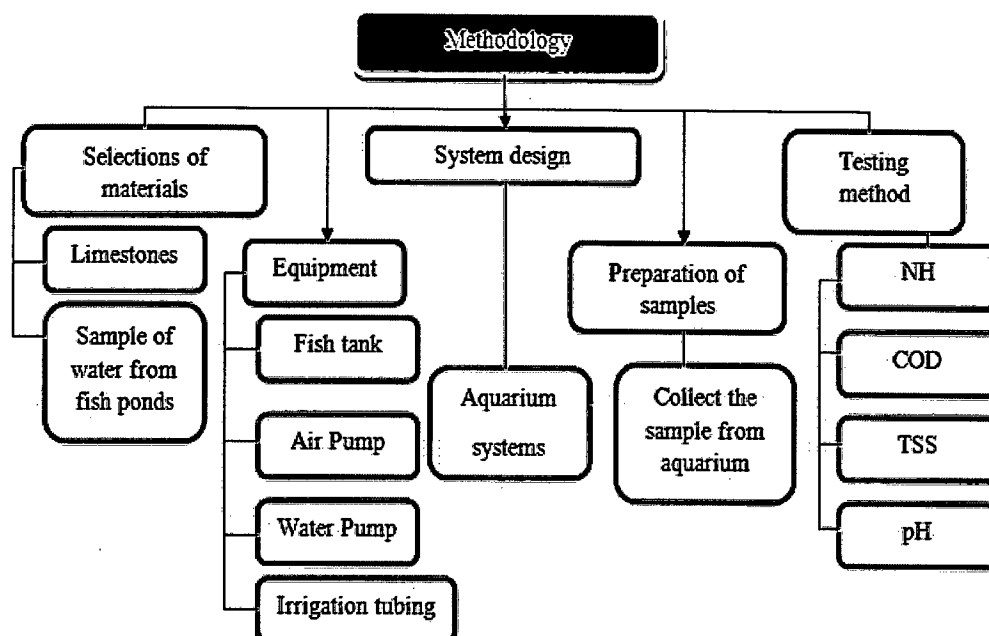
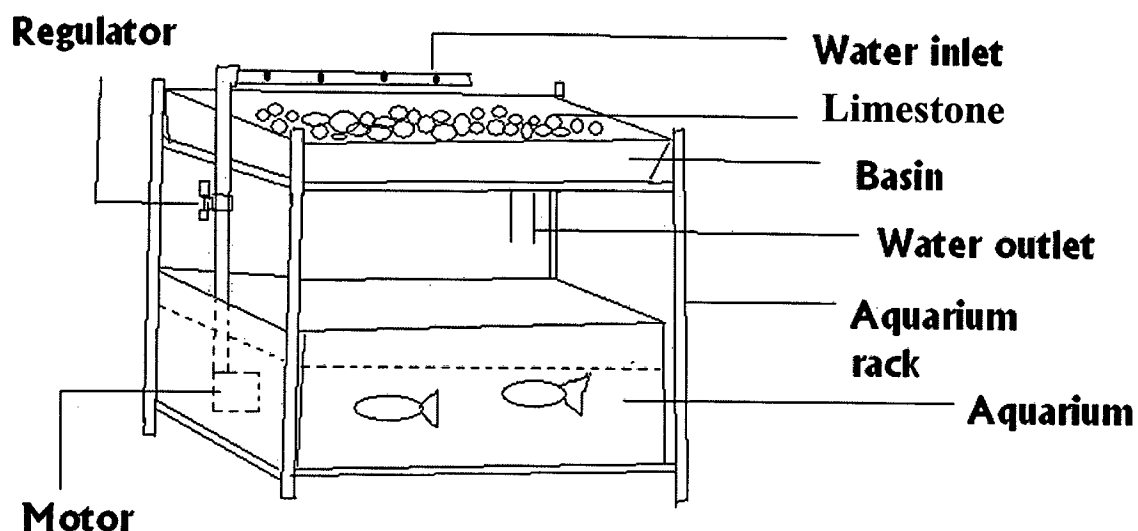


Figure 3.1: Methodology Process Flow Char

3.3 AQUARIUM SYSTEMN DIAGRAM



3.4 PROCEDURES

- i. During the first week, I set up the aquarium, take samples of water from the fish ponds at Gallery Universiti Malaysia Pahang.
- ii. The water is isolated according to the different variables.
- iii. I will put fertilizer (N:P:K) and know how many algae grow.
- iv. Second week, I collected water sample from aquarium for water analysis.
- v. The parameters observed are COD, TSS, pH and NH.
- vi. The water sample through limestone filter.
- vii. The parameter test again for the water effluent.
- viii. Every week, I observed and record the analysis of water.
- ix. I conducted this test for 3 weeks.

3.5 LABORATORY TESTING

There are five parameter test which is Chemical Oxygen Demand (COD), Ammonia Nitrate (NH_3), Total Suspended Solid (TSS), and pH.

3.5.1 Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) is the measure quantity of oxygen need to chemically oxidize the organic compound sample. COD testing is done by following DR500 procedure method. For this experiment, high range is used, it depends on the clear or dirty the sample. The range for high range is 20-150mg/L. The procedure is:-

- i. COD reactor is turned on and heated to 150 °C.
- ii. Pipet 2mL sample into one COD vial (the prepared sample) and 2mL of distilled water into another COD vial (the blank).
- iii. The COD vial is cap and inverted several times to mix.
- iv. The vials are inserting into COD reactor at 150 °C. Digest for 2 hours.
- v. The vials are removed and placed in cooling rack for 30minutes.
- vi. Test the COD using DR500. COD HR (435)

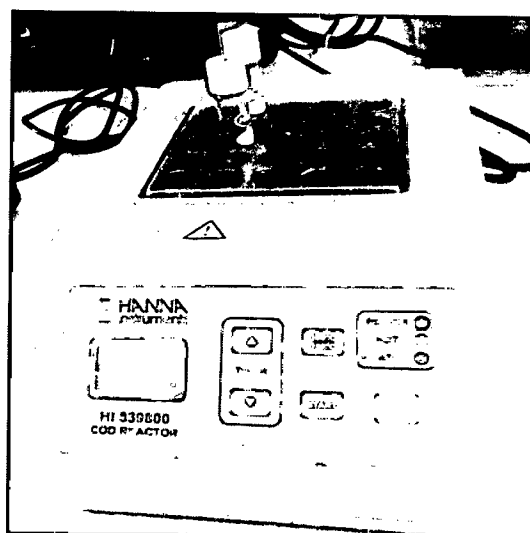


Figure 3.2: COD testing

3.5.2 Ammonia Nitrate (NH₃)

- i. Ammonia reagent 1 and ammonia reagent 2 is mixed in Ammonia Nitrogen (NH₃-N) test tube and shakes.
- ii. After that, 2 mL water sample is prepared and added into test tube and shakes.
- iii. The test tube is waited in 20 minutes.
- iv. Then, the test tube value is read.
- v. The color of the test tube is observed and matched to chart.

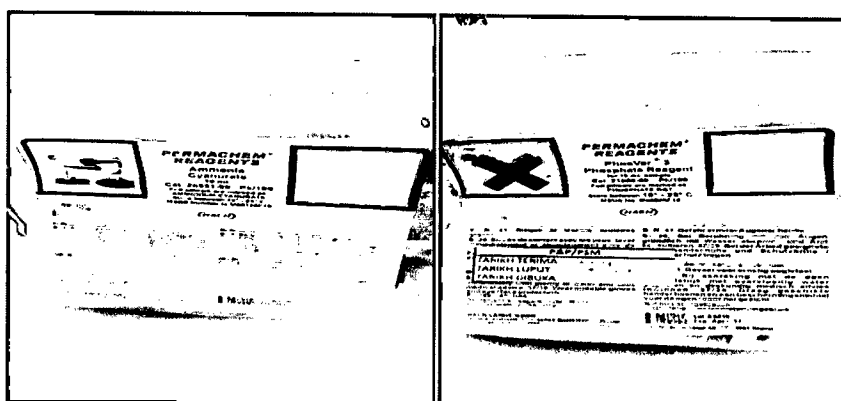


Figure 3.3: Reagent for Ammonia Nitrate testing

3.5.3 Total Suspended Solid (TSS)

Total Suspended solid is measure undissolved material in water. Suspended solid refer to small particles which remain in suspension in water. The procedure is:-

- i. The glass-fiber filter is prepared.
- ii. Assemble a glass fiber disc on the filter funnel.
- iii. While vacuum is applied, the disc is washed with 60mL distilled water.
- iv. Filter is removed from holder and the filter disk is dry in oven at 103°C for 1 hour.
- v. Transfer into desiccator for 30minutes and then weight (B)
- vi. For sample: 100mL of sample is transfer to the funnel