# WATER QUALITY ASSESSMENT OF UMK LAKE AND THE EFFECT OF SEAWEED TREATMENT

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**A report submitted in fulfilment of the requirements for the degree Bachelor of Applied Science (Bioindustrial Technology) with Honours**

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**DECLARATION**

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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Student

Name :

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Date :

I certify that the report of this final year project entitled "**Water Quality Assessment Of UMK Lake And The Effect Of Seaweed Treatment"** by **Arbia Binti Bacho,** matric number **F15A0018** has been examined and all the correction recommended by examiners have been done for the degree of Bachelor of Applied Science (Bioindustry Technology) with Honours, Faculty of Bioengieneering and Technology, Universiti Malaysia Kelantan.

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**Penilaian kualiti air Tasik UMK dan kesan rawatan rumput laut**



## ABSTRAK

Danau telah dikenali sebagai sumber air tawar kepada manusia dan telah dilabelkan sebagai sumber air tawar yang terbaik di permukaan bumi. Oleh kerana pencemar buatan manusia dan air kumbahan yang berasal dari tapak pertanian dan saliran dari makmal berhampiran Tasik UMK, tasik kini terhad kepada sebarang aktiviti manusia. Oleh itu, dengan merawat air Tasik UMK dengan rumput laut, air boleh bebas dari sebarang pencemar. Objektif kajian ini adalah untuk mengukur parameter kimia fizikal Tasik UMK, untuk merawat air dengan spesies alga merah iaitu Kappaphycus alvarezii dan kemudian sampel air terawat diukur semula. Kualiti Tasik UMK dikenalpasti dalam empat parameter air tasik yang merupakan jumlah pepejal terlarut (TDS), pH, kekeruhan dan permintaan oksigen biologi (BOD). Sebagai contoh, ia datang dari dua sumber jenis yang bukan sumber dan sumber titik. Sampel air sumber titik mungkin mempunyai nilai yang tinggi dalam semua parameter sementara sampel air sumber bukan titik mempunyai nilai yang sedikit rendah dalam semua parameter. Parameter kualiti air yang dianalisis dalam kajian ini menyatakan bahawa jumlah larutan pepejal terlarut dari 27 mg / L hingga 46 mf / L sebelum rawatan rumpai laut meningkat hingga 60 mg / L hingga 71 mg / L selepas rawatan rumput laut, untuk BOD nilai, hasil sebelum rawatan rumput laut dari 30.6 mg / L hingga 45 mg / L berkurangan ke nilai dari 18.0 mg / L ke 26.4 mg / L, untuk nilai pH, hasil sebelum rawatan rumput laut berkisar antara 7.7 hingga 8.2 dan berkurangan daripada 7.0 kepada 8.0 selepas rawatan rumput laut dan untuk kekeruhan nilai, hasil sebelum rawatan rumput menunjukkan nilai dari 8.58 NTU hingga 15.30 NTU meningkat dari 9.46 NTU hingga 18.45 NTU selepas rawatan rumput laut. Kecuali untuk nilai pH, ketiga parameter melebihi nilai standard pada Standard Kualiti Air Tasik Kebangsaan (NLWQS). Selepas dirawat dengan rumpai laut, parameter pH dan BOD menunjukkan penurunan nilai manakala bagi nilai pepejal dan turbidty yang dibubarkan, ia menunjukkan peningkatan nilai yang mungkin berasal dari zarah rumpai itu sendiri. Namun begitu dirawat dengan rumpai laut, nilai parameter masih belum mencapai nilai yang boleh diterima untuk kategori tasik. Dengan menggunakan spesies alga merah, bahan pencemar yang tidak diingini dapat dikurangkan kerana ia bertindak sebagai penyerap kerana rawatan mungkin menurunkan nilai parameter tertentu.

## ABSTRACT

Lakes have been known as fresh water resources to mankind and have been labeled as the best available freshwater source on the Earth's surface. Due to man-made pollutant and wastewater that comes from agricultural site and drainage from laboratories nearside UMK Lake, the lake nowadays being restricted from any human activities. Thus, by treating the UMK Lake water with seaweed, the water can be free from any pollutant. The objectives of this study are to measure the physical-chemical parameter of UMK Lake, to treat the water with red algae species which is Kappaphycus alvarezii and then the treated water sample measured again. The quality of UMK Lake is identified in four lake water parameter which is total dissolved solid (TDS), pH, turbidity and biological oxygen demand (BOD). As for the sample, it comes from two type source which is non-point source and point source. Point source water sample likely to have high value in all parameter while the non-point source water sample has slightly low value in all parameter. Parameter of water quality analyzed in this study state that the total dissolved solid range from 27 mg/L to 46 mf/L before the seaweed treatment increasing to value up from 60 mg/L to 71 mg/L after the seaweed treatment, for BOD value, the result before seaweed treatment range from 30.6 mg/L to 45 mg/L decreasing to value from 18.0 mg/L to 26.4 mg/L, for pH value, the result before seaweed treatment range from 7.7 to 8.2 and decreasing from 7.0 to 8.0 after seaweed treatment and for turbidity value, the result before seaweed treatment show value from 8.58 NTU to 15.30 NTU increasing from 9.46 NTU to 18.45 NTU after the seaweed treatment. Except for pH value, all three of the parameter is exceed the standard value on National Lakes Water Quality Standard (NLWQS). After being treated with seaweed, pH and BOD parameter shows the decreasing value while for total dissolved solid and turbidty value, it shows an increasing value which may come from the seaweed particles itself. However after being treated with seaweed, the parameter values still not reach the acceptable value for any lake categories. By using red algae species, the unwanted pollutant can be decreased as it acts as absorber as the treatment likely to decrease the value of certain parameter.

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## LIST OF ABBREVIATION

| | |
|---|---|
| BOD | Biological Oxygen Demand |
| TDS | Total Dissolved Solid |
| NLWQS | National Lake Water Quality Standard |

## LIST OF SYMBOL

| | |
|---|---|
| °C | degree Celcius |
| % | Percent |
| mg/L | Milligram per litre |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of Study

Earth is covered with 70% of our water that provide the possibility of life exist (Patil et al, 2012). Water is the only inorganic liquid and chemical compound that existed in all three physical states which is liquid, solid and vapour. Recognise as the major requirement of any organism, water helps in many activities such as nourishment, sustenance of life functioning of body organs, circulation of elements in the body. Also it can be used easily as a flow resource and for removing waste (Khanna & Bhutiani, 2008). Being known as integral part of human civilisation, water distributed unevenly around the world and region where water is insufficient are called dessert while area where over supply called wetlands and area that store water called water bodies (Lau, 2011).

Sources of water largely comes from rivers, lake, wells and natural springs where nowadays are exposed to a variety of condition that can contaminate water. Water contaminant increasingly comes from human activities, agricultural practices, industrialization which mainly is the material that use to improve the quality of life in no small measure like combustion of coil and oil, detergent, disinfectant, fertilizers, herbicides, insecticides and pesticides (Sharip & Zakaria, 2008; Owa, 2013). Pollutant

make fresh water no longer fit for drinking which lead thousands of children die due to diarrhoea (Pandey, 2002).

Surface water such as streams, rivers, lakes, reservoirs and wetland is important as it provide habitat to many plant and animal species. Also surface water contributes about 78 percent for human activity. However, throughout the development of world, air pollutant such as sulfur (S), nitrogen (N), toxic like mercury (Hg), pesticides and combustion by-products adversely affects surface water and their watersheds as it will give impact to water quality and harm sensitive species of aquatic life (Sullivan et al., 2015). Nitrate and phosphorus believed being a pollutant to water body from agriculture activities (Suhaimi et al., 2007). Lakes known as fresh water resources to mankind that unfortunately being contaminate along urban pollution which became a breeding ground for many harmful disease (Moses et al., 2011).

Water quality used to describe the chemical, physical and biological characteristic of water that affects water suitability for human consumption and ecosystem health (Li & Magliaccio, 2011). Gases, metals, nutrients, pesticides, and other organic compound are the example of chemical constituent of water. This contaminant need to reduce or totally removed before the water can be complying based on drinking water standard stipulated by the Ministry of Health Malaysia (Smol, 2008)

Contaminant that found in raw material classified as physical parameters, inorganic parameter, metals, organic compound and microbes where physical parameters include turbidity, colour and pH can be found from water surround by clay and slit or peat and soil humus. Also, natural water may possess several inorganic constituents like ammonia which come from decomposition of plant and animal matters,

sewage effluent, industrial effluent and biological reduction of nitrates (Heng et al., 2016).

Efficient techniques for the removal of highly toxic organic compounds from water have been drawn significant interest where a number of method like coagulation, filtration, precipitation, ozonation, ion exchange and oxidation has been used for the removal of organic pollutant from polluted water and wastewater even though these method found to be limited as it involve high capital and operational cost (Nageeb, R. 2012).

In recent years, variety of adsorbent material studies in order to reduce the man-made pollutant that comes from the industrial or agricultural effluent. These adsorbent ranges from biomass like rice husk, baggase, wheat straw dust, saw dust and coconut jute. This treatment is done in order to reduce the parameter of the industrial waste before it can be release to the environment and water bodies (Inamdar, S. 2017).

Therefore, nowadays seaweed has been discovering as an alternative solution to clean up pollution from human sources, fish and people. Charles Yarish, Stamford professor has been researching on the relationship between seaweed and their interaction with ecosystem. He stated that nutrient-enriched system will lead to algae bloom phenomenon that deplete the oxygen level in water and shellfish as well as seaweed will provide a good ecosystem services by extracting organic and inorganic nutrient from water (Buckley, C. 2010).

Seaweed is a good carbon dioxide uptake and storage where it can decrease carbon dioxide level and mitigate water acidification. By 2050, the World Bank predicted that by achieving global production of 500 million tons of seaweed, it will absorb 10 million tons of nitrogen, 15 million tons of phosphorus and 135 million tons

of carbon in ocean. Also seaweed has the ability to breakdown environmental pollutant and been found to be a solution to mitigate the excess of organic and inorganic that left from aquaculture industries. (Tyler, W. 2017)

## 1.2 Problem Statement

UMK Lake in fact can be defined as storage pond where it store waste water from the drainage. Lake with high water quality possesses properties that make it high valued resources to society and nature. Unfortunately, UMK Lake is located in the middle of laboratory and agricultural site which make the possibility of contamination from chemical and pesticide is high. Man-made pollutants are chemically toxic to living thing that the presences of pollution in water system definitely affect all aquatic organisms.

The excessive amount of pollutants in water system provide nutrients that promote algae bloom where the blooming of algae consume oxygen in the lake then block sunlight which is needed by submerged aquatic plant to initiate photosynthesis. Thus, due to the lack of oxygen in the water, it will lead to suffocation of fishes. This phenomenon called eutrophication which defines as the increase of nutrient in a water body.

In recent years, industrial sector has been used highly effective and low-cost waste treatment that reduces the parameter within the disposal standard where it involves the preferential partitioning of the substances from the fluid phases onto the surface of the solid. Basically, these low-cost adsorbent materials come from industrial waste and agricultural waste like fly ash, waste biomass, activated slag and iron oxide coated sand.

Seaweed and algae species studied have been studied for bio-indicator for water quality as they have short life cycle and it respond in a short time to changes in the environment. Also they can be found in all aquatic ecosystem and being found to be a secret behind water quality improvement. By using seaweed species as a treatment to water might be improve the quality in water bodies.

Seaweed has been used in aquaculture sector to improve water quality where the parameter such as pH, dissolved oxygen and biological chemical demand shows the decreasing value. Thus, this study will determine the function of red algae as seaweed sample in lowering the water quality parameter in term of their physic-chemical parameter. The values obtained were compared with the National Lake Water Quality Standard (NLWQS) that provide by National Hydraulic Research Institute of Malaysia (NAHRIM)

## 1.3 Expected outcome

This study will evolve at water quality assessment parameter. The test done by calculating the dissolved oxygen (DO), biological oxygen demand (BOD), and total dissolved solid (TDS) before and after the seaweed treatment. After this study, the status of the UMK Lake water will be analysed after being treated with seaweed species. The result then will be compared to National Lake Water Quality Standard (NLWQS).

## 1.4 Objective

The objectives of this study are:

i. Measuring UMK Lake physical-chemical parameter.
ii. Subjecting the wastewater to a treatment using red algae, Kappaphycus alvarezii.
iii. Measuring physical-chemical parameters after the treatment.
iv. Comparing the parameter with National Lake Water Quality Standard (NLWQS).

## 1.5 Scope of Study

The scope of this study is starting from analyse the water sample in term of physical-chemical parameter then the sample will be subjecting into seaweed treatment. The result than will be compared to National Lake Water Quality Standard (NLWQS) and the quality water will be determined based on classification of lake water standard under National Hydraulic Research Institute (NAHRIM).

## 1.6 Significant of Study

Freshwater functioned to provide essential services to society like fresh drinking water for municipalities, power generation, water for bathing, sites for recreational activity and important fisheries while seaweed species being studied due to its ability to improve water quality and breakdown the environmental pollutant. Therefore, it is important to determine the water quality of UMK Lake so that it can be used for human activities and find the solution to mitigate the water pollution. In this study, the physical-chemical parameters were measured and compared to NLWQS. Therefore, this study will be the handful for the UMK society and the management to know the standard of the UMK Lake and the improvement that can be make from the seaweed treatment.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Lakes

Lake define as inland bodies of water that lack any direct exchange with an ocean that may be deep or shallow, containing fresh or salt, permanent or temporary (Bhateria & Jain, 2016). Based on National Lakes Information of Database of Malaysia which compiled by National Hydraulic Research Institute of Malaysia (NAHRIM), there is about 90 lakes which is natural and man-made found in Malaysia. These lakes are a source of water supply, flood control hydropower and irrigation. Lakes are a source of freshwater, life habitat, component of water cycle, air conditioning, recreational, sporting and fishing activities (Ashraf et al., 2010).

Lakes are essential elements of the landscape for several reasons as they provide important habitat for wildlife where people can enjoy lakes for their beautiful scenery and use them for recreational activities. Another reason is for ecosystem services where lakes acts as natural regulators of river flow, trapping sediments and nutrients from rivers and streams that flow into them.

Lakes can be divided into two basic habitats which is pelagic zone, the deep and open water and benthic zone, the bottom area. The deep, open water zone is where free floating organism like microscopic algae and animal can be found while benthic zone is where the attached algae on the surface of the rocks or other substrate can be found.

Lake also defines as relatively discrete ecosystem where the interplay between physical, biogeochemical and organismal processes can be studied. Sunlight penetrating from the lake surface provides energy that warms the surface water, energy for photosynthesis and an environment that suitable for any predators. All organisms in lakes have adaption that affects the strength of their interactions with their physical and biogeochemical environments or with other species in the food web (Hairston et al., 2014).

Due to some factors lake pollutions were become worst nowadays as it can donate an impact to the quality of the lake water. The greatest threat to the lake water comes from eutrophication where the phenomenon becomes common trends in many developing countries including Malaysia. the major problem facing the lakes comes from non-point source pollutant that contributed by agricultural and domestic runoff lead to the depleted of water quality status (Zukri et al., 2017).

Natural disaster like forest fire can lead lakes to burn and become acidic and human activities can cause water pollution and reduces the quality of water bodies. The quality of freshwater sources especially lakes are threatened by both population growth and industrialization. Although the industrial disposal standard been established, such waste is released into water bodies joining lakes or directly into lakes (Antara, C., 2018).

## 2.2 Water Quality

The increase in socio-economic activities in the area can lead to faster growth of pollution stress on water quality as water pollution comes from both point and non-point

sources. Most of the water pollution comes from point sources to freshwater was originating from collection and discharge from domestic wastewater, industrial waste or certain agricultural activities like farming (Cleophas et al., 2013). Water quality is a term that indicates the suitability of water to sustain water uses and processes (Bartram et al., 1996). Water Quality Index (WQI) is a reference to the quality of surface water in Malaysia set by the Department of Environment, Malaysia. The parameter involve is pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solid (TDS), and ammoniacal nitrogen ($NH_3$-N).

Monitoring water quality in lakes is a key in maintaining safe water for drinking, bathing, fishing and agricultural activities and the long term trend and short term changes are indicators of environmental health and changes in the water catchment area. Due to their transitional position in the landscape between terrestrial and aquatic ecosystem, some of the water bodies have been subjected to wastewater discharge thus spread the water pollution (Bastian & Benfrodo, 2018).

At present, the water from rivers or lakes in Malaysia for human consumption is questionable due to its quality as water quality refer to the level of suitability for human use and that could sustain other living organism. The significant changes to the water quality indicates the incidence of land development and most common measurement used for physical parameter associated with scent, temperature, solid material and water taste, while for chemical and biological parameter consist of nutrient, heavy metals and faecal coliform. High concentration of phosphorus and nitrogen in the water could limit the productivity of the water body system and would lead to increase of nutrient exportation into the water and causing of eutrophication phenomenon (Zullyadini et al.,2016).

## 2.3 Physical Parameter

Physico-chemical water quality can defined as the combination of the physical characteristic and water quality where it provide a clearer insight as to the ability of water bodies to support A healthy aquatic community and to the present of chemical and non-chemical stressors to the river ecosystem (Chin, 20016). Physical parameters that involve in this study are turbidity test.

### 2.3.1 Turbidity

Turbidity is a measure of water clarity that closely related to the amount of particle matter that is suspended in water such as clay, silt, finely organic and inorganic matter and microscopic matter. Turbidity is a visual characteristic of water that represents the amount of light that scattered and adsorb by material in the water when a light shined through sample. High turbidity may come from domestic waste discharge, vegetable fibres and microorganism (Kamarudzaman et al, 2014).

Clarity of water plays an important role in producing destined for human consumption in manufacturing industries. Water which are clear definitely do not absorb light, thus if there is a sign of turbidity then it indicates water pollution. As for drinking water, the value needs to be lower than 5 NTU as some materials that give turbidity may be toxic to consumers (Gaurab, K. 2018).

Turbidity is a key indicator used in assessing the suitability of water for human consumption. The material suspended in turbid water can contain a large number of pathogens and the high turbidity can also have a variety of negative effects on various methods of water use and treatment. Furthermore, it also can stimulate the growth of bacteria such as E. coli (Shahad, S. 2015).

## 2.4 Chemical Parameter

Chemical parameter play an important roles in the health, abundance and diversity of aquatic life and the excessive amount of some constituent like nutrients or the lack of others like dissolved oxygen will lead to imbalance in water chemistry. The imbalance somehow will degrade aquatic conditions and harm aquatic life and it make the water unsuitable for human consumption or greatly increase the cost of water treatment before it can be used (Gaurab, K., 2018). Chemical parameter that used for this research is pH, total dissolved solid (TDS), dissolved oxygen (DO), and biological oxygen demand (BOD).

### 2.4.1 Total Dissolved solid

Solid are found in water bodies in two from which is suspended and dissolved. Suspended solid contains silt, stirred up bottom sediment, decaying plant matter or sewage treatment effluent and this type of solid will not pass through filter while for

dissolved solid it contain soluble salt that yield ions like sodium, calcium, magnesium, bicarbonate, sulphate and chloride ( Hassanpour et al., 2013).

Total dissolved solid (TDS) is a measure of solid remaining in water sample where the water is filtered through filter paper with pore size of 1.2um. It can be determined by evaporating a pre-filtered sample to dryness then finding the mass of the dry residue per litre of sample. Dissolved solid may be organic that comes from animal or plant waste or inorganic compounds that comes from carbonate, sulphate and bicarbonate which gives variety of effects like hardness, taste and odour depending on nature of dissolved solid (Gaurab, K., 2018).

The concentration of TDS in water bodies affected by variety of factor and the high concentration of dissolved ions are not solely indicate for water pollution and unhealthiness. Fertilizers from agricultural sites, runoff from road, and organic matter from wastewater treatment plant may contributes to elevate TDS reading (Gaurab, K. 2018).

### 2.4.2 Biochemical oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) is a measurement of oxygen consumed by aerobic microorganism when decomposing organic matter in water. BOD is measured over five day period at 20°C that represent the amount of oxygen consumed per liter of water sample. BOD value commonly expressed in milligrams of oxygen consumed per litre of sample during five days of incubation and often used as surrogate of the degree of organic pollution of water (Clair et al., 2003).

BOD is an important water quality parameter due to the facts that it provides an index to assess the effect of discharge wastewater will have on the receiving environment. The higher the BOD value represents the greater amount of organic matter for oxygen consuming bacteria. When BOD levels are high, dissolved oxygen level decrease due to the oxygen that is available in the water is being consumed by the bacteria. Depletion of dissolved oxygen from aquatic plants organism making the environment unsuitable for life and dramatic depletion will lead to hypoxia or anoxic environment (Clair et al., 2003). The lower the BOD level means the healthier the water. Water need to have oxygen in order to support aquatic life.

A five-day BOD test are commonly used in environmental monitoring where this test utilized as a mean of stating what level of contamination from the pollutant is entering a body of water. In other words, this test measure the oxygen requirement of the bacteria and other organisms as they feed upon and bring about the decomposition of organic matter (Mark, R., 2002).

### 2.4.5 pH

Degree of alkalinity or acidity, pH is a measure of concentration of hydrogen ions in water. This parameter represent the negative value of the logarithm of the concentration of hydrogen ion that express by $pH = -log[H^+]$. pH of water in natural condition is between the range of 6-8. Water is slightly acidic mainly due to the dissolved carbon dioxide from the atmosphere while water is slightly alkaline due to the

presence of calcium carbonate. At the range of pH <4 which is very acidic or pH>9 indicates the presence of industrial discharge or acid mine discharge that both condition will affect aquatic life (Sophocleous, 2002).

pH indicates the sample acidity but define as a measurement of the potential activity of hydrogen ion in the sample. The pH scale is logarithmic, thus each one unit change in pH represent a ten-fold change in acidity. The pH of water body is affected by several factors and the most important factors are the bedrock and soil composition through water movements both in water bed and groundwater. Some of the rock types like limestone neutralize the acid while granite type of rock having no effect on pH. Another factor that can be included is the amount of plant growth and organic material within water body where the material decompose will released carbon dioxide that will combine with water to form carbonic acidic. Changes in the pH value of water are important to many organism as most of it adapted to life in water of a specific pH and may die if the water pH change slightly(Brian, O., 2014).

## 2.5 Red Algae: Kappaphycus alvarezii

Seaweed play important role in water quality where it can clean the excess nutrient supply and other animal metabolic by-products and simultaneously grow and provide a significant amount of the needed oxygen through photosynthesis activity. Some species able to absorb or remove soluble nutrient like nitrogen and phosphorus.

Kappaphycus alvarezii or known as Eucheuma Cottoni are the larger tropical red algae with fastest growing rates. It's known to be tough fleshy and firm and can grow

up to 2 meter tall. Kappaphycus alvarezii usually grow at 1 to 17 meters deep on reef flat or reef edges where it loosely attached to broken coral. Cultivated type grows rapidly in areas of strong tidal current with high salinity and bright light. Kapparhcus alvarezi thought to reproduce vegetative but recent studies shows that it also can reproduce sexually. (Raheem, T., 2013). These algae were used as experimental materials for integrated cultivation which found can removed waster that released by pearl oyster efficiently especially ammonium.

Some red algae are important food that retains both their color and gelatinous nature when being cooked and mostly this species are used as gelatin substitute in pudding, toothpaste, ice cream and preserve. (Guiry, M. D., 2014)

## 2.6 National Lake Water Quality Standard (NLWQS)

National Lake Water Quality Standard (NLWQS) for Malaysia provide the required information in making judgements to the fitness of the water for human protection of recreational purposes and ecosystem health for the diversity or aquatic life protection. This standard is applied to any lake or reservoir, dam, ponds and other impoundments water of any usage or purposes. The NLWQS develop to be used as the basis for the future research on Lakes in Malaysia to protect or improve water quality in lakes.

NLWQS consist of four categories which is A, B, C and D. category A is for lakes that used for primary body contact recreation. The lake is managed in the manner

where people will be allowed to do activities like swimming, diving and kayaking as the water quality id free from water borne disease.

Category B is for lakes that used for the secondary body contact recreation which mainly for recreational purposes like cruising. The lake will be kept from any pollutant but people still not allowed to be swimming in it which leads the measure to microbiological and water borne disease parameter are not compulsory.

Category C is for lakes that are managed for the purposes of preserving aquatic life and biodiversity where the status of the aquatic living things in this lake must be of the best condition as it is the main intention of the lake management of these lake categories. The diversity of living organisms in this type of lakes is also considered as a good measure of healthy lakes and of paramount importance.

Category D is for lakes that are managed for the minimum preservation of good aquatic life in the lakes and this lake category must be kept in good condition as it will prevent it to be nuisance to its surrounding. Also, all the possible pollutant must be kept out of the lake even this lake category is not meant for any particular purpose (NAHRIM, 2015).

Table 2.1 National Lakes Water Quality Standard for Malaysia

| Parameter | Unit | Category A | Category B | Category C | Category D |
|---|---|---|---|---|---|
| pH | - | 6.5-8.5 | 6.5-8.5 | 6.0-9.0 | 5.5-9.0 |
| Turbidity | NTU | 40 | 40-170 | 70 | 250 |
| Total dissolved solid | mg/L | 1000 | 1000 | 1000 | 1000 |
| Biochemical oxygen demand (BOD) | mg/L | 3 | 6 | 6 | 8 |

Source: NAHRIM, 2015

# CHAPTER 3

# MATERIAL AND METHOD

## 3.1 Study Area

In this research, water sample will be taken from UMK Lake that located surround BAP Building, aquaculture laboratories, chemical laboratories and a land that use for agriculture activities. Figure 3.1 show the exact location of UMK Lake. Water sampling will be taken at four point location. Table 3.1 shows the coordination of the UMK Lake. Each point location water sample will be taken up to 1L for ex-situ test with water sampler.


Figure 3.1 Location of UMK Lake.

Source: Google Map

Table 3.1 Coordination Of Four Point Water Sampling

| Sample | Coordination |
|---|---|
| **Point 1** | 5.745577, 101.864920 |
| **Point 2** | 5.745560, 101.864954 |
| **Point 3** | 5.745426, 101.865330 |
| **Point 4** | 5.745205, 101.865353 |

Source: GPS

Sample from UMK Lake will be divided into two categories which is the non-point source sample and point source sample. Point 1 and point 3 will be point source sample as the sample taken from the runway drain that comes from the drain from laboratories. As for point 2 and point 4 is the non-point sources which taken from the middle side of UMK Lake.

### 3.2 Water Sampling and Preservation

Before sampling, icebox was completely filled with ice. All the bottles samples were labelled with the sampling point, name and date. For this study, bottle sample used is the dark glass bottle sample. The water sample from four different locations was taking up by water sample. Figure 3.2 shows the water sampler equipment. as for

precaution step, water sampler was rinse using distilled water to avoid any microorganism or bacteria infect the sampling water.

Figure 3.2: Water Sampler

### 3.3 Material and Reagent

#### 3.3.1 Apparatus and Equipment

Apparatus and equipment that will be used in this study are DO bottles, glass bottles, conical flask, measuring cylinder, beaker, dropper, and hot plate pH meter, water sampler, turbidimeter and YSI multi-parameter.

### 3.3.2 Reagent

Chemicals that will be used in this study are Ferric Chloride ($FeCl_3$), Magnesium Sulphate ($MgSO_4$), Phosphate buffer solution and Calcium Chloride ($CaCl_2$).

## 3.4 Methodology

### 3.4.1 Turbidity

Turbidity measures by HACH model 2100Q Portable Turbidimeter where used to measure the relative clarity of a fluid by measuring the amount of light scattered by particles suspended in a fluid sample. Turbidity both before and after treatment are test at the laboratory using turbidimeter.

### 3.4.2 pH

pH value measured by chemical portable pH meter that used to measure hydrogen-ion activity in the sample. The equipment consists of voltmeter attached to pH-responsive electrode and a reference electrode. For this study, multi instrument parameter, YSI-556 are used for in-situ test and pH meter are used in ex-situ test.

### 3.4.3 Total Dissolved Solid

Total dissolved solid measured using YSI 556 MPS Multi-parameter where the probe connected with intellical parameter that measure dissolved oxygen, pH, temperature and TDS simultaneously.

### 3.4.4 BOD determination

10 mL of water sample being pipet into 300 mL BOD bottle using serological pipette. The bottle filled with 290 mL pre-prepared of dilution water seeded with powder pillow and mixed. After that water added carefully to prevent bubbles from foaming then placed a stopper and inverted several time for mixing process. Initial dissolved oxygen value determines thrice using a BOD kit. Dilution water added to fill the bottle and placed in an incubator at 20°C and leave in the dark for five days. After five day, the final reading of the dissolved oxygen being taken thrice.

For accurate result, some precaution need to be taken such as additional air cannot be introduced, and temperature must be 20°C as the usual temperature of bodies of water in nature.

### 3.4.5 Seaweed treatment

Dried red algae wash with running tap water for about 5 minutes to removes dirt and salt. Then the washed red algae proceed to soaked with water for about 30 minutes. Red algae then drain and proceed to drying process. The temperature used for drying is 60°C for 24 hours. After dried, the red algae then blended to make small particle and proceed to sieve with size of 0.75μm.

5 g of dried blended seaweed inserted into 450 mL water sample and being stirred with stirred plate for about 1 hour, after 1 hour, the water sample then filtered with vacuum pump. The water sample that have been filtered then test again for after seaweed treatment result. Figure 3.3 shows the flow chart of the seaweed treatment.

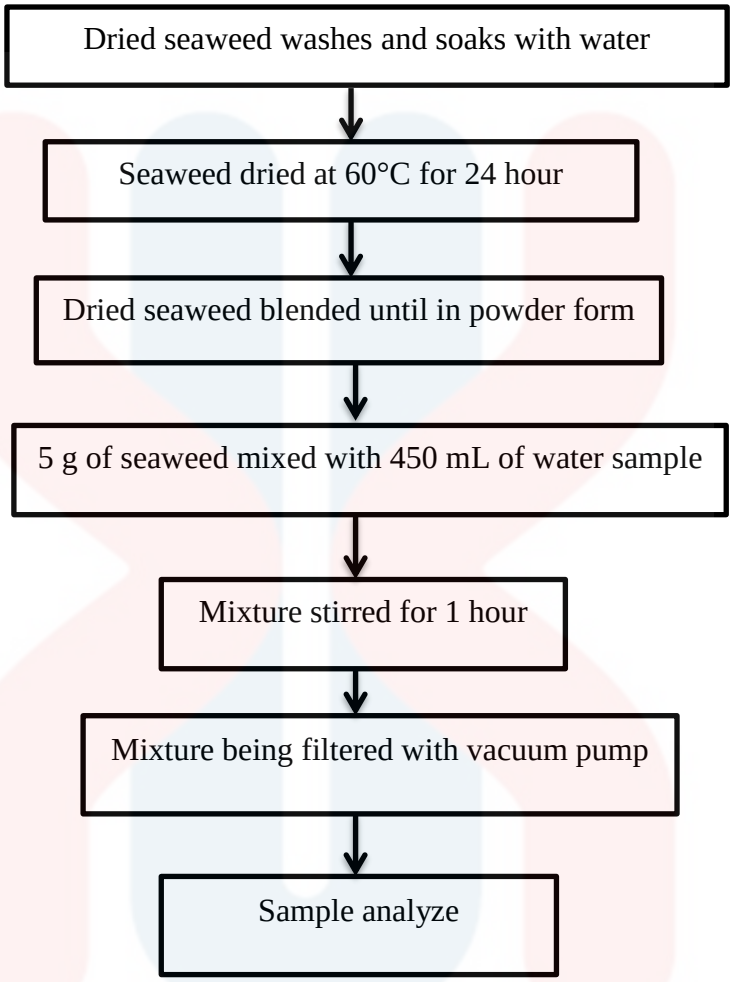


Figure 3.3: Seaweed Treatment Flow Chart

# Chapter 4

# RESULT AND DISCUSSION

## 4.1 Total Dissolved Solid

Total dissolved solid (TDS) are a measure of the combined content of all inorganic and organic substance. Figure 4.1 show the average of TDS before and after seaweed treatment at four point sample. Dissolved solid may be organic that comes from animal or plant waste or inorganic compounds that comes from carbonate, sulphate and bicarbonate which gives variety of effects like hardness, taste and odour depending on nature of dissolved solid (Gaurab, K., 2018).

TDS parameter is an important water quality indicator for drinking water and a general indicator for pollution which refer to the amount of cations which is the positively charge ions and anion which is the negatively charge ion in water. TDS contain inorganic salt like calcium, magnesium, potassium, sodium, bicarbonate, chloride and sulphate and he rest of portion lies with organic materials (Zullyadini, R., 2016).

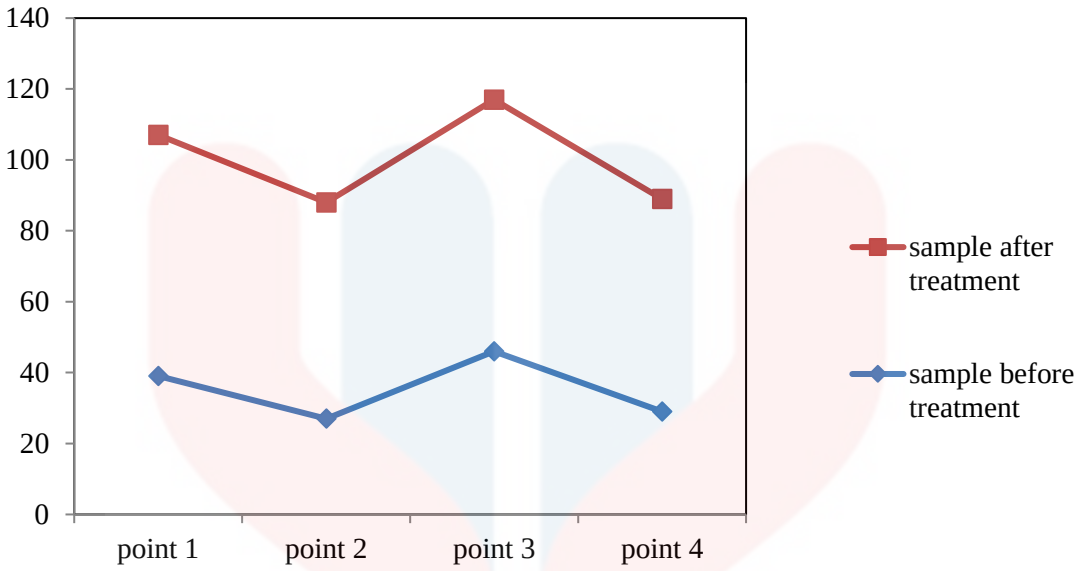


Figure 4.1: Graph of TDS value before and after treatment

Table 4.1: Table of percentage of increasing on TDS value

| Sample | Percentage of increasing on TDS value, (%) |
|---|---|
| Point 1 | 27.10 |
| Point 2 | 38.64 |
| Point 3 | 21.37 |
| Point 4 | 34.00 |

TDS values after seaweed treatment are higher than before the seaweed treatment due to the seaweed particle that dissolved with the sample. The TDS value for point 1 increase from 39 mg/L to 68 mg/L, point 2 increase from 27 mg/L to 61 mg/L, point 3 increase from 47 mg/L to 71 mg/L and for point 4 the value increase from 29

mg/L to 60 mg/L. Table 4.1 shows the percentage of increasing value on TDS before and after the seaweed treatment. TDS value for sample at point 1 increase with 27.10%, point 2 increase with 38.64%, point 3 increases with 21.37% and point 4 increase with 34.00%.

The increasing of total dissolved solid value after seaweed treatment in water due to mineral nature of seaweed particles that releasing its ion from the structure to water (Hassanpour et al., 2013). Based on NLWQS, the total dissolved solid range until 1000 mg/L which all point samples are in acceptable value (NAHRIM 2015). This result shows that for TDS parameter are not suitable for seaweed treatment as the particles from the seaweed itself are dissolved in the water.

### 4.2 Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand is a measure of the oxygen that being consumed by microorganism in order to decompose waste like dead plant, manure, sewage and food waste that present in water supply. The larger amount of organic waste in water supply means there will be a lot of bacteria present and the demand of oxygen will be high (Clair et al., 2003).

Figure 4.2 shows the BOD value before the treatment with seaweed where point 1 state the highest value with 45.0 mg/L, while point 2, 3 4 state value of 33.0 mg/L, 30.6 mg/L and 42.9 mg/L relatively. The result shows that there is decline in DO levels as the BOD value are quite high. This due to the facts that bacteria present in water sample taking the oxygen from the oxygen dissolved in water.

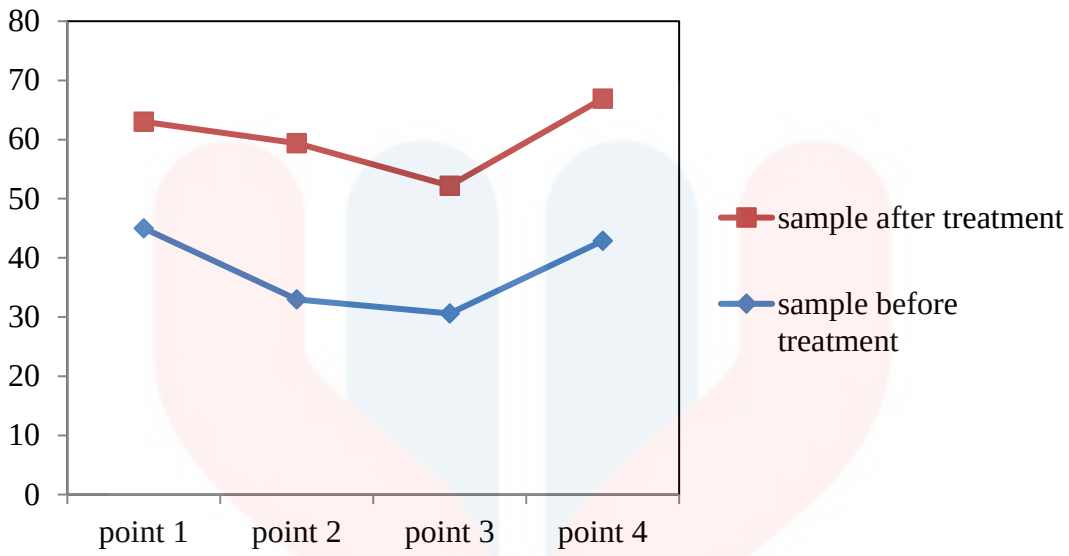


Figure 4.2: BOD value before and after treatment

Table 4.2: Percentage of decreasing on BOD value

| Sample | Percentage of decreasing on BOD value (%) |
|---|---|
| Point 1 | 42.86 |
| Point 2 | 11.11 |
| Point 3 | 17.24 |
| Point 4 | 28.25 |

The BOD value after seaweed treatment decreasing to 18.0 mg/L, 26.4 mg/L, 21.6 mg/L and 24.0 mg/L relatively. Figure 4.2 show the percentage of decreasing on BOD value. The BOD value for sample point 1 shows the decreasing value until

42.86%, point 2 decrease to 11.11%, point 3 show decreasing value to 17.24% and for point 4 shows the decreasing value up to 28.25%.

The considered value for lake based on NWQS only up to 8.0 mg/L which means that water from UMK Lake completely contain higher quantity of bacteria and not recommended for any human activities. NLWQS standard for BOD value range from 3 to 8 mg/L which is the BOD value for any point both before and after seaweed treatment are still not acceptable.

Based on study by Inamdar S. (2017), it state that the reduction of Bod Value decrease with particles diameter. Since the diameter of the seaweed particle used in this study are constant which are 0.75 microns, the effect of BOD reduction will be the same. Presence of the large number of smaller particles provides the sorption system with a greater surface area available for BOD reduction. Also it reduces the external mass transfer resistance.

### 4.3 Turbidity

Turbidity is a measure of clarity of water that was caused by particles that dissolved in the water making the water became cloudy in color. Turbidity in water can comes from various materials such as suspended solid, dissolved materials and microbial loads. Thus the increases in quantity of these materials will increase turbidity value (Kamarudzaman et al, 2014).

The average value of turbidity which shown in Figure 4.3 show that point 3 have the highest with 46 NTU while point 1 is 39 NTU, point 2 is 27 NTU and point 4 is 29 NTU.

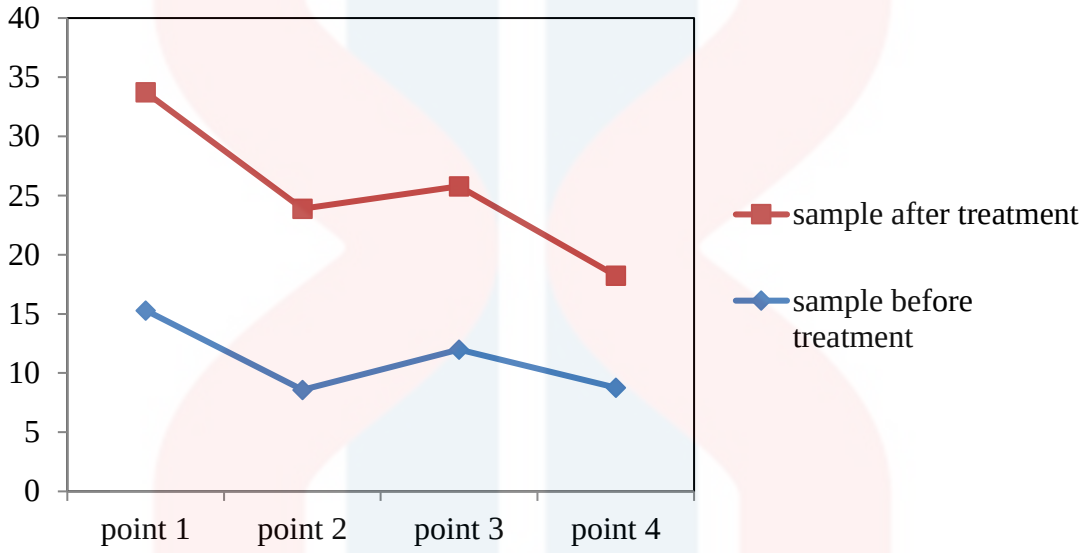


Figure 4.3: Turbidity value before and after treatment

Table 4.3: Percentage of increasing value on turbidity

| Sample | Percentage of increasing value on turbidity (%) |
|---|---|
| Point 1 | 9.28 |
| Point 2 | 28.14 |
| Point 3 | 6.87 |
| Point 4 | 3.73 |

After being treated with seaweed, the turbidity value shows drastic change. The average of turbidity value where point 1 increase to 18.43 NTU, point 2 increase to 15.30 NTU, point 3 increase to 13.77 NTU and point 4 increase 9.46 NTU. Table 4.3 shows the percentage of increasing value on turbidity test sample where point 1 increase to 9.28%, point 2 increase up to 28.14%, point 3 increase to 6.87% and point 4 increase up to 3.73%.

The increasing of turbidity value might be due to seaweed particle dissolve in water. In a study done by Shahad, S. (2015), it state that the present in significant concentration, particles consisting of light-absorbing materials will lead to a negative interference. Furthermore, on natural state most particle including bacteria have a negative electric charge, thus rather than the seaweed particles and the water particles clump together to form larger particles, the particles repel each other. Also the increasing turbidity caused from the addition of more concentration that comes from the seaweed to suspended particles in water sample.

Based on NWQS value on turbidity above 40 NTU categorized as lake on Category B and for this result, it shows that the test for water quality in turbidity parameter are not suitable as the seaweed particle will interfere with the water clarity and increase the turbidity value (NAHRIM, 2015).

**4.4 pH**

pH is a measure of hydroxyl ions and free hydrogen that present in water and commonly measure in the first place as it may indicate the conductivity level of the

water. Some of the organism can survive at specific level of pH and it may die when slight changes happen (Sophocleous, 2002).

Figure 4.4 show the average pH value before the treatment with seaweed. The highest pH value before treatment is at point 1 with 8.2 and lowest is at point 4 with 7.7. Point 2 has value of 8.1 while point 3 is 7.8. The pH value after seaweed treatment is decreasing. pH at point 1 decrease to 7.8, point 2 decreased to 8.0, point 3 to 7.0 and point 4 to 7.4. As for point 1, the sample are from the drainage system from the chemical and microbial laboratory shows a slightly alkaline and point 2 is the point where the source meet the lake shows a decreasing 0.1 pH value while for point 3 is the point source from drainage system at agricultural laboratories shows a normal pH value. Table 4.4 shows the decreasing value on pH where point 1 decrease up to 1.86%, point 2 decrease up to 0.62%, point 3 decrease up to 5.41% and point 4 decrease up to 1.99%.

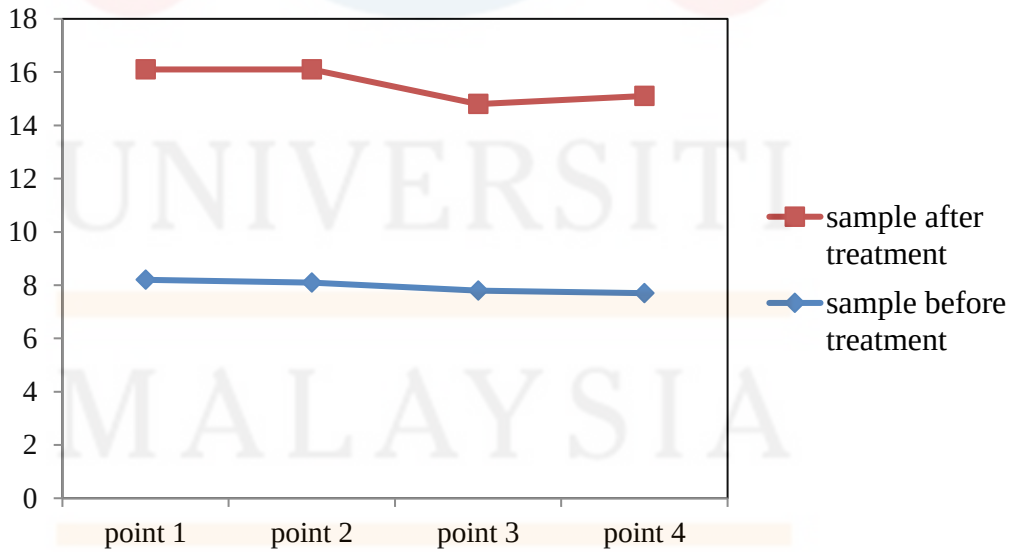


Figure 4.4: pH value before and after treatment

Table 4.4: Percentage of decreasing value on pH

| Sample | Percentage of decreasing value on pH |
|---|---|
| Point 1 | 1.86 |
| Point 2 | 0.62 |
| Point 3 | 5.41 |
| Point 4 | 1.99 |

The pH value before seaweed treatment is slightly alkaline and the value decrease a bit nearing the neutral point. The decreasing value of pH level due to the fact where the seaweed particles that work as adsorbent are negatively charge favoring the adsorption of cationic species or any particles in water sample (Nady et al., 2013). Others contributors of the decreasing pH value come from the chemical characteristic from the seaweed that may lead to more acidic pH value.

NLWQS standard for pH value range from 5.5 – 9.0 which indicates that the pH value is totally acceptable for any categories (NAHRIM, 2015). This result shows that seaweed treatment is suitable to decrease the pH to its neutral value. Seaweed particle seems like to absorb hydrogen ions that tend to increase the pH value.

## 4.5 Result Summary

Table 4.1 shows the average result of UMK Lake. From the result that were get on the study area on the lake when compared with the standard NLWQS indicates that all studied parameter are not in acceptable limit accept the pH value. The values for pH and BOD parameter after seaweed treatment likely to decrease while the value for turbidity and TDS are likely to increase. pH value and TDS value still in the range of acceptable range in NLWQS but the value for parameter BOD and turbidity are quiet high and it exceed the range.

Table 4.1: The Average Values on UMK Lake.

| Parameter | Unit | Sample before seaweed treatment | | | | Sample after seaweed treatment | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Point 1 | Point 2 | Point 3 | Point 4 | Point 1 | Point 2 | Point 3 | Point 3 |
| pH | - | 8.2 | 8.1 | 7.8 | 7.7 | 7.9 | 8.0 | 7.0 | 7.4 |
| BOD | mg/L | 45.0 | 33.0 | 30.6 | 42.9 | 18.0 | 26.4 | 21.6 | 24.0 |
| TDS | mg/L | 39 | 27 | 46 | 29 | 68 | 61 | 71 | 60 |
| Turbidity | NTU | 15.30 | 8.58 | 12.00 | 8.78 | 18.43 | 15.30 | 13.77 | 9.46 |

# Chapter 5

# CONCLUSION AND RECOMMENDATION

## 5.1 Conclusion

As for conclusion, since UMK Lake are used to gather waste water from laboratory drain thus the water seem to not recommended for human activities as it may contain much more bacteria. Parameter of water quality analyzed in this study state that the total dissolved solid range from 27 mg/L to 46 mf/L before the seaweed treatment increasing to value up from 60 mg/L to 71 mg/L after the seaweed treatment, for BOD value, the result before seaweed treatment range from 30.6 mg/L to 45 mg/L decreasing to value from 18.0 mg/L to 26.4 mg/L, for pH value, the result before seaweed treatment range from 7.7 to 8.2 and decreasing from 7.0 to 8.0 after seaweed treatment and for turbidity value, the result before seaweed treatment show value from 8.58 NTU to 15.30 NTU increasing from 9.46 NTU to 18.45 NTU after the seaweed treatment.

As for the value comparing the result with NLWQS, the parameter of TDS and pH are range in acceptable value while for turbidity and BOD value are not in acceptable value  Although some of the test seems to fit certain categories on National Lakes Water Quality Standard (NLWQS), the lake might harm human due to bacteria that present in water.

Seaweed treatment in this study may be categorized as successful studies as some of the physic-chemical parameter studied is decreasing from its original value. As for turbidity and total dissolved solid, these parameters are not suitable to be analyzed as the particle from the seaweed will increase its value. Thus seaweed particle are likely to absorb any material or substance in water and treated it to acceptable standard value.

## 5.2 Recommendation

It is recommended that for next research all the physical, chemical and biological parameter will be included to get more accurate information of the water quality in the study area. By measuring all these parameters, a clear view of the water quality status can be obtained. The combination of the data and the seaweed treatment can be used to generate essential information for managing sustainable water resources for the benefit of future generation. As for seaweed treatment, the sample after being treated recommended to filter twice or thrice to get more acceptable value and removed all seaweed particle. Also, various measure must be put in place in order to improve the existing water quality and to control pollution of UMK Lake. In order to make the UMK Lake able to use for recreational purposes, the water quality need to be in an acceptable range of value in National Water Quality Standard that have been provide by Department of Environmental.

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Appendix A

Figure 6.1: Dried Red Algae

Figure 6.2: Blended Red Algae