POTENTIAL STUDY OF TREATED EFFLUENT ORGANIC MATTER (EfOM) AS FERTILIZER

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ABSTRACT

The treated effluent organic matter (EfOM) will be generated as long as human activity continues. World produces large quantities of treated effluent organic matter that much every year and number increasing year after year. Treated EfOM emissions from sewerage treatment plant to channel water may cause pollution. Thus, this approach can be taken to reduce pollution by reuse treated EfOM performance potential sectors which is agriculture. This thesis has revealed the results of a preliminary study in the areas of reuse potential treated EfOM. The study found that sprinkling the plants not only affect plant growth, but also acts as a fertilizer to the plant factor. However, the concentration of bacteria in plants is given anointing the treated EfOM should be given to protecting public health. The treated EfOM also concentration was tested by parameter which are, COD, TSS, NH3-N, Pottasium, and Phosphorus. Characterization treated EfOM from sewerage Treatment Plant at Universiti Malaysia Pahang was matched for reuse. Based on the analysis results, reuse treated EfOM practicable implementation in the landscape Universiti Malaysia Pahang to reduce the cost of chemical fertilizers.

ABSTRAK

Bahan organik efluen EFOM akan dijana selagi aktiviti manusia berterusan. Dunia menghasilkan kuantiti bahan organik efluen yang banyak setiap tahun dan jumlah meningkat tahun demi tahun. Pelepasan EFOM dari tapak rawatan kumbahan ke saluran air mungkin menyebabkan pencemaran. Maka, pendekatan untuk mengurangkan pencemaran boleh diambil dengan guna semula EFOM dalm sektor berpotensi. Ini juga selaras dengan usaha mengatasi masalh kekurangan sumber bekalan air bersih. Tesis ini mendedahkan hasil kajian awal guna semula EFOM dalam sector berpotensi serta keperluan kualiti air untuk tujuan penggunaan tersebut. Kajian penyiraman tumbuhan mendapati penyiraman ke atas tumbuhan bukan sahaja tidak mempengaruhi tumbesaran tumbuhan, malahan bertidak sebagai faktor baja kepada tumbuhan tersebut. Namun, tumpuan bakteria pada tumbuhan yang diberi siraman EFOM harus diberi perhatian untuk melindungi kesihatan awam. Pencirian EFOM dari loji olaham kumbahan Universiti Malaysia Pahang bersesuian untuk guna semula. Berdasarkan kepada keputusan kajian, guna semula EFOM boleh dipraktikkan pelaksanaannya pada lanskap dalam Universiti Malaysia Pahang untuk mengurangkn kos pembelian baja kormesial.

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LIST OF ABBREVIATIONS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolve Oxygen
$NH\text{-}NO_3$	Ammonia Nitrogen
TSS	Total Suspended Solid
WWTP	Wastewater Treatment Plant
EfOM	Effluent Organic Matter
NOM	Nature Organic Matter
SMP	Soluble Microbial Products
WQI	Water Quality Index
DOE	Department of Environment
ICP	Inductively Coupled Plasma
UMP	Universiti Malaysia Pahang

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Treated Effluent Organic Matter (EfOM) is a complex of organic matter, especially of bio-treated sewage effluent and is consider as the main barrier for further treatment. However, treated EfOM is the combination of those of Nature Organic Matter (NOM), soluble microbial products (SMPs) and trace harmful chemicals. The one of the major components in wastewater is the most of the NOM originate from drinking water. Addition, while SMPs come from biological treatment with the wastewater treatment plant and non-biodegradable organic matter. Treated EfOM should be carefully characterized in order to find an optimum treatment method for water reuse. The cause of increasing public concern in recent decades traces organic pollutant in wastewater. This is to be potential health risks to people. Wastewaters like treated EfOM consist of both particulates and dissolved substance.

Waste water treatment of domestic and industrial effluents has becom an imperative component of new urban planning and infrastructure. Wastewater reuse is being increasingly emphasized as a strategy for rational use of limited resources of freshwater and as a means of safeguarding the deteriorating aquatic environment due to wastewater disposal. Reuse of wastewater has become all the more important in small and isolated communities where alternative sources of freshwater are neither available nor cost effective. The effluent coming out of this treatment can be discharged into waterway but cannot be recycled.

Study of treat effluent organic matter as fertilizer will know the nutrient from that organic matter. Fertilizer can add nutrients to the cells of the plant and can divide the plant will grow. However, using the research can get the characteristic of treated EfOM and percentage the all components that have in that fertilizer. The nutrient from the fertilizer can be benefit for the vegetation or plant growth.

1.2 PROBLEM STATEMENT

Treated Effluent Organic Matter (EfOM) is one of the main sources of the pollution. Treated EfOM always makes our natural resource get polluted. When these wastes go in the certain aquatic life, sometime make the toxic and low of the water quality. Basically, municipal the high level of Chemical Oxygen Demand (COD) is contained in wastewater. The high level of Chemical Oxygen Demand (COD) can lead to mortality of aquatic life because it results low Dissolve Oxygen (DO) in water. Biological Oxygen Demand (BOD) also is contained in wastewater municipal. Besides that, municipal wastewater also contains high levels of Total Suspended Solid (TSS) such as organic and inorganic material that can cause dirt and odor to the water. Besides that, excessively used in the agriculture cause the ground water pollution gives the dangerous for the human health. To solve this problem, treated EfOM need to be treated before it is can be release to the rivers. Waste needs to be treated in order to keep our environment clean and safe to be used.

1.3 OBJECTIVE

The objectives of this study are:

i. To determine the characteristic of treated Effluent Organic Matter (EfOM)
ii. To determine the effectiveness of treated EfOM as fertilizer to vegetable during treatment.

1.4 SCOPE OF STUDY

In the proposed study, treated effluent organic matter (EfOM) is my conducted research. For this research, determine the water quality parameter from the treated (EfOM) will do. The Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), and pH of waste are the process to observe the treatment. The experiment was conducted in the Environmental Engineering Laboratory, Faculty of Civil Engineering, Universiti Malaysia Pahang (UMP). Treated EfOM are taken from the treatment plant at Universiti Malaysia Pahang (UMP). Furthermore, the one types of plant used for this research. Vegetable that use in the experiment is mustard. The planting is doing in 3 pots for 3 difference fertilizer to watering. Using the fertilizer sewage, commercial fertilizer and water on the plant can compare the effectiveness of each plant.

1.5 EXPECTED OUTCOME

Treated effluent organic matter (EfOM) has component that have many nutrients. This study can be producing the Nitrogen, Phosphorus and Potassium in the treated effluent organic matter (EFOM). However, the treated EFOM will be used for all the plants around the Universiti Malaysia Pahang. Furthermore, this treated EFOM can reduce the cost of commercial fertilizer. Utilization of treated effluent organic matter can replace of commercial fertilizer.

1.6 SIGNIFICANT OF STUDY

Treated effluent organic matter (EfOM) as fertilizer is more save and benefit to the environment and society. Contribute to society in preventing the community from any harm and danger chemical for water and vegetation is one of benefit to this research. Besides that, preserving and protecting the environment from pollution is the beneficial of treated EFOM. Reduce life cost since treated EFOM can produce the plant

is one of the significant for this study. The application of treated EFOM in our life is can reduce and protect our environment from pollution. Then, the vegetable free from any chemicals when used treated EFOM.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In chapter two, it is about search the related and relevant literature to research project has been chosen. It also summarizes the literature and finds the evidences which can answer the research objectives. This chapter will explain about Effluent Organic Matter (EfOM), Fertilizer, vegetation and water quality parameter in this study. Water quality parameters are based on the Water Quality Index (WQI) from the Department of Environment (DOE).

2.2 EFFLUENT ORGANIC MATTER (EFOM)

Treated effluent organic matter (EfOM) consists of natural organic matter originating from the drinking water and anthropogenic pollutants brought by human activities (Shon et al., 2006). Wastewater reuse is being increasingly emphasized as a strategy for conservation of limited resources of freshwater and as a mean of safeguarding the aquatic environment due to contaminants present in wastewater. One of the parameters of concern for human and environment health is components of

organic matter originating from wastewater treatment plant (WWTP) effluents. This treated effluent organic matter (EfOM) should be carefully characterized in order to find an optimum treatment method for water reuse. This review presents the components of treated EFOM present in WWTP effluent and various treatment methods that may be employed for reduction of treated EFOM.

Treated effluent Organic Matter (EfOM) is a combination of those Natural organic matter, soluble microbial product and trace harmful chemicals. Treated EfOM will reuse by production of vegetation. This treated EfOM should be carefully characteristics and analyses of component present in wastewater treatment plant effluent. However, treated EfOM has become more important when that concerns related to water reuse increase an interest in characterizing.

2.3 FERTILIZER

Fertilizer 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, shrubs and flowers. The population in Malaysia was 26.7 million in the year 2006 and out main economic sector are industrial, agricultural and eco-tourism. Large population of people encourages Malaysia to involve in agriculture filed actively to support the population's demand for more food supplies. Fertilizer application is essential in Malaysia agriculture as it plays a major in improving growth and yields in our highly leached infertile acid tropical soils (Ahmad, 2001).

Fertilizer functions to replace the chemical components that are taken from the soil by the growing plants. However, at the same time they are also designed to improve the growing potential of soil, and fertilizers can provide a better growing environment that natural soil. They can also be used to suit the type of crop that is being grown. According to Pimentel (1997), fertilizer also contain with trace element that improve the growth of plant.

Fertilizer consumption in agriculture thus plays a great role in the growth of the plants and used widely in cultivating the plants. Fertilizer application is essential in Malaysian agriculture as it plays a major role in agriculture industry. This study is conducted to effectiveness of fertilizer on the vegetation.

2.4 PLANT

Plant need to be fertilized because most soil does not provide the essential nutrients required for optimum growth. Plant must obtain the elements essential for their growth, other than carbon and hydrogen, from the soil. Thirteen elements essential for plant growth have been identified. The essential elements are called nutrients; those needed in the greatest amount are called micronutrients, (Prof. Shakhashiri, 2011).

2.5 WATER QUALITY PARAMETER

2.5.1 BOD

The Biochemical Oxygen Demand (BOD) is a measure of the amount of oxygen consumed by the bacteria to degrade the organic matter (Singh, 2004). Bacteria utilize organic matter in their respiration and remove oxygen from the water. The BOD test provides a rough idea of how much biodegradable waste is present in the water.

Biodegradable waste is a waste usually composed of organic wastes. According to Veslind et. al., (1994), Biochemical oxygen demand is determined by incubating a sealed sample of water for five days and measuring the loss of oxygen from the beginning to the end date of the test.

2.5.2 COD

Chemical Oxygen Demand (COD) is also one of the water quality parameter that also important. COD known as the value of oxygen needed to oxidize organic matter chemically to produce carbon dioxide and water. COD measured in mg/l which indicates the mass of oxygen consumed per liter of solution. It can be used to determine the concentration level of the organic waste in water. Usually in water the value of COD will be greater than the BOD value (Cude, C., 2001).

According to Veslind et al., (1994), the weakness of COD reading was it will not show any result on the rate of organic matter that has been biodegradable. However, this test will yield more accurate reading and fast. The chemical that was used in this test involve strong chemical such as sulphuric acid and potassium permanganate.

2.5.3 DO

Dissolved oxygen (DO) is the measure of free oxygen which dissolved in water. The dissolved oxygen test measures the amount of life sustaining oxygen dissolved in the water. This is the oxygen that is available to the entire living thing in the water. Most aquatic plants and animals need oxygen to survive in fact, fish will drown in water when the dissolved oxygen levels get too low.

According to Cude C., (2001), DO usually measure in miligrams per liter, or as a percent saturation. The DO level in water generally depends on the temperature, quantity of sediment in the stream, the amount of oxygen taken out of the system by respring and decaying organisms, and the amount oxygen put back into the system by photosynthesizing plants, stream flow, and aeration. Low levels of dissolved oxygen in water are sign of possible pollution.

2.5.4 ph

The ph level is a measure of the acidity or alkalinity of a water body. Most forms of aquatic life are very sensitive to water ph. Water containing a great deal of organic pollution will normally tend to be acidic. Water with ph of 7 is considered neutral. If the ph is below 7, it is classified as acidic, while water with ph greater than 7 is classified alkaline, which is the measure of the acidity or alkalinity of a water body (Letterman, 1999).

2.5.5 AMMONIA NITROGEN

Nitrogen is one of the important elements in a biological reaction. One of the substances that occur during the biological metabolism process is ammonia nitrogen. Ammonia is an element that can be used to determine the pollution cause by the domestic waste water, industrial and agriculture activities.

According to Singh, R.B., (2004), high level of nitrate concentration in drinking water is highly poisonous to human. Which can cause decease such as fatal oxygen levels in babies also known as blue-baby syndrome, spontaneous abortions, and possible cancer. High amount of nitrate and low amount of ammonia indicate that the water is polluted. Ammonia can be oxidized to produce nitrite and nitrate by aerobic process.

2.6 INDUCTIVELY COUPLED PLASMA (ICP)

The determination of the Elemental Content of Environment Samples Using Inductively Coupled Plasma (ICP) describes a method for quantifying the dissolved element barium, calcium, cadmium, iron, potassium, magnesium, manganese, phosphorus, sulphur and zinc in digest of plant and animal sample material (Dr. Heinz

Rudel, 2007). According to Xiandeng and Bradley (2000), ICP is one of the most powerful and popular analytical tools for the determination of trace elements in a myriad of sample type in table 2.1.

According to Ruth E. Wolf (2005), Inductively Coupled Plasma Mass Spectrometry (ICPMS) is an analytical technique used for elemental determinations. The technique was commercially introduced in 1983 and has gained general acceptance in many types of laboratories. ICPMS has many advantages over other elemental analysis techniques such as atomic absorption and optical emission spectrometry. An ICPMS combines a high temperature ICP source with a mass spectrometer.

Table 2.1: survey of elemental application areas of ICP

Categories	Examples of samples
Agricultural and food	Animal tissues, beverages, feeds, fertilizers, garlic, nutrients, pesticides, plant material, rice flour, soil, vegetables, wheat flour.
Biological and Clinical	Brain tissue, blood, bone, bovine liver, feces, fishes, milk powder, orchard leaves, pharmaceuticals, pollen, serum, urine
Geological	Coal, minerals, fossils, fossil fuel, ore, rocks, sediments, soils, water
Environmental and water	Brines, coal fly ash, drinking water, dust, mineral water, municipal wastewater, plating bath, sewage sludge, slags, seawater, soil
Metal	Alloys aluminium high-purity metals, iron, precious metals, solders, steel, tin
Organic	Adhesives, amino acids, antifreeze, combustion material, cosmetics, cotton cellulose, dried wood, dyes, elastomers, epoxy, lubricant, organometallic, organophosphates, oils, organic solvent, polymers, sugars

Other materials	Acids, carbon, catalytic materials, electronics, fiber, film, packaging materials, paints and coatings, phosphates, semiconductors, superconducting materials

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter is about research methodology. This chapter focuses on the setting of the research, the instrument of data collection and data analysis of thus research. The sample of treated effluent organic matter (EfOM) has collected at effluent location of the tank. Then, the water quality is determined by done the test according to the parameter of pH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Ammonia Nitrogen (NH_3-N), Total Suspended Solid (TSS), and Inductively Coupled Plasma Mass Spectrometry (ICPMS). All the parameters are based on the Water Quality Index (WQI) from the Department Environment (DOE).

3.3 SETTING

For the purpose of this study, mini agriculture system will be setting out of the first week of the semester. The treated effluent organic matter from the sewage treatment plant at Universiti Malaysia Pahang (UMP), Gambang and the plants have used for this research. The effectiveness growth of plants have identified during experimental. Six laboratory testing according to Inductively Coupled Plasma Mass Spectrometry (ICPMS) and the parameter of pH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Ammonia Nitrogen (NH_3-N), and Total Suspended Solid (TSS) have conducted

3.3.1 MATERIAL SELECTION

The materials selection for this research study are treated Effluent Organic Matter (EfOM).

Figure 3.2: Sample of Treated Effluent Organic Matter (EfOM)

3.3.2 SAMPLE COLLECTION

In this study, the treated effluent organic matter (EfOM) is collected from sewerage treatment plant at Universiti Malaysia Pahang (UMP). The treated effluent organic matter (EfOM) collected from discharge point at Loji A sewerage treatment plant Universiti Malaysia Pahang, Gambang.

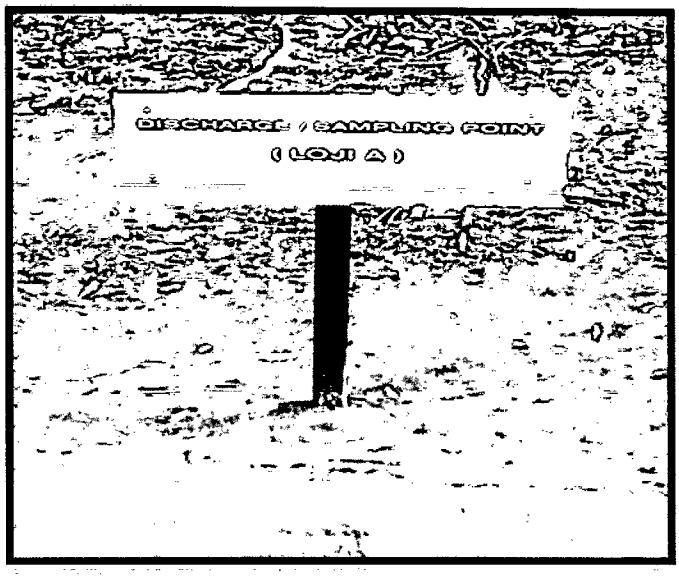

Figure 3.3: Discharge point sewerage treatment plant, Universiti Malaysia Pahang, Gambang

3.4 PROCEDURE

3.4.1 BOD

Biochemical oxygen demand (BOD) measures the amount of oxygen consumed by microorganisms in decomposing organic matter in stream water. A test is used to measure the amount of oxygen consumed by these organisms during a specified period

of time (usually 5 days at 20 C). For this experiment it is to determine the BOD of sample.

Dilution water

i. 8000ml water was added into a gallon using a 1000ml cylinder. Air bubbles are avoided during the transferring process.
ii. 1mg/l each of phosphate buffer, magnesium sulfur solution, calcium chloride solution and ferric chloride solution was added into the gallon until they completely dissolved.
iii. Aerating the sample about 30 minute to allow the water to become saturated with dissolved oxygen before it can be used in BOD_5 test.

BOD_5

i. A 100ml water sample containing degradable organic matter and a 400ml dilution water is placed in a different cylinder.
ii. Put the water sample into 1000ml beaker; make it slowly to avoid bubble. Dilution water was added into the beaker. Stir to make the well mix.
iii. A sample is placed in a 300ml special bottle. Stopper it to exclude air bubbles.
iv. DO in the bottle was measured after 15 minute. (DO_i).
v. Bottle was closed amd placed it in incubator for 5 days at temperature 20°C.
vi. After 5days, the DO in the bottle will be measured again. (DO_t)

3.4.2 COD

The Chemical oxygen demand (COD) test is widely used to indirectly estimate the amount of organic compounds in water. The objective of COD test is to determine the COD of sample.