PUBLIC SEWAGE WASTEWATER TREATMENT BY USING ELECTROCOAGULATION PROCESS

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ASBTRACT

Sewage wastewater is polluted and it can be treated by using the method of electrocoagulation process. The electrocoagulation process is one of the methods to clean the sewage wastewater. Sewage wastewater characteristic can be divided into three major categories which are physical, chemical, biological, and chemical. The primary objective of this study are to characterize the sewage waste water properties in terms of the BOD, COD, SS and the pH affluence before and after the sample is being treated by the electrocoagulation process and to determine the effect of ampere through the process and the sewerage properties that involve. There are five parameter experiments that has been done to determine the quality of the effluent which are biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solid (SS), pH and the gases that produce. From the experiment, the reading of the BOD, COD, SS, pH and gases are within the as stated in table 4.1, 4.2, and 4.3. Based on the result, the sewage wastewater quality is compare according to the standard that stated in the Environmental Quality Act (Sewage and Industrial Effluents) Regulations 1979, Maximum Effluent Parameter Limit Standard A and B as stated in appendix A. The sewage wastewater condition result after treated was filling up the standard which is fixed by and the result was based on the ampere effect through the electrocoagulation process to the sewage wastewater. This is show that the sewage wastewater can be treated by using the electrocoagulation process.

ABSTRAK

Air kumbahan adalah air yang telah digunakan dimana ianya tercemar dan ia boleh dirawat menggunakan kaedah proses electrocoagulasi. Proses electrocoagulasi adalah satu dari kaedah yang boleh digunakan untuk membersihkan air kumbahan. Ciri-ciri air kumbahan boleh dibahagikan kepada tiga kategori iaitu fisikal, biologi dan kimia. Objektif utama kajian ini dijalankan adalah untuk mengkategorikan sifat air kumbahan yang mengalir keluar dalam terma BOD, COD, SS dan pH sebelum dan selepas sampel air dirawat menggunakan kaedah electrocoagulasi ini dan juga mengkaji kesannya terhadap ampere melalui proses dan sifat kumbahan yang terlibat. Sebanyak lima parameter eksperimen telah dijalankan untuk menentukan kualiti air kumbahan sebelum dan selepas rawatan iaitu permintaan biokimia 5 hari (BOD), permintaaan oksigen kimia (COD), pepejal terampai (SS), nilai pH dan juga gas yang terhasil. Keputusan daripada analisis tersebut bagi bacaan BOD, COD, SS, pH dan juga gas adalah seperti dalam jadual 4.1, 4.2 dan 4.3. Berdasarkan keputusan sebelum dan selepas eksperimen, kualiti air kumbahan adalah dibandingkan mengikut piawaian yang telah ditetapkan oleh Kualitin Alam Sekitar (Kumbahan dan Hasil Industri) Peraturan 1979, Parameter Had Maksima bagi Standart A dan B seperti didalam apendik A. Keadaan air kumbahan selepas rawatan adalah didapati memenuhi piawaian yang telah ditetapkan oleh akta tersebut bergantung terhadap kesan ampere daripada proses electrocoagulasi terhadap air kumbahan tersebut. Ini menunjukkan bahawa air kumbahan adalah sesuai dirawat menggunakan proses electrocoagulasi ini.

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(COD)	-	Chemical Oxygen Demand
$(BOD)_5$	-	Biological Oxygen Demand at 5 days
SS	-	Suspended Solid
EC	-	Electrocoagulation
WWTPs	-	Wastewater treatment plants
°C	-	Degrees celsius
ECF	-	electrocoagulation/flotation
(HRT)	-	hydraulic residence time
Mg/L	-	Milligram perliter
mL	-	mililiter
L / min	-	Liter per minute
IWK	-	Indah Water Konsortium
FKASA	-	Fakulti Kejuruteraan Awam dan Sumber Alam
NaOH	-	Sodium hydroxide
H_2SO_4	-	Sulfuric acid
DO	-	Dissolved Oxygen

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CHAPTER 1

INTRODUCTION

1.1 Background to the study

Over the last few years Malaysia has enhanced the development process of the country through the changes of its economy. The through rapid changes, rural-urban migration, and increased population, also wealth has led to increased pollution that could affect the environment and especially human.

Overall, it was found that the amount of pollution that has been produced by humans is far exceeding the capacity of cleaning the environment and is not good for human health and their safety now. Generally the use of other material such as chlorine to treat the contaminated water matter that can worsen the environmental conditions.

As populations increase by leaps and bounds, it places more pressure on the environment and threatening sources of fresh water supplies, it was recognized that the problem of 'human waste' needed proper management.

From the early 1900s there has been a steady evolution of sewage treatment into today's modern sewage treatment plants producing high quality effluent, which can be safely discharged to the environment or reused.

More recent developments in sewage treatment have been to improve the reliability and efficiency of treatment systems to treat sewage to meet standards and reduce the land area occupied by treatment works through accelerating natural treatment rates under controlled conditions.

However, despite these developments sewage treatment systems are still mainly concerned with the removal of suspended and floatable materials, the treatment of biodegradable organic and in some cases the elimination of pathogenic organisms.

Sewage treatment methods may be classified into physical unit operations, chemical unit processes and biological unit processes.

Various methods of sewage treatment systems have been developed over the last fifty years to meet the need to protect public health and the environment. For urban centres where the population is concentrated and the receiving environment is not able to cope with the waste discharge, sophisticated treatment systems have evolved, which produces a high quality effluent. Simpler systems have been used to service small communities although ever increasing environment standards means that even these areas must eventually install better treatment systems.

The electrocoagulation is one of the good method to clean the sewage wastewater. The project involves using the electrocoagulation method to treat the waste water system. This instrument could be use by the other people and industry after the experiment was done. As the Degree final year project allocates the duration of one semester, this project only focused to how to use the electrocoagulation method effectively when we want to treat the waste water.

The project will be funded by student final year project funding, University Malaysia Pahang short term project funding as well as sponsorship attained from industrial sponsors in terms of equipments, products and also monetary funding.

The project title is the Public sewage wastewater treatment by using electro coagulation process. The project involves time that will be setting in order to use the machine to get the effective result. Modifications to the system are required to

improve appearance, comfortable and suitable with the people and industry especially. The projects prerequisites are Environmental Engineering.

1.2 Problem Statement

Sewage wastewater from public are often rich in color and containing of chemical which is needs a proper treatment before it is realizing into the environment such as river and pond. Under Malaysian Environmental Regulation the parameter such as Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), total iron, also color effluent does not unacceptable. To make sure environmental protection, it is important to find the best method to overcome this problem due of that factor.

Water is one of the important needs in human life. Contaminated water, both of the remaining results from human activities or natural around various issues and bring discomfort to everyday people life. The daily life activity such as cleanings, washing and marketplace activities contribute large of wastewater quantities. These activities always contribute a problem to the environment and the socity such as river pollution. In fact of that, this study looked into the method of manage the public waste water quality.

Nowadays Malaysia had produced many of waste water especially for the industrial sector and residential that mostly may affect the environmental life to the world. In order to this problem there are some method that can use to reduce this problem such as electrocoagulation, electrode position, membrane separation, cementation, nanofiltration and biodegradation process. To decrease this environmental pollution, especially water is safe for the environmental life the method electrocoagulation processes have been proposed and receive increasing intension during few years.

1.3 Research objective.

Basically this project is base on these objectives:

i. Characterize the sewage waste water properties in terms of the BOD, COD, SS and the pH affluence before and after the sample is being treated.

ii. To determine the effect of ampere through the process and the sewerage properties that involve.

1.4 Scope of study

The scope of this study is to determine the different of effluent quality from the public sewage before and after using the electrocoagulation method. Here, the library test is needed to find the diffrencess.

By the public sewage, the affluent taken will be part of the sample that will test according the Biochemical Oxigen Demand (BOD), Chemical Oxigent Demand (COD), and Suspended Solid (SS).

There are two vary that need to be consider during this test. The first thing is the current ampere and the second part is the retention time.

There are two stages of process in the laboratory's experimental which is the first, need to determine the quality of the samples without processing the wastewater by electrocagulation process. Then the second process is to determine the quality of the samples after the electrocoagulation process is done.

After the experiment done, the data collect is use for classification the standard quality of effluent from public place by using Environmental Quality Act (Sewage and Industrial Effluents) Regulations 1979, Maximum Effluent Parameter Limit Standard A and B as stated in appendix B..

1.5 Expected outcomes

The expected outcomes from this project are:

i. To analyze what is different in term of the maybe the defection of COD, reduction of BOD, and suspended solid.

ii. What are the mechanism that involve, how it is being treated mechanism, what are the factor that is infusing the efficiency of the treatment and then what is the main or significant parameter that contribute to the treatment.

1.6 Significance of study

The significance of study are:

i. The electrocoagulation process can be as the learning purpose to the student, researcher and industry.

ii. The projectile can be commercial in the market and textile industry in other to reduce the environment pollution.

CHAPTER 2

LITERITURE REVIEW

2.1 Introduction

In recent years, several studies have focused on electrocoagulation, which is an effective process used to destabilize and remove finely dispersed particles from waters and wastewaters. These studies have shown that electrocoagulation is a competitive technology for the removal of pollutants from supply water urban wastewaters and also in the treatment of actual and synthetic industrial effluents such as those generated in the agro-alimentary, metalworking and textile industries. (P. Ca˜nizares et al,)

The advantages reported for this technology, as compared to the conventional coagulation process (addition of coagulant by solution dosing), are the simplicity of the equipment required, versatility, safety and easy automation of the process as this approach does not require the addition of any chemicals. The process results in high-energy efficiency, selectivity and cost effectiveness, as well as a decreased amount of precipitate or sludge, which sediments rapidly . In addition, the low current requirement allows such processes to be run by green energy sources such as solar power, wind mills and fuel cells. (P. Ca˜nizares et al,)

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By this chapter the main aim of this review, the things that will be find out is the concept from the research terms of sewage wastewater and to present bench and field scale research studies for the EC technology to remove different pollutants from public wastewater treatment and the electrocoagulation through others people experiment. By the result that obtained, it can be allow classifying this technique as a good method to treating sewage wastewater polluted with colloid and colorant.

This project is provided the instrument for testing the electrocoagualation process which can explore of considered of great significance in improving the method and manage it to increase the quality which complies with the Malaysian standard or world standard.

This chapter is summarizing of all the literature review gathered from many academic resources such as journals and etc.

2.2 Paper Review

2.2.1 Sewage

Sewage is characterized in terms of its physical, chemical and biological composition. The main physical properties including color, odor, solids and temperature. For the chemical constitutes as organic which is Carbohydrates, Fats, Oil, Grease, Proteins, and Surfactants and for the inorganic which is pH, Chlorides, Citrogen, Phosphorus, Sulfur Gases - Hydrogen Culphide, Methane, Oxygen.(www.iwk)

Sewage treatment, or domestic wastewater treatment, is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical, and biological processes to

remove physical, chemical and biological contaminants. Its objective is to produce a waste stream (or treated effluent) and a solid waste or sludge suitable for discharge or reuse back into the environment. This material is often inadvertently contaminated with many toxic organic and inorganic compounds.

Sewage sludge can be defined as the residue generated from the treatment of wastewater. The two principal types of sludges are primary sludge and secondary sludge. Primary sludge constitutes the material collected from the primary settling tanks employed in wastewater treatment plants (WWTPs). Secondary sludge, also known as biological sludge (BS), constitutes the sludge generated from the biologicaltreatment of the wastewater drained from the settling tanks. Chemical sludge is another commonly occurring form of sludge, and constitutes sludge that has been produced with the aid of chemicals. Typically the chemicals are used either to facilitate the precipitation of hard-toremove substances, or to improve suspended solid removal (Smith et. Al., 2009).

2.2.2 Wastewater

Wastewater is any water that has been adversely affected in quality by antrophogenic influence. It comprises liquid waste discharge by domestic residences, commercial properties, industries, or agriculture and can encompass a wide range of potential contaminant and concentration. In the most comman usage, it refers to the municipal wastewater that contains a broad spectrum of contaminant resulting from the mixing of wastewater from different sources (Salt,2001).

2.2.3 Definition of wastewater

Generally waste water is synonymously with sewage even though sewage is a more general term that refers to any polluted water including wastewater, which may contain organic and inorganic substance, industrial waste, groundwater that happens to infiltration and to mix with contaminated water, storm, runoff, and other similar liquids (Miretzky et al. 2004). In other words, waste water can be describe as using the water with dissolved or suspended solid, discharge from homes, commercial establishment, farms and industries (Rock, 1997).

2.2.4 Characteristic of wastewater

In general, wastewater is a water that has been generated from domestic and industrial sources where throughtout the world by dumping 10,000 new organic compound each year. These compound need to be properly handled and removed if they cause health problem. There are many industrial plants that has required to pre-treat their wastewater before dumping in the wastewater system (Chandra and Kulshrenta 2004).

2.2.4.1 Physical characteristic

The important physical characteristic of wastewater is its total solid content, which is composed of floating matter, settleable matter, colloid matter, and matter in solution. Other important physical characteristic include odor, temperature, color, and turbidity.

i. Total solids

The total solids content of a wastewater is meaning as all the matter that remains as residue upon evaporation at 103 to 105°C. matter that has a significant vapor pressure at this temperature is lost during evaporation it is not define as a solid. Total solids, or residue upon evaporation can be further classified as non filterable (suspended) or filterable by passing a known volume of liquid through a filter (Rovers, 1997).

The dissolved solid consist of both organic and inorganic molecules and irons that are present in true solution in water. The colloidal fraction cannot be removed by settling. The suspended solid are found in considerable quantity in many industrial wastewater, such as cannery and paper mill effluents. They are screened and settled out at the treatment plant. Solids are removed by settling and separated from wash water are called sludge, which may then be pumped to filter for extraction of additional water (Baber,2004).

2.2.4.2 Chemical characteristic

Chemical of wastewater are typically classified as organic and inorganic. Organic constitutes in wastewater can be classified as aggrega and individual. Meanwhile, inorganic constituents in water can be divided into individual elements such as Zinc (Zn), iron (Fe), chloride (Cl), and a wide variety of compound, for example, nitrate (NO_3) and sulfate (SO_4). The inorganic and organic compound in the wastewater will be discussed I details in following discussion (Salt, 2001).

i. Organic compound

Normally, organic compounds are composed of carbon, hydrogen, and oxygen, together with nitrogent in same cases. Other important elements, such as sulfur phosphorus, and iron, may also be present (Rock, 1997). Not only that,

industrial wastewater may contain small quantities of a large number of different synthetic organic molecules ranging from simple to extreamly complex in structure. For example include surfactants, organic priority pollutant, volatile organic compounds and agricultures pesticides. The presence of these substanceces has complicated industrial wastewater treatment because many of them either cannot be or are very slowly decomposed biologically (Eddy, 1998).

ii. Biological oxygen demand (BOD)

The BOD test is used to determine the relative oxygen requirements of wastewaters, effluents, and polluted waters. The test measure the oxygen utilized during a specified incubation period for the biochemical degradation of organic material. It is also used to determine treatment plant efficiency. These parameters are a chemical procedure for determining how fast biological organism use up oxygen in a body of water. It is used in water quality management assessment, ecology and environmental science. BOD is not an accurate quantitative test although it could be considered as an inclination of the quality of a water sources (Theriault et al., 2003).

iii. Chemical oxygen demand (COD)

The COD test is used to measure the organic matter in industrial wastewater that contains compounds that are toxic to biological life (Frukawa et al., 2000). The COD of wastewater is in general higher than that of BOD_5 because more compounds can be chemically oxidized then can be biologically oxidized. For many types of wastewater, it is possible to correlate COD with BOD_5. This can be very useful because COD can be determine in 3 hours, compare with 5 days for the BOD_5. Once the revelation has been established, COD measurement can be used to good advantage for treatment-plant control and operations (Theriault et al., 2003)

iv. Inorganic chemical

Several inorganic components of wastewater are important in establishing and controlling wastewater quality. Industrial wastewater has to be threated for removal of the inorganic constituents that are added in the life cycle. Concentration of

inorganic constituents also are increased by the natural process, which removes some of surface water and leaves the inorganic substance in wastewater (Llorans, 2000).

v. pH

the hydrogen-ion concentration is an important quality parameter of wastewater. The concentration range suitable for the existence of most biological life is quit narrow and critical. Wastewater with an adverse concentration is not altered before discharge, the wastewater effluent may alter the concentration in the natural water. (Barber, 2004)

vi. Heavy metal

Trace quantity of many metals, such as nikel (Ni), manganese (Mn), led (Pb), chromium (Cd), zinc (Zn), cooper (Cu), iron (Fe) and mercury (Hg) are important constitutes of some industrial wastewater. The presence of any of these metals in excessive quantities will interfere with many beneficial uses of the water because of their toxicity. Therefore, it is frequently desirable to measure and control the concentration of these substance (Satyakala and Jamil, 2001).

Chromium is one of the elements that become an increasing problem because of its toxic effects on biological. This is because chromium is a non-essential elements to the plants. It is compound are highly toxic to plants, detrimental to their growth and development if in high concentration (Rai et al.,2001).

2.2.5 Effect of Wastewater on public health and environment

Nowadays, it is normally involves determination of dissolved organic and inorganic material are well as suspended solid present in the wastewater. Toxic metal compound have to be identified and quantitatively measured if present even in trace levels (Frederick,2001).