HEAVY METAL REMOVAL FROM INDUSTRIAL WASTEWATER USING
PARKIA SPECIOSA POD

VANITHAA PONNAIAH

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Bachelor Engineering (Hons.) Civil Engineering

Faculty of Civil Engineering & Earth Resources

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering and Earth Resources.

Signature   :
Name of main supervisor : SURYATI BINTI SULAIMAN
Position   : LECTURER
Date   :16 JANUARY 2017

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :
Name   : VANITHAA PONNAIAH
ID Number   : AA13272
Date   :16 JANUARY 2017

Dedication

To the Almighty, parents, siblings, supervisor and friends for the encouragement given throughout the completion of this research project.

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%	Percentage
°	Degree

LIST OF ABBREVIATIONS

COD   Chemical Oxygen Demand

TSS   Total Suspended Solid

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ABSTRACT

Heavy metals normally caused by manufacturing, agriculture, sewage and motor vehicle emission have been a main reason for polluted rivers nowadays. The common wastewater treatment that been done in Malaysia are chemical precipitation and reverse osmosis. Even both methods are commercialized, they are expensive. To cut cost, adsorption method can be implemented to reduce the heavy metals that polluted the river. Parkia speciosa pod which is known as stink bean or 'petai', is one of the agricultural waste which can be used as activated carbon to remove the heavy metal in industrial waste water. By adapting the views and methods from the journal, the percentage of copper and zinc contaminating the wastewater was tested. The Parkia Speciosa pod was obtained, cut, washed and dried in oven. Later the pod was grounded into powder and burnt in furnace. The product was later tested contact time and size of particle. The aim of this research is to determine the effect of size and effect of contact time in reducing the percentage of heavy metal mainly copper and zinc in water sample. The size used are 1.18 mm, 600 micron and powder form activated carbon from Parkia Speciosa pod. The contact time tested was 4 weeks. As the treatment goes, the content of zinc was reducing drastically and on week two where 1.18 mm removed about 95% of zinc ,600 micron about 99% of zinc and powder about 100% of zinc. On the third week, all the sizes removed 100% of the zinc present in water. The content of copper was reducing drastically and on week two where 1.18 mm removed about 71% of zinc ,600 micron about 98% of copper and powder about 100% of copper. On the third week, all the sizes removed 100% of the copper present in water. The zinc, copper and COD drop drastically during the treatment proving longer period of contact able to remove all inorganic matter in water by conducting this study, the amount of zinc and copper that contaminated the wastewater was reduced and this is one of the cheapest method that can be used in wastewater treatment.

Keywords: Industrial wastewater, Adsorption, Agricultural waste, Activated Carbon

ABSTRAK

Logam berat biasanya disebabkan oleh sektor perkilangan, pertanian, kumbahan dan kenderaan motor pelepasan telah menjadi punca utama sungai tercemar pada masa kini. Rawatan air sisa biasa yang telah dilakukan di Malaysia adalah pemendakan kimia dan osmosis . Walaupun rawatan air yang menggunakan kaedah osmosis dan pemendakan kimia telah dikomersilkan, kaedah tersebut sangat mahal. Untuk mengurangkan kos, kaedah penjerapan boleh dilaksanakan untuk mengurangkan logam berat dalam air yang tercemar.Petai adalah salah satu daripada sisa pertanian yang boleh digunakan sebagai karbon aktifan untuk membuang logam berat dalam air sisa industri. Berdasarkan pandangan dan kaedah dari jurnal, peratusan tembaga dan zink mencemarkan air kumbahan telah diuji.Sisa petai diperolehi, cut, dibasuh dan dikeringkan dalam ketuhar. Kemudian petai dikisar menjadi serbuk dan dibakar dalam relau. Karbon aktifan telah diuji dengan masa sentuhan dan saiz carbon aktifan. Tujuan kajian ini adalah untuk menentukan kesan saiz dan kesan masa sentuhan dalam mengurangkan peratusan logam berat terutamanya tembaga dan zink dalam sampel air. Saiz yang digunakan adalah 1.18 mm, 600 mikron dan serbuk karbon aktifan daripada petai. Tempoh masa diuji adalah 4 minggu.Kandungan zink telah mengurangkan secara drastik dan pada minggu dua mana 1.18 mm dikeluarkan kira-kira 95% zink, 600 mikron kira-kira 99% zink dan serbuk kira-kira 100% zink. Pada minggu ketiga, semua saiz menyingkirkan 100% zink di dalam air. Kandungan tembaga telah mengurang secara drastik dan pada minggu kedua dimana 1.18 mm berjaya menyingkirkan kira-kira 71% daripada zink, 600 mikron kira-kira 98% tembaga dan serbuk kira-kira 100% tembaga. Pada minggu ketiga, semua saiz dikeluarkan 100% tembaga .Tembaga dan COD turun secara mendadak semasa rawatan membuktikan tempoh yang lebih lama dapat menyingkirkan benda asing di dalam air .Dengan menjalankan kajian ini, jumlah yang zink dan tembaga yang tercemar air sisa telah dikurangkan dan ini adalah salah satu kaedah yang paling murah yang boleh digunakan dalam rawatan air sisa.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The earth surface is covered with 70.9% of water and it is very important for the entire earthling's usage. Out of the 70.9% of water, only 2.5% are fresh water that can be consumed and used by life. Even with good hydrological cycle, the amount of water might not enough in future usage. One of the proper ways to avoid this from happening is by treating the wastewater before being discharge into rivers.

Wastewater is water that has been contaminated with suspended particles like inorganic and organic particles which do not readily settled or the particles are dissolved in the water. There are many sources that contribute to wastewater such as commercial and domestic discharges. This normally leads to the growth of microorganism and presences of heavy metals in the water. This will lead to water pollution. Water pollution is an anything or process that causes or tends to cause a change in the state, nature, character of water in terms of colour, taste, texture (softness), temperature, pH value etc.by any means is referred to as water pollution (Thyagaraju, 2016). As the water is polluted, the amount of fresh water in earth will be gradually decreasing and leads to major problem.

With fast improvement done in agriculture, industry, commerce, clinic and health-care facilities, human activities are expending critical amounts of toxic chemicals and generating an expansive measure of risky waste. Currently, there are about 110 000 types of harmful chemicals economically accessible. Every year, an alternate 1 000 new chemicals would into the market for streamlined. The majority risky pollutants clinched alongside earth is heavy metals (Sud *et al.,* 2008).

This contamination has motivated people to develop purification and extraction method to keep the water clean before being discharge to river (Renata S. D. Castro *et al.,* 2011). There are many ways and technologies that been adapted to ensure the wastewater is being treated. For example, the water from industrial area will have higher percentage of copper and zinc compared to normal water. This will contribute to the hardness of water if it is not properly treated.

Mechanical industries and domestic processes contributed significant sums of conceivably dangerous heavy metals into the atmosphere, aquatic and terrestrial environments. In small quantities, certain heavy metals are nutritionally essential for healthy life. Some of these are referred to as the trace elements (e.g., iron, copper, manganese, and zinc). These elements, or some form of them, are commonly found naturally in foodstuffs, in fruits and vegetables, and in commercially available multivitamin products. Heavy metals are also common in industrial applications such as in the manufacture of pesticides, batteries, alloys, electroplated metal parts, textile dyes, steel, mining, refining ores, fertilizers industries, paper industries and so forth (Sud *et al.,* 2008).

However, high concentrations of heavy metals are known to produce a range of toxic effect and have a potentially damaging effect on human physiology and other biological systems. For example, lead can cause

encephalopathy, cognitive impairment, behavioural disturbances, kidney damage, anaemia, and toxicity to the reproductive system. At high exposure level, cadmium can cause nephrotoxic effect, while after long term exposure it can cause bone damage. Other study reported that copper can cause weakness, lethargy, anorexia, and gastrointestinal tract (Dewayanto , 2010).

1.2 PROBLEM STATEMENT

Excessive release of heavy metals into the environment due to industrialization and urbanization has posed a great problem worldwide. These heavy metals are of specific concern due to their toxicity, bio-accumulation tendency and persistency in nature. There are several past disasters due to the contamination of heavy metals in aquatic streams are Minamata tragedy in Japan due to methyl mercury contamination and 'Itai-Itai due to contamination of cadmium in Jintsu river of Japan (Sud *et al.,* 2008). Unlike organic pollutants, most which are susceptible to biological degradation, heavy metal ions do not degrade into harmless end products. So, heavy metals can give bad effect to human body and environment itself.

The water that been polluted with heavy metals can be treated. Reduction method, precipitation method, ion exchange method, electrochemical reduction and reverse osmosis can be performed to treat the water that been polluted with heavy metals. However, the cost of the treatment is so expensive. To reduce the cost of treatment, other alternative method which is cheaper must be found. Many researchers have done the research and found that adsorption is the most effective technique to remove heavy metals. The common adsorbent that has been used before to remove heavy metals from wastewater is activated carbon but it is expensive material. Therefore, this research is aiming to solve the problem by using a low-cost material from agricultural waste as an effective adsorbent to remove heavy metal ion from wastewater.

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