TREATMENT OF INDUSTRIAL WASTEWATER USING KARIBA WEED (*SALVINIA MOLESTA SP*.)

SITI HAFIEZA IDAYU BINTI CHE SAIDI

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree in Civil Engineering

____

(Supervisor's Signature)

Full Name : DR. MIR SUJAUL ISLAM

Position :

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

____

(Student's Signature)

Full Name : SITI HAFIEZA IDAYU BINTI CHE SAIDI

ID Number : AA 15179

Date : 28th May 2019

TREATMENT OF INDUSTRIAL WASTEWATER USING KARIBA WEED (*SALVINIA MOLESTA SP*.)

SITI HAFIEZA IDAYU BINTI CHE SAIDI

Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

Praised be to Allah, for giving me life and strength to carry out this research as it is a great testimony of my life. I am most grateful to my supervisor, Dr. Mir Sujaul Islam for his patience, guidance, ever listening ear and willingness to render assistance throughout the period of my degree's study from the beginning to the final draft of my thesis. Thank you for making this research a reality

I would like to express my appreciation and thanks to all my family members for their support throughout the work. And also thanks to my friends for their valuable advices and opinion.

ABSTRAK

Pada masa kini, dengan teknologi perindustrian dan moden berkembang pesat, pencemaran air menjadi salah satu masalah besar bukan sahaja untuk negara dunia ketiga dan negara-negara pembangunan tetapi juga negara-negara maju. Proses Phytoremediation adalah kaedah rawatan mesra alam dan kos rendah. Kajian ini dijalankan untuk meneroka kebolehlaksanaan dan kecekapan loji air akuatik daripada air kumbahan industri yang telah dirawat. Objektif penyelidikan ini adalah untuk mencirikan status air kumbahan perindustrian di estet perindustrian Gebeng dan menentukan kecekapan fiztoremediasi *Salvinia Molesta sp.* dalam menghilangkan bahan pencemar dari air kumbahan. Untuk mencapai matlamat ini, tumbuhan Kariba dipilih untuk penyelidikan. Parameter air yang telah dipantau dan diuji ialah oksigen terlarut (DO), pH, kekeruhan, pepejal terampai (TSS), permintaan oksigen kimia (COD), permintaan oksigen biokimia (BOD), ammoniacal nitrogen (NH_3-N), tembaga(Cu), kadmium (Cd), dan plumbum (Pb). Dari keseluruhan hasil yang diperolehi dalam eksperimen, kepekatan air sisa sebanyak 50% menyumbang kecekapan penyingkiran peratusan tertinggi adalah 8.16%, 11.69% dan 12.79% daripada pH, 17.95%, 33.70% dan 41.88% daripada BOD, 26.09%, 39.13% dan 60.87 % NH3-N, 26.67%, 43.33% dan 56.67% COD, 28.57%, 50% dan 64.29% Pb, 33.33%, 50% dan 66.67% Cd, 21.05%, 31.58% dan 47.37% sepanjang minggu 1, minggu 2 dan minggu 3 manakala peratusan DO meningkat 5.27%, 15.96% dan 19.73% untuk minggu 1 hingga minggu 3. Tambahan pula, peningkatan jumlah pepejal terampai untuk kepekatan 50% air kumbahan adalah terendah di antara tiga kepekatan yang 5.26%, 21.05% dan 38.60% untuk minggu 1 hingga minggu 3. Tetapi bagi kekeruhan, kepekatan kumbahan 75% menyumbang kecekapan kenaikan peratusan tertinggi iaitu 5.62%, 12.29% dan 15.05% untuk minggu 1, minggu 2 dan minggu 3. Perbandingan dilakukan oleh tiga kepekatan yang berlainan dan kepekatan air 50% adalah yang paling sesuai untuk menghapuskan kebanyakan parameters.

ABSTRACT

Nowadays, with the industrial and modern technologies develop rapidly, water pollution has become one of the massive problems for not only third world countries and development countries but also to very advanced countries. Phytoremediation process is environmental friendly and low cost treatment method. This research was conducted to explore the feasibility and efficiency of aquatic plants remediate effluent from industrial wastewater that has been treated. The objectives of the research were to characterize the status of industrial wastewater in Gebeng industrial estate and determine the phytoremediation efficiency of *Salvinia Molesta sp.* in removing pollutant from wastewater. To achieve these objectives, Kariba weed was selected for the research. The water parameters that had been monitored and tested were dissolved oxygen (DO), pH, turbidity, total suspended solids (TSS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammoniacal nitrogen (NH_3-N), copper (Cu), cadmium (Cd), and lead (Pb). From the overall results obtained in the experiments, 50% concentration of wastewater contributed the highest percentage removal efficiency were 8.16%, 11.69% and 12.79% of pH, 17.95%, 33.70% and 41.88% of BOD, 26.09%, 39.13% and 60.87% of NH_3-N, 26.67%, 43.33% and 56.67% of COD, 28.57%, 50% and 64.29% of Pb, 33.33%, 50% and 66.67% of Cd, 21.05%, 31.58% and 47.37% of Cu for week 1, week 2 and week 3 while percentage of DO is increased which were 5.27%, 15.96% and 19.73% for week 1 to week 3. Furthermore, the increasing of total suspended solid for 50% concentration of wastewater was lowest among three concentration which were 5.26%, 21.05% and 38.60% for week 1 to week 3. But for the turbidity, 75% concentration of wastewater contributed the highest percentage of increasing efficiency which were 5.62%, 12.29% and 15.05% for week 1, week 2 and week 3. Comparisons done by three different concentration and 50% concentration of wastewater was the most suitable to remove most of the parameters.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

L	Litre
mg	Milligram
ml	Millilitre
mg/L	Milligram Per Litre
%	Percent
°C	Degree Celsius
µS	MicroSiemens

LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
Ag	Silver
APHA	American Public Health Association Arsenic
BOD	Biochemical Oxygen Demand
$Ca(ClO)_2$	Calcium Hypochloride
COD	Chemical Oxygen Demand
Cd	Cadmium
Cr	Chromium
Cu	Copper
DO	Dissolved Oxygen
DW	Distilled Water
Fe	Iron
H^+	Hydrogen ions
H_2O	Water Molecule
N	Nitrogen
NaClO	Sodium Hypochloride
NH_3-N	Ammoniacal Nitrogen
Ni	Nickel
NTU	Nephelometric Turbidity Unit
OH-	Hydroxide ions
Pb	Lead
TOC	Total Organic Carbon
TSS	Total Suspended Solid
UMP	Universiti Malaysia Pahang
WHO	World Health Organization
WW	Wastewater
Zn	Zinc

CHAPTER 1

INTRODUCTION

1.1 Background of study

Water is primary component of the biosphere. It is colourless, tasteless, transparent and odourless chemical substance which we can found all over the world. Water pollution is the contamination of water bodies such as oceans, rivers, lakes and ground water caused by human activities. There are many sources of water pollution which are industrial, municipal and agricultural. The example of pollution comes from industrial area are chemical, organic, and thermal wastes while pollution of municipal come from largely sewage consisting of human wastes, detergents and other organic wastes. For pollution of agricultural area, it come from animal wastes, pesticides, and fertilizers. Generally, the main global water resources are polluted through human activities which is anthropogenic. This is because the industrial revolution contributed immensely to the global environmental degradation (Sayyed and Sayadi, 2011).

Actually, our country is one of the country that faced the water pollution crisis especially in wastewater and effluent pollution. It was estimated that the world population would increase to 9 billion at the end of this century and more than 80% of this population would live in the cities (DESA, 2009; Godfray et al., 2012). A clean environment is the most important for sustenance of our better present and future generation. The way to overcome these problem is by treating the water using the method that is more sustainable technology and environmental friendly. The method is called phytoremediation process which is biological wastewater treatment. Phytoremediation come from the Greek 'phyto' which means plant, and Latin 'remedium' means restoring balance or remediating. Actually, phytoremediation is a bioremediation process which is responsible to remove, transfer, stabilize and destroy contaminants in the soil and groundwater by using various type of plant such as water mimosa, water hyacinth and water lily. Apart from that, phytoremediation also become the alternative method for efficient wastewater treatment which is well accepted by the people around the world for the reason that is cost effective and eco-friendly (Hazrat and Ezzat, 2013).

Salvinia molesta sp., a floating aquatic weed, is a global menace in most of the water bodies and waterways. It also has wide ranging economic and health impacts. Apart from that, the weed disrupts the ecological balance wherever it invades (Maseko, 2016). *Salvinia Molesta sp.* also can be called as Kariba weed is an annual floating aquatic plant that can be appear superficially similar to moss. It is found throughout the world where there is plentiful standing fresh water, sunlight and humid air. For the information, *Salvinia Molesta sp*. also has two nickel-sized leaves lying flat against the surface of the water, and a third submerged leaf which functions as a root. Flotation is made possible by pouches of air within the leaves. Cuticular papillae on the leaves' surface keep water from interfering with the leaves' functioning, and serve to protect them from decay. Spore cases form at the plant's base for reproduction. The leaves of *Salvinia Molesta sp*. block sunlight from reaching very far underwater. This is helpful to many freshwater fish, providing safe hiding places to breed in, but can interrupt the photosynthesis of many underwater plants. *Salvinia Molesta sp*. can eventually cover entire ponds or lakes without ecological competition, starving other plant species.

1.2 Problem Statement

Nowadays, as we can see, water pollution is one of the serious problem our world facing besides soil and air pollution. Water pollution can give bad impacts to us and communities if we ignore and do not take action to overcome this problem. Besides, due to ascending demand of freshwater which also affected by the ascending in world population, industrialization and urbanization natural water also become under severe stress (Gleick and Palaniappan, 2010). The increasing demand for petrol causes the developing of petrochemical industry in Gebeng. In the same time, the problems of water pollution occur in Gebang are because of the discharge of industrial effluent into water without adequate removal of unwanted constituents. There are three sources of water pollution in Malaysia which are domestic sewage, industrial effluents and agricultural (Rafia et al., 2014).

From this research, phytoremediation is new method and rapidly developing from bioremediation, which used green plants whereby to be realized the National Policy on the Environment (NPE) in the way forward Malaysia's green strategies. Phytoremediation also has several promising abilities for cost effective and act good performance in removing organic and inorganic contaminants from surface water and soil (Nwoko, 2010).

1.3 Objectives

The objectives of this research are:

i) To characterize the status of industrial wastewater in Gebeng industrial estate.

ii) To determine the phytoremediation efficiency of *Salvinia Molesta sp.* in removing pollutant from wastewater.

1.4 Scope of Research

The scope of this research is to use locally available plant to remove heavy metals contain in industrial wastewater. In this research, only one species of aquatic plant is choose and selected as the phytoremediation medium in this study which is *Salvinia Molesta sp.* or in local calls as Kariba weed.

Apart from that, this research is focus on industrial wastewater, so the sample of wastewater can be obtained from Gebeng industrial area. As we know, Gebeng is a small town and become the main industrial area in Kuantan District, Pahang, Malaysia and also located about 35 kilometres from Kuantan town. Furthermore, Gebeng is one of the suitable area to conduct the research about phytoremediation process because it is one of the large and famous industrial zone that produces large amount of petrochemical industry to fulfil the huge demand of market.

Besides that, the sample of wastewater from the Gebeng will be test in environmental laboratory in UMP which are to measure the parameters of the wastewater such as Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), total suspended solid (TSS), turbidity, pH value, Ammonia-Nitrate (NH_3-N) and also heavy metals.

REFERENCES

Abou-Shanab, R. A., Angle, J. S., Delorme, T. A., Chaney, R. L., Van Berkum, P., Moawad, H., Ghozlan, H. A. (2012). Rhizobacterial effects on nickel extraction from soil and uptake by Alyssum murale. New Phytologist, 158(1), pp, 219–224.

Akpor, O.B., Muchie, M. (2010). Remediation of heavy metals in drinking water and wastewater treatment systems: Processes and applications. International Journal of the Physical Sciences, 5(12), 1807-1817.

Carr, G. M., & Neary, J. P. (2009). Water quality for ecosystem and human health, 2nd. Ontario, Canada: United Nations Environment Programme (UNEP).

DESA, U. (2009). World population prospects: the 2008 Revision database.working paper No. ESA/P/WP. 210, United Nations Department of Economic and Social Affairs.

EPA, Drinking water treatability database: chlorine (2014)

Gleick, P. H., & Palaniappan, M. (2010). Peak water limits to freshwater withdrawal and use. Proceedings of the National Academy of Sciences of the United States of America, 107(25), pp.11155–62.

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F & Toulmin, C. (2012). The challenge of food security. Science, 327, pp. 812

Hazrat Ali, Ezzat Khanb, M. A. S. (2013). Phytoremediation of heavy metals--concepts and applications. Chemosphere, 91(7), pp.869–81.

Herman, I. P. (2016). Physics of the human body. Springer.

Joseph, A., Amen, O., Science, P., & State, E. (2013). The environmental consequences of pollution in Ado-Ekiti, Nigeria. International Journal of Arts and Commerce, 2(11), pp.73–82.

Józef Szmeja & Agnieszka Gałka (2013) Survival and reproduction of the aquatic fern Salvinia natans (L.) All. during expansion in the Vistula Delta, south Baltic Sea coast, Journal of Freshwater Ecology, 28:1, 113-123, DOI: 10.1080/02705060.2012.716375

Kanakaraju D., Ravichandar S., Y.C. Lim, J. Environ. Sci. 55 (2017) 214. [35] S. Satyro, R. Marotta, L. Clarizia, I. Di Somma, G. Vitiello, M. Dezotti, G. Pinto, R. F. Dantas, R. Andreozzi, Chem. Eng. J. 251 (2014) 257.

Lorestani, B., Cheraghi, M., & Yousefi, N. (2011). The potential of phytoremediation using hyperaccumulator plants: A case study at a lead-zinc mine site. International Journal of Phytoremediation, 14(8), 786-795.

Maseko, Z. (2016). The effect of shade on the biological control of Salvinia molesta D . S . Mitchell [Salviniaceae] by the weevil , Cyrtobagous salviniae Calder and Sands [Curculionidae], (June).

Muhamad Asri, N. H. (2015). Impact of Industrial Effluents on Water Quality At the Tiram, (June).

Nagajyoti, P.C., Lee, K.D., Sreekanth, T.V.M. (2010). Heavy metals, occurrence and toxicity for plants: a review. Environmental Chemistry Letters, 8(3), 199-216.

Nassef, E., Y.A. El-Taweel, J. Chem. Eng. Process Technol. 6 (2015) 214. [17] I.M. Ahmed, Y.A. El-Nadi, J.A. Daoud, Hydrometallurgy 110 (2011) 62. [18] J.-L. Gong, X.-Y. Wang, G.-M. Zeng, L. Chen, J.-H. Deng, X.-R. Zhang, Q.-Y. Niu, Chem. Eng. J. 185–186 (2012) 100.

Nazir, A., Malik, R., Ajaib, M., Khan, N., & Siddiqui M. (2011). Hyperaccumulators of heavy metals of industrial areas of Islamabad and Rawalpindi. Pakistan Journal of Botany, 43(4), 1925-1933. Retrieved from: http://www.pakbs.org/pjbot/pjhtmls/PJB.html

Nizam, 2008. Industrial wastewater treatment using phytoremediation process via typha latifolia sp and nymhaea sp at gebeng industrial area, pp 4-5

Noraidah Mohd Zaini. Removal of contaminants in industrial wastewater via salvinia molesta sp. and lolium temulentum sp

Normazita binti abu bakar, 2008. Phytoremediation process in treatment of petrochemical effluent industry using juncus effuses sp & selimpat tree, pp11.

Nwoko, C. O. (2010). Trends in phytoremediation of toxic elemental and organic pollutants. African Journal of Biotechnology, 9(37), pp.6010–6016.

Oley Phearkeo (2015). A study on removal of heavy metals from wastewater by floating plants pp16-17.

Rafia A., Masud, M. M., Akhtar, R., & Duasa, J. B. (2014). Water pollution: challenges and future direction for water resource management policies in Malaysia. Environment and Urbanization Asia, 5(1), pp.63–81.

Sayyed, M. R. G., & Sayadi, M. H. (2011). Variations in the heavy metal accumulations within the surface soils from the Chitgar industrial area of Tehran. Proceedings of the International Academy of Ecology and Environmental Sciences, 1(1), pp.36–46.

Suryati Sulaiman, 2017. BAA3613 Learn module environmental engineering

Swaddiwudhipong W, Limpatanachote P, Mahasakpan P, Krintratun S, Punta B, Funkhiew T (2012) Progress in cadmium-related health effects in persons with high environmental exposure in northwestern Thailand: a five-year follow-up. Environ Res 112:194–198.

Swearingen, Jil M. (7 July 2009). "PCA Alien Plant Working Group - Purple Loosestrife (Lythrum salicaria)". National Park Service. Retrieved 24 September 2011.

Tangahu, B., Abdullah, S., Basri, H., Idris, M., Anuar, N. & Mukhlisin M. (2011). A Review on Heavy Metals (As, Pb, and Hg) Uptake by Plants through Phytoremediation: International Journal of Chemical Engineering, 201. doi: 10,1155/2011/939161.

Varsha G., Sengupta, M., Prakash, J., & Tripathy, B. C. (2017). Basic and applied aspects of biotechnology. In Basic and Applied Aspects of Biotechnology (pp. 333-349). Springer Singapore.

White, H. M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. Journal of Environmental Psychology, 30(4), pp.482–493.

WHO (2008) Guidelines for drinking water quality: recommendations, vol 1, 3rd edn. World Health Organisation, Geneva, pp 317–318.

Wu X, Liang Y, Jin T, Ye T, Kong Q, Wang Z, Lei L, Bergdahl IA, Nordberg GF (2008) Renal effects evolution in a Chinese population after reduction of cadmium exposure in rice. Environ Res 108(2):233–238.