THE PERFORMANCE OF DYE REMOVAL BY MALAYSIA SEAWEED BIOMASS

NUR NADIAH BINTI RAZAK

BACHELOR OF ENGINEERING (HONS) IN CIVIL ENGINEERING UNIVERSITI MALAYSIA PAHANG

THE PERFORMANCE OF DYE REMOVAL BY MALAYSIA SEAWEED BIOMASS

NUR NADIAH BINTI RAZAK

Thesis submitted in fulfillment of the requirements for the award of the degree of

Bachelor of Engineering (Hons) in Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JULY 2016

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 degree of Bachelor (Hons.) of Civil Engineering.

Signature :

Name of Supervisor : DR.EDRIYANA BT AB.AZIZ

Position : LECTURER

Date : 29 JUNE 2016

Signature :

Name of Co-supervisor : NADIAH BT MOKHTAR

Position : LECTURER

Date : 29 JUNE 2016

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries that have been duly acknowledge. The thesis has not been accept for any degree and is not concurrently submit for award for other degree.

Signature :
Name : NUR NADIAH BINTI RAZAK
ID Number : AA12097
Date : 29 JUNE 2016

TABLE OF CONTENTS

THE PERFORMANCE OF DYE REMOVAL BY MALAYSIA SEAWEED BIOMASS

NUR NADIAH BINTI RAZAK

Thesis submitted in fulfillment of the requirements for the award of the degree of

Bachelor of Engineering (Hons) in Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JULY 2016

ABSTRACT

Textile industry generate millions of gallons of wastewater which consist of hazardous toxic waste, colours and chemical substances from dyeing process, finishing process and high pH and temperature. The textile wastewater gave negative effects towards environments such as the toxicity that causes death of aquatic organisms, sewage bacteria and plants. Adsorption process will be used as a physical method for the textile wastewater treatment. Therefore, the adsorption process will be done by using seaweed biomass with size that passed 0.7 – 1.5mm sieve to be the filter medium in order to treat the colour (dye). The data obtained from the adsorption of concentration of dye by using UV-vis spectrophotometer at 640 nm wavelength. All data will be represents the mean of triplicates with average and standard deviation. The experiments done by different types of seaweed to choose the best performance of dye removal.

ABSTRAK

Industri tekstil menjana berjuta-juta gelen air sisa yang terdiri daripada sisa toksik berbahaya, berwarna dan mengandungi bahan-bahan kimia daripada proses pencelupan, proses penyiapan dan pH dan suhu yang tinggi. Air sisa daripada tekstil memberi kesan negatif terhadap persekitaran seperti keracunan yang menyebabkan kematian organisma akuatik, bakteria kumbahan dan tumbuh-tumbuhan. Proses penjerapan akan digunakan sebagai kaedah fizikal untuk rawatan air sisa tekstil. Oleh itu, proses penjerapan akan dilakukan dengan menggunakan rumpai laut biomass dan di ayak menggunakan penapis dengan saiz yang diluluskan iaitu antara 0.7 - 1.5 mm untuk merawat warna (pewarna). Data yang diperolehi daripada penjerapan kepekatan pewarna dengan menggunakan UV-vis spektrofotometer pada 640 nm panjang gelombang. Semua data mewakili tiga bacaan dengan sisihan purata dan standard. Eksperimen yang dijalankan oleh pelbagai jenis rumpai laut adalah untuk memilih jenis manakah yang menunjukkan prestasi terbaik daripada penyingkiran pewarna.

CHAPTER 1

INTRODUCTION

1.1 Background of the problem

Textile wastewater contains a large variety of dyes and chemical substances that make the environmental challenge for textile industry not only as liquid waste but also in its chemical composition (Alen and Vinodha, 2014). Basically, the main pollution contributed by textile wastewater comes from dyeing and finishing processes. Water is used as the principal medium to apply dyes and various chemicals for finishes and since all of them are not contained in the final product, they eventually became waste and caused disposal problems. Among major pollutants in textile wastewaters are known as high suspended solids, chemical oxygen demand, heat, colour, acidity, and other soluble substances, which need to be removed from textile wastewater are COD, BOD, nitrogen, heavy metals and dyestuffs.

The textile wastewater is a complex and variable mixture of polluting substances like inorganic, organic, elemental and polymeric products (Brown and Laboureur, 1983). The textile wastewater containing dye substances is not only toxic to the biological world, its dark colour blocks sunlight that leads to severe problems to the ecosystem (Choi et al., 2004). Due to low biodegradation of dyes, conventional biological treatment process is not very effective in treating dye wastes. The usual treatment processes like physical and chemical methods such as coagulation,

flocculation, adsorption, membrane filtration and irradiation. (Robinson et al., 2001) achieve good decolorizing efficiency but they are high cost and the production of the significant amount of sludge material requires final disposal again. Among all the methods, adsorption is one of the most effective methods of removing dyes from waste sewage (Deans and Dixon, 1992 and Nigam et al., 2000). The process of adsorption has an advantage over the other methods due to its sludge free operation and complete removal of dyes even from dilute solutions. Activated carbons have been extensively utilized in various industrial adsorption and separation processes because of its efficient adsorption of the organic compound.

Recently, a considerable amount of research has been undertaken to find cheaper substitutions to activated carbon. Recent developments of new strategies of making use of low cost, easily available biological and agricultural waste materials for the adsorption process is gaining much importance to replace activated carbon. Some of the low cost adsorbents that are tested for the dye sorption process are rice husk (Manoj kumar, 2013), bark, hair and coal (Ho and McKay, 1999), wood dust (Garg et al., 2004), tree bark powder (Paul Egwuonwu, 2013), peat (Fernandes et al., 2006), lignin (Cotoruelo et al., 2010), wheat bran (Ata et al., 2012 and Ozer and Dursun, 2007), brown sea weed (Vijayaraghavan and Yun, 2008), banana and orange peel (Annadurai et al., 2002), fly ash (Janos et al., 2003), pineapple stem waste (Hameed et al., 2009), water hyacinth pulp powder, tuberous pulp, sugarcane pulp, and coconut pulp (Pramanik et al., 2011).

1.2 Problem Statement

Recently, the problems created by textile wastewater getting more serious concerns especially in developing country. This is due to low biodegradation of dye and chemical used in commercial textile are hazardous and danger to the environment. Approximately 10000 different dyes mainly used in the dying and printing industries are produced annually worldwide (Zollinger, H. 1978) and (Robinson, T., McMullan, G., Marchant, R., & Nigam, P. 2001). Due to low biodegradation of dyes, conventional biological treatment process is not very effective in treating dye wastes. In order to overcome these problems, the research for environmental friendly and low cost treatment is essential. It is thought that adsorption processes by seaweed biomass is comparatively effective for the removal of dye from wastewater (Suzuki, Y., Kametani, T., & Maruyama, T. 2005). However, none has been reported on the dye removal by using our local seaweed through adsorption process. Furthermore, Malaysia has abundance of seaweed.

1.3 Objectives

There objectives of this research are as the followings:

1. To study the equilibrium time of dye removal by Malaysia seaweed biomass.
2. To investigate the effect of Malaysia seaweed mass on the performance of its adsorption.
3. To study the effect of initial concentration to the dye removal by Malaysia seaweed biomass.
4. To compare the performance of dye removal by *Eucheuma Spinosum*, *Kappaphycus Alvarezii*, *Kappaphycus Striatum* and *Sargassum Polycystum.*

REFERENCES

Volesky, B. (1990). *Biosorption of heavy metals*. CRC press.

El Hassouni, E., Abdellaoui, D., El Hani, S., & Bengueddour, R. (2014). Biosorption of cadmium (II) and copper (II) from aqueous solution using red alga (Osmundea pinnatifida) biomass. *Journal of Materials and Environmental Science*, *5*, 967-974.

Suzuki, Y., Kametani, T., & Maruyama, T. (2005). Removal of heavy metals from aqueous solution by nonliving Ulva seaweed as biosorbent. *Water research*, *39*(9), 1803-1808.

Seif, H., & Malak, M. (2001). Textile wastewater treatment. In *Sixth International Water Technology Conference (IWTC)* (pp. 608-614).

Ahmed, M. A. H. D. I., Idris, A. Z. N. I., & Adam, A. O. F. A. H. (2007). Combined anaerobic-aerobic system for treatment of textile wastewater. *Journal of Engineering Science and Technology (JESTEC)*, *2*(1), 55-69.

Mrowiec, B. The Impact of Textile Wastewater on Nutrients Removal.

Halimoon, N., & Yin, R. G. S. (2010). Removal of heavy metals from textile wastewater using zeolite. *Environment Asia*, *3*(special issue), 124-130.

Sarker, B. C., Baten, M. A., Haque, M. E. U., Das, A. K., Hossain, A., & Hasan, M. Z. Heavy Metals Concentration in Textile and Garments Industries' Wastewater of Bhaluka Industrial Area, Mymensingh, Bangladesh. *Current World Environment*, *10*(1).

Fan, B., Liang, J., Men, J., Gao, F., Li, G., Zhao, S., & Zhang, L. (1997). Effect of total alkaloid of Peganum harmala L. in the treatment of experimental haemosporidian infections in cattle. *Tropical animal health and production*, *29*(4), 77S-83S.

Ganesan, M. Physico-Chemical Analysis Of Contaminated Soil Collected From Different Areas Of Karur Textile Industries Region.

A Latinwo G. K., a Jimoda L. A., a *Agarry S. E. and b Adeniran J. Biosorption of some heavy metals from Textile Wastewater by Green Seaweed Biomass.

Lakherwal, D. (2014). Adsorption of heavy metals: A review. *International Journal of Environmental Research and Development*, *4*(1), 41-48.

Suzuki, Y., Kametani, T., & Maruyama, T. (2005). Removal of heavy metals from aqueous solution by nonliving Ulva seaweed as biosorbent. *Water research*, *39*(9), 1803-1808.

Sweetly, J. D., Sangeetha, K., & Suganthi, B. (2014). Biosorption of Heavy Metal Lead from Aqueous solution by Non living Biomass of Sargassum myriocystum. *Inter. Journal of Appl or Inno. In Eng. and Management*, *3*, 4.

Kordrostami, S. (2015). Sewage/Wastewater Treatment.

Suzuki, Y., Kametani, T., & Maruyama, T. (2005). Removal of heavy metals from aqueous solution by nonliving Ulva seaweed as biosorbent. *Water research*, *39*(9), 1803-18

Fu, F., & Wang, Q. (2011). Removal of heavy metal ions from wastewaters: a review. *Journal of Environmental Management*, *92*(3), 407-418.

Chakravarty, S., Mohanty, A., Sudha, T. N., Upadhyay, A. K., Konar, J., Sircar, J. K., ... & Gupta, K. K. (2010). Removal of Pb (II) ions from aqueous solution by adsorption using bael leaves (Aegle marmelos). *Journal of hazardous materials*, *173*(1), 502-509.

Deng, L., Zhang, Y., Qin, J., Wang, X., & Zhu, X. (2009). Biosorption of Cr (VI) from aqueous solutions by nonliving green algae Cladophora albida. *Minerals Engineering*, *22*(4), 372-377.

Ghoneim, M. M., El-Desoky, H. S., El-Moselhy, K. M., Amer, A., El-Naga, E. H. A., Mohamedein, L. I., & Al-Prol, A. E. (2014). Removal of cadmium from aqueous solution using marine green algae, Ulva lactuca. *The Egyptian Journal of Aquatic Research*, *40*(3), 235-242.

Barakat, M. A. (2011). New trends in removing heavy metals from industrial wastewater. *Arabian Journal of Chemistry*, *4*(4), 361-377.

Gautam, R. K., Mudhoo, A., Lofrano, G., & Chattopadhyaya, M. C. (2014). Biomass-derived biosorbents for metal ions sequestration: Adsorbent modification and activation methods and adsorbent regeneration. *Journal of environmental chemical engineering*, *2*(1), 239-259.

Khokhar, A., & Siddique, Z. (2015). Removal of heavy metal ions by chemically treated Melia azedarach L. leaves. *Journal of Environmental Chemical Engineering*, *3*(2), 944-952.

R. Senthilkumar, K. Vijayaraghavan, M. Thilakavathi, P.V.R. Iyer, M. Velan, Application of seaweeds for the removal of lead from aqueous solution, Biochem. Eng.J. 33 (2007) 211–216.

Williams, C. J., & Edyvean, R. G. J. (1997). Optimization of metal adsorption by seaweeds and seaweed derivatives. *Process safety and environmental protection*, *75*(1), 19-26.

Lee, K. O., Ramli, N., Said, M., Ahmad, M., Yasir, S. M., & Ariff, A. (2011). Competitive metal sorption and desorption onto Kappaphycus alvarezii, seaweed waste biomass.

Pandey, P., Sambi, S. S., Sharma, S. K., & Singh, S. (2009, October). Batch adsorption studies for the removal of Cu (II) ions by zeolite NaX from aqueous stream. In *Proceedings of the world congress on Engineering and computer science* (Vol. 1).

Zou, H. X., Li, N., Wang, L. H., Yu, P., & Yan, X. F. (2014). Equilibrium and kinetic studies of Cd2+ biosorption by the brown algae sargassum fusiforme.*PloS one*, *9*(4).

Aldrich, C., Esau, A., & Qi, B. (2005). *Biosorption of Heavy Metals from Aqueous Solutions*. Water Research Commission.

Shi, H. (2009). Industrial wastewater–types, amounts and effects in point sources of pollution: local effects and control. *Department of Environmental Science and Engineering, Tsinghua University-Encyclopedia of Life Support Systems (EOLSS), Japan*.

Ayres, D. M., Davis, A. P., & Gietka, P. M. (1994). Removing heavy metals from wastewater. *Engineering Research Centre Report*, *90*.

Tzoupanos, N. D., & Zouboulis, A. I. (2008). Coagulation-flocculation processes in water/wastewater treatment: the application of new generation of chemical reagents. In *Proceedings of 6th IASME/WSEAS International Conference on Heat Transfer, Thermal Engineering and Environment* (pp. 20-22).

Parmar, M., & Thakur, L. S. (2013). Heavy metal Cu, Ni and Zn: Toxicity, health hazards and their removal techniques by low cost adsorbents: A short overview. *Int. J. Plant. Anim. Environ. Sci*, *3*(3), 143-157.

Talwar R, Agrawal S, Bajpai A, Malik S. Assessment of Concentration and Variations due to Seasonal Effect on the Presence of Heavy Metals in the Water of Upper Lake, Bhopal. *Curr. World Environ.* 9(2): 421-425 (2014).

Malarkodi M., Krishnasamy R., Kumaraperumal R. and Chitdeshwari T., Characterization of heavy metal contaminated soils of Coimbatore district in Tamil Nadu. *J. Agron*., 6: 147-150 (2007).

Alkorta, I., Hernández-Allica, J., Becerril, J. M., Amezaga, I., Albizu, I., & Garbisu, C. (2004). Recent findings on the phytoremediation of soils contaminated with environmentally toxic heavy metals and metalloids such as zinc, cadmium, lead, and arsenic. *Reviews in Environmental Science and Biotechnology*, *3*(1), 71-90.

Duffus, J. H. (2002). "Heavy metals" a meaningless term? (IUPAC Technical Report). *Pure and Applied Chemistry*, *74*(5), 793-807.

Tong, H. K., Lee, K. H., & Wong, H. A. (1979). Study of the water extractable components of the red seaweed Eucheuma spinosum.*International Journal of Food Science & Technology*, *14*(3), 265-275.

Kiefer, S., & Robens, E. (2008). Some intriguing items in the history of volumetric and gravimetric adsorption measurements. *Journal of thermal analysis and calorimetry*, *94*(3), 613-618.

Cheremisinoff, N. P., & Cheremisinoff, P. N. (1993). Carbon adsorption for pollution control.

Mohan, N., & Balasubramanian, N. (2006). In situ electrocatalytic oxidation of acid violet 12 dye effluent. *Journal of hazardous materials*, *136*(2), 239-243.

Cengiz, S., & Cavas, L. (2008). Removal of methylene blue by invasive marine seaweed: Caulerpa racemosa var. cylindracea. *Bioresource Technology*, *99*(7), 2357-2363.

Sokolowska-Gajda, J., Freeman, H. S., & Reife, A. (1996). Synthetic dyes based on environmental considerations. Part 2: Iron complexes formazan dyes. *Dyes and pigments*, *30*(1), 1-20.

Ivanov, K., Gruber, E., Schempp, W., & Kirov, D. (1996). Possibilities of using zeolite as filler and carrier for dyestuffs in paper. *Papier*, *50*(7-8), 456.

Bensalah, N., Alfaro, M. Q., & Martínez-Huitle, C

A. (2009). Electrochemical treatment of synthetic wastewaters containing Alphazurine A dye. *Chemical Engineering Journal*, *149*(1), 348-352.

Wróbel, D., Boguta, A., & Ion, R. M. (2001). Mixtures of synthetic organic dyes in a photoelectrochemical cell. *Journal of Photochemistry and Photobiology A: Chemistry*, *138*(1), 7-22.

Dawood, S., Sen, T. K., & Phan, C. (2014). Synthesis and characterisation of novel-activated carbon from waste biomass pine cone and its application in the removal of congo red dye from aqueous solution by adsorption. *Water, Air, & Soil Pollution*, *225*(1), 1-16.

Dawood, S., Sen, T. K., & Phan, C. (2014). Synthesis and characterisation of novel-activated carbon from waste biomass pine cone and its application in the removal of congo red dye from aqueous solution by adsorption. *Water, Air, & Soil Pollution*, *225*(1), 1-16.

Clarke, E. A., & Anliker, R. (1980). Organic dyes and pigments. In*Anthropogenic compounds* (pp. 181-215). Springer Berlin Heidelberg.