VOL. 9, NO. 6, JUNE 2014 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

WASTEWATER TREATMENT THAT CONTAMINATED WITH LEAD

Prayong Keeratiurai
Department of Civil Engineering, Faculty of Engineering, Vongchavalitkul University, Nakhon Ratchasima Province, Thailand
E-Mail: keeratiurai_pray@windowslive.com

ABSTRACT

This study was conducted to reduce the lead content in wastewater of metal plating factory. Wastewater contaminated with lead was filtered with carbon. Types of wood carbon for filtration were tamarind wood carbon and rubber wood carbon. The thickness of the carbon filter layer was 30 centimeters. Wastewater pretreatment improved wastewater with lime and leaved the reaction completely. Then the wastewater was filtered by the slow filtering process. Wastewater samples were collected every 1 hour to analyze the concentration of lead before and after filtration. The results of this study showed that the wastewater filtration with tamarind and rubber wood carbon reduced lead more than 99.75%. Wastewater through the filtration would have 0.003 mg of lead per liter, which was below the standard of industrial effluents defined 0.2 mg of lead per liter. The filtration lifetime of tamarind wood carbon and rubber wood carbon was 15 days and 4 hours, and 8 days and 9 hours, respectively. The result showed that the tamarind wood carbon have a lifetime for filtration more than the rubber wood carbon that was 6 days and 8 hours. The tamarind wood carbon was most appropriate for used as a filter.

Keywords: wastewater treatment, leads, filtration,.

INTRODUCTION

Pollution from heavy metals was a problem that Thailand was experiencing. Lead poisoning is harmful to the human body. It may cause illness and death when the amount of lead into the body has a lot. This problem occurs from the manufacture of industrial products with heavy metals. These factories released toxins in contaminated wastewater into rivers without treatment process. Ministry of Industry has set standards of lead in the effluent. The standard of industrial effluents defined 0.2 mg of lead per liter. Lead is a chemical element in the carbon group with symbol Pb. Lead is a soft and malleable metal, which is regarded as a heavy metal and poor metal. Lead is in the form of organic and inorganic compounds. Lead is used in building construction, color, medicines, and lead-acid batteries. Lead is poisonous to animals, including humans. It damages the nervous system and causes brain disorders. Excessive lead also causes blood disorders in mammals.

Adsorption is the adhesion of atoms, ions, or molecules from liquid, or dissolved solid to a surface. Adsorption is present in many natural, physical, biological, and chemical systems, and is widely used in industrial applications such as activated carbon. Carbon is an element with a molecular mass of 12. Carbon atoms are arranged, unlike other elements. All the carbon atoms are stretched to the four neighboring atoms. These atoms were seized with other atoms of carbon that will be adjacent to one another. It is so difficult to make carbon atoms separated. Figure-1 showed the micrograph of activated carbon.

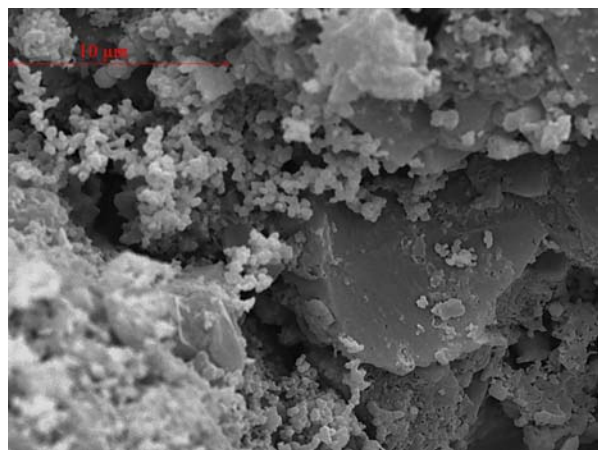

Figure-1. A micrograph of activated carbon under scanning electron microscope.
Source: de.wikipedia.org/wiki/Benutzer:Mydriatic

Activated carbon is used in metal extraction, water purification, sewage treatment and many other applications. One major industrial application involves use of activated carbon in the metal finishing field. It is very widely employed for purification of electroplating solutions. Activated carbon treatment removes such impurities and restores plating performance to the desired level. Activated carbon is usually used in water filtration systems.

Wastewater treatment by filtering could be done in several ways, such as rapid filter and slow filter. Rapid filtration system is similar to a combination of straining system and sedimentation system together. The rapid filter was used to filter with large rock or gravel. Typically, rapid filter tank was opening where the wastewater would flow by gravity. It had a thick layer of sand at the top of model as 0.4-0.7 meter and had 0.3-0.6 meter of thick gravel layer to support sand layer. Wastewater was above

ARPN Journal of Agricultural and Biological Science

the top of the sand layer should been approximately 0.9-1.50 meter. Filtration rate of this filter was in the range of 4 to 6 cubic meter. Slow filter system is similar to a combination of straining system, Adsorption system, and biological and flocculation system together. Slow filter was used to filter with sand or porosity of carbon that sizes of filter was smaller than rapid filter. This wastewater filter system was composed of a thick layer of sand about 0.6-1.02 meter and a diameter of sand about 0.2-0.35 millimeter. This filter also had gravel layer to support sand layer. The thickness of the gravel layer was about 0.30 meter. The rate of slow filtration was in the range of 0.1 to 0.4 cubic meters. If the wastewater had low turbidity, slow carbon filter could eliminated lead with the use of chemicals aid in precipitation.

This study was conducted to reduce the lead content in wastewater of metal plating factory. Wastewater contaminated with lead was filtered with carbon. The carbon filtration process was studied that was slow filter with using the tamarind wood carbon and the rubber wood carbon in the filter. The research also studied to evaluate the lifetime of the both carbon filters. Wastewater flowed through the carbon filter layer of the model with changing the chemical properties of wastewater. The material was used as a filter in the model, which consists of gravel layer (5 cm.), carbon layer (30 cm.), and sand layer (5 cm.). The wood carbons arranged in layers that they could to trap sediments, debris and night soil that did not decompose at the filter layer. The suspended solids such as sediments, sludge, bacteria, algae, colloids, and heavy metals that they were trapped with carbon filter layer. Let the wastewater flowed through the spaces of the carbon layer.

RESEARCH METHODOLOGY

Filtration was commonly the mechanical or physical operation which was used for the separation of solids from wastewater by interposing a medium through which only the wastewater could pass. The size of reactor of this study was 50 x 40 x 50 centimeters. Wastewater samples were collected at inlet and outlet of model and brought it to the analysis in the laboratory. This study installed the multi-layer filtration model for wastewater treatment that it had carbon layer was between sand layer and gravel layer as shown in Figure-2. Types of wood carbon for filtration were tamarind wood carbon and rubber wood carbon. The both of carbon filters were crushed to effective size that was 0.3 millimeter and uniformity coefficient was 3 with the sieve analysis method. The thickness of the carbon filter layer was 30 centimeters.

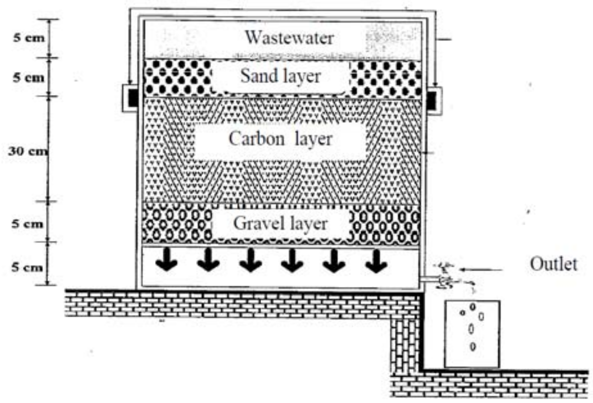

Figure-2. The model of wastewater treatment with multi-layer filtration.

Preparation of wastewater

This study used the wastewater of metal plating factory. Wastewater contaminated with lead was filtered with carbon. Wastewater was filled with lime and stirred until pH of the wastewater samples ranged from 8.4 to 9.0. After that letting it sediment for 30 minutes to ensure that the reaction was complete, and some heavy metals have been precipitation. Solution of lead in water changed in the form of $Pb\ (OH)_2$ which was insoluble.

Method of operation

Sampling of the wastewater of metal plating factory which has not improved quality was conducted to analyze the contents of lead in laboratory. Then the wastewater was filtered by the slow filtering process and analyzed the flow rate. Wastewater samples were collected every 1 hour to analyze the concentration of lead before and after filtration. The lifetime analysis of the both of carbon filters with the filter operation for 30 days and measured the rate of filtration per area per hour (liter/m^2/hour). This filtration was operated until the efficiency of the both of filters to the minimum of rate flow.

RESULTS

Lifetime of tamarind wood carbon and rubber wood carbon

The tamarind wood carbon and rubber wood carbon have effective size that were 0.3 millimeter and uniformity coefficient were 3, and the thickness of the carbon filter layer were 30 centimeters. The result of this study found that the tamarind wood carbon had lifetime more than the rubber wood carbon. In the 1 cycles of filtering since the filtered until the filters clogged, the tamarind wood carbon had lifetime that was 160-180 hours while the rubber wood carbon had lifetime per cycle about 100-110 hours as showed in Figure-3.

VOL. 9, NO. 6, JUNE 2014 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science

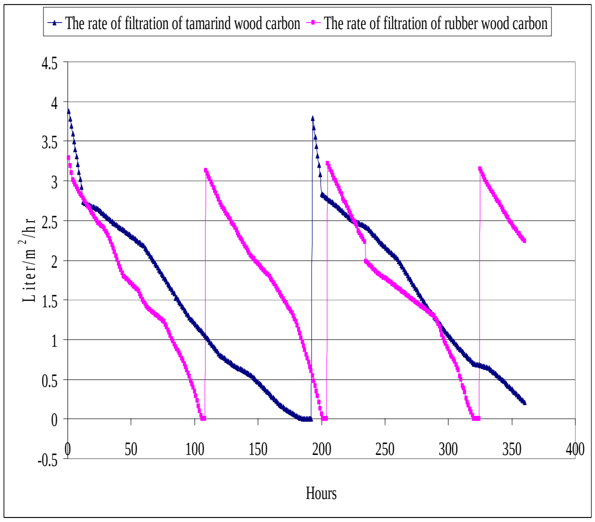

Figure-3. Lifetime of tamarind wood carbon and rubber wood carbon.

The comparison of the rate of wastewater filtration or the volume of wastewater that was filtered from both of carbon filters at the same time found that the tamarind wood carbon had filtration efficiency better than the rubber wood carbon. This research also showed the relation of the rate of wastewater filtration per area of filter and the lifetime of tamarind wood carbon as y = -0.0183(x) + 3.1559 at R^2 = 0.9814 as shown in Figure-4. While the relation of the rate of wastewater filtration per area of filter and the lifetime of rubber wood carbon as y = -0.0269(x) + 3.1233 at R^2 = 0.9909 as shown in Figure-5. The comparison of the slopes of linear graphs with equations as showed in Figure-4 and Figure-5. The results found that the linear graph of tamarind wood carbon had the slope less than the linear graph of the rubber wood carbon. They showed that the tamarind wood carbon had lifetime more than the rubber wood carbon.

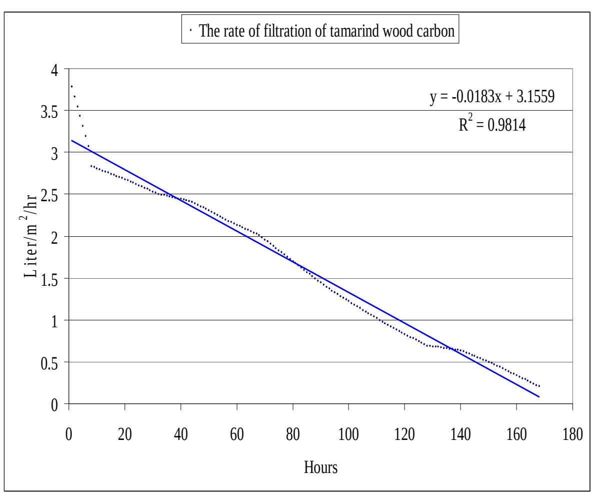

Figure-4. The relation of the rate of wastewater filtration per area of filter and the lifetime of tamarind wood carbon.

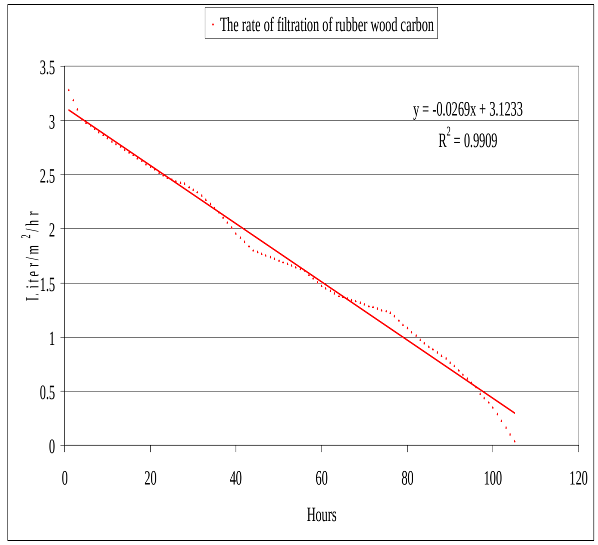

Figure-5. The relation of the rate of wastewater filtration per area of filter and the lifetime of rubber wood carbon.

Effectiveness of reducing the lead content in waste water from the two types of wood carbon

When the discharge of wastewater into the tank filter and check the times of the flow of wastewater that permeated through the filters for the evaluation of the rate of filtration per area per hour with measurement of the volume of wastewater that flow through the filters as showed in Table-1.

Table-1. Times of absorption and the filtration rate of wastewater per unit area of the filters.

Wood carbon	**Times of absorption** (hour)	**Filtration rate in one hour** (liter/m^2)
Tamarind	5	3.879
Rubber	3	3.284

The results of analysis of the lead contents in wastewater before were filtered with carbon filters as showed in Table-2. The results of analysis of the lead contents in wastewater after were filtered with the tamarind wood carbon and the rubber wood carbon in 1, 2 and 3 hours that they were evaluated the trend of the reducing of lead contents in wastewater on times as showed in Figure-6 and Figure-7, respectively.

Table-2. The lead contents in wastewater before were filtered with carbon filters in 1, 2, and 3 hours.

Hours	**Lead contents in wastewater before was filtered with filters**	
	Tamarind wood carbon	**Rubber wood carbon**
1	2.0 mg/L	2.0 mg/L
2	2.0 mg/L	2.0 mg/L
3	2.0 mg/L	2.0 mg/L

ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

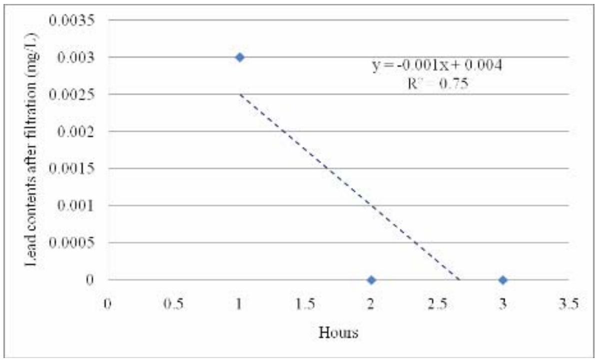

Figure-6. Trend of the reducing lead contents in wastewater on times that were filtered with tamarind wood carbon.

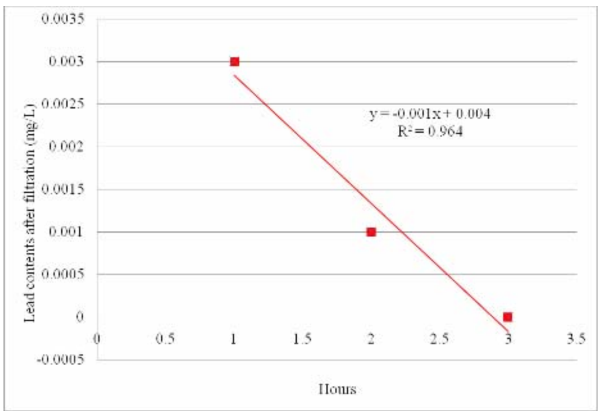

Figure-7. Trend of the reducing lead contents in wastewater on times that were filtered with rubber wood carbon.

This study also showed comparison of the removal efficiency of lead contents in wastewater with filters as shown in Figure-8. Figure-8 showed that the tamarind wood carbon removed lead than the rubber wood carbon in the same period. The tamarind wood carbon used times as 2.65 hours in the lead removal to complete. While the rubber wood carbon removed lead completely takes 2.9 hours. The results of this study also showed that the beginning of tamarind wood carbon filter could remove lead immediately to 99.8%. They were removed more than the beginning of rubber wood carbon filter. It was consistent with the findings as shown in Table-1. Takes time to wastewater to seep through the tamarind wood carbon and rubber wood carbon equals 5 and 3 hours, respectively. That was, the results of this study could another summarized as a tamarind wood carbon had porous in texture than rubber wood carbon.

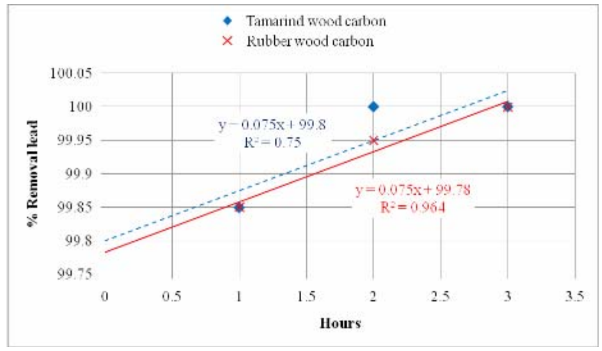

Figure-8. Lead removal efficiency of both types of filters.

The result of this study also showed that tamarind wood carbon had the rate of filtration per area more than rubber wood carbon at the same times as shown in Figure-9. Figure-9 showed that the rate of filtration of tamarind wood carbon reduced to less than the rate of filtration of rubber wood carbon. In other words, tamarind wood carbon could filter wastewater that contaminated with lead better than rubber wood carbon.

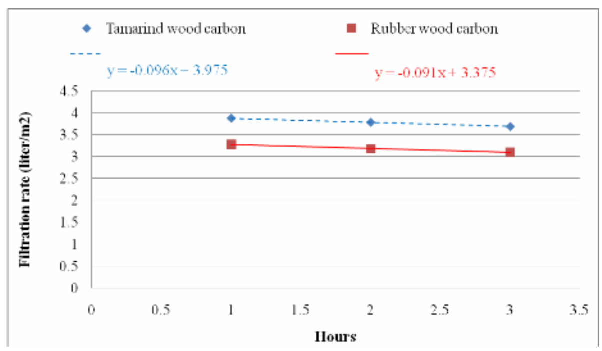

Figure-9. The rate of filtration per area of carbon filters.

CONCLUSIONS

This study was conducted to reduce the lead content in wastewater of metal plating factory which was below the standard of industrial effluents defined 0.2 mg of lead per liter. Wastewater contaminated with lead was filtered with carbon. Wastewater was filled with lime and stirred until pH of the wastewater samples ranged from 8.4 to 9.0. After that letting it sediment for 30 minutes to ensure that the reaction was complete, and some heavy metals have been precipitation. The size of filtration reactor of this study was 50 x 40 x 50 centimeters. Wastewater samples were collected at inlet and outlet of model and brought it to the analysis in the laboratory. This study installed the multi-layer filtration model for wastewater treatment. Types of wood carbon for filtration were tamarind wood carbon and rubber wood carbon. The thickness of the carbon filter layer was 30 centimeters.

The results of this study showed that the wastewater filtration with tamarind and rubber wood carbon reduced lead more than 99.75%. Wastewater through the filtration would have 0.003 mg of lead per liter, which was below the standard of industrial effluents

ARPN Journal of Agricultural and Biological Science

defined 0.2 mg of lead per liter. The filtration lifetime of tamarind wood carbon and rubber wood carbon was 15 days and 4 hours, and 8 days and 9 hours, respectively. The result showed that the tamarind wood carbon have a lifetime for filtration more than the rubber wood carbon that was 6 days and 8 hours. Tamarind wood carbon could filter wastewater that contaminated with lead better than rubber wood carbon. This study concluded that the tamarind wood carbon was most appropriate for used as a filter.

REFERENCES

APHA AWWA WEF. 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. Wash. D.C., USA. American Public Health Association.

Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin. 2003. Chemistry for Environmental Engineering and Science. 5th Ed. New York: McGraw-Hill.

Hammer Mark J. 1975. Water and Waste-Water Technology. John Wiley and Sons.

Metcalf and Eddy Inc. 1991. Wastewater Engineering Treatment, Disposal, and Reuse. 3rd Edition. Singapore. McGraw-Hill International Editions.

Norton John F. 1946. Standard Methods for the Examination of Water and Sewage. 9th Ed. American Public Health Association. p. 139.

Prayong Keeratiurai. 2014. Wastewater treatment with aerobic filtration process by rock layer. ARPN Journal of Agricultural and Biological Science. 9(4): 152-156.

Urquhart Leonard Church. 1959. Civil Engineering Handbook. 4th Ed. McGraw-Hill. pp. 9-40.

U.S. Environmental Protection Agency (EPA). Washington, DC. Secondary Treatment Regulation. Code of Federal Regulations, 40 CFR Part 133.

http://de.wikipedia.org/wiki/Benutzer:Mydriatic.

www.lenntech.com/chemistry/filtration.htm.