ASSESSMENT OF WATER QUALITY AND TREATMENT OF WATER FROM MONE CHAUNG STREAM IN SIDOKTAYA TOWNSHIP

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Abstract

In this research work, three water samples from Mone Chaung stream were collected to assess the water quality in January, 2018. Three sampling sites, Site-1 (Le Pyin Su), Site-2 (Nyaung Aing) and Site-3 (Auk Pon) were selected in Mone Chaung stream, Sidoktaya Township. The physicochemical properties of all water samples such as turbidity, pH, total dissolved solids, total hardness, total alkalinity, sulphate and chloride were determined. Turbidity values (6.15 - 6.38 NTU) and total hardness (105 - 130 mg/L) were higher than the highest desirable level of the WHO standard. Moreover, the dissolved oxygen (DO), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) of all three water samples were also analyzed and BOD (92-115 mg/L) and COD (210-248 mg/L) were found to be higher than the CPCB standard. For the treatment of water samples, activated rice husk charcoal was used. After treatment, physicochemical properties of the water samples were found to decrease. Before and after treatment, the heavy toxic metal, lead was also determined by using complexometric titration. More than 82 % of lead was removed after treatment with activated rice husk charcoal for 3 weeks.

Keywords: Physicochemical properties, activated rice husk charcoal, complexometric titration, heavy toxic metal

Introduction

Life depends on water, which is by far the most abundant substance in most of the world. It is undeniably obvious that no one can live for long without water. Water is used not only in households but it is also used for agricultural and industrial production. Since the rate of use is increasing rapidly, water is not always where the people are. Quite often, freshwater supplies are so badly polluted that they are unfit for human use (Gray, 1994).

A major source of pollution in developing countries is industrial activities and this has gradually increased the problem of waste disposal. Increasing industrial activities has led to pollution stress on the surface water.

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There are many causes for water pollution but two general categories exist, direct and indirect contaminant sources. Direct sources include effluent outfalls from factories, refineries, waste treatment plant etc., that emit fluids of varying quality directly into urban water supplies (EPA, 1991).

Over the years the adsorption process has emerged as a viable and effective alternative to most of these conventional methods of treatment, which are rather expensive. Adsorption process offers a great potential for treating effluents containing undesirable compounds and renders them safe and reusable (Dadhich *et al*., 2004). An adsorbent is a substance, usually porous in nature and with a high surface area that can absorb substances onto its surface by intermolecular forces. Adsorbents in liquid-solid chromatography have a very wide variety of application area. Charcoal is used in water purification, air purification and removing undesirable odours and impurities in food (Mantell, 1951). Activated carbon happens to be the most frequently used conventional adsorbent because of its high surface area. But it is expensive and at the same time the high cost of regeneration and losses during regeneration made carbon black less attractive. Therefore research is on to look for economic, abundant and eco-friendly adsorbent (Janveja *et al*., 2008; Wang *et al*., 2005).

In this research work, before and after treatment with activated rice husk charcoal, an agricultural adsorbent, the quality of three water samples collected from different sites of Mone Chaung Stream was studied.

Materials and Methods

Sample Collection

The water samples were collected from Mone Chaung Stream, Sidoktaya Township to analyze the water quality, in January, 2018. All water samples were taken from 2 ft depth from the water level.

These water samples were collected from three different sites of Mone Chaung Stream such as Site-1 (Le Pyin Su), Site-2 (Nyaung Aing), and Site-3 (Auk Pon) (Figure 1). The collected water sample was filled into purified plastic containers which were first rinsed several times with distilled water.

Figure 1: Sample collection area (a) Site1- Le Pyin Su (b) Site 2 - Nyaung Aing and (c) Site 3- Auk Pon

The rice husk was collected from Sidoktaya Township, Magway Region. Rice husk charcoal was made by control burning of rice husk until only the charcoal remained (Figures 2 and 3).

Figure 2: Rice husk

Figure 3: Rice husk charcoal

Determination of Physicochemical Properties of Water Sample (Before Treatment)

About 1 L of water sample was used to determine the physicochemical properties. The results are shown in Tables 1 and 2. The temperature of water samples were determined by a thermometer. pH and conductivity of water samples were determined by pH meter (MP-551) and conductivity meter (MP-551), respectively. Total dissolved solid (TDS) value of water samples were determined by gravimetric method. The total hardness of water samples were determined by EDTA titrimetric method. The chloride and sulphate of water samples were directly measured by Lamotte model, TRL Colorimeter. Dissolved oxygen (DO) was determined by DO meter (MP-551). Biochemical oxygen demand (BOD) was determined by incubation method using incubator at 20 °C for 5 days (Rand *et al*., 1975). Chemical oxygen demand was determined by permanganate titrimetric method (Rand *et al*., 1975).

Activation of Rice Husk Charcoal

About 250 g of rice husk charcoal was placed into a plastic container and 500 mL of 5 % NaOH solution was added to the rice husk charcoal and stirred. The mixture was allowed to stand for 3 h. The mixture was then filtered and washed with distilled water until it became neutral. Then, 500 mL of 5 % NaOCl solution was added into the neutral rice husk charcoal for decolourization and stirred. The mixture was allowed to stand for 24 h. The mixture was filtered and washed with distilled water to become neutral. Rice husk charcoal was dried in sunlight for 24 h. The resulting charcoal was ground and sieved by using 60 mesh size sieve. The activated rice husk charcoal powder was obtained (Figure 4).

Figure 4: Activated rice husk charcoal powder

Determination of Lead from Water Sample before Treatment

Firstly, 5 mL of water sample was taken out from plastic tank and put into a conical flask. Next, 3 drops of xylenol orange indicator were then added. The colour of solution was changed to wine red. Then three drops of dilute HNO_3 was added and the colour was changed to yellow. In this solution a few amount of hexamine powder was added. The colour was changed from yellow to red. Finally this solution was titrated with 0.001 M EDTA solution and at the end point, the colour of solution was changed to yellow. The experiment was repeated three times and the data were recorded.

Treatment of Collected Water by Filtration through Activated Rice Husk Charcoal

Activated rice husk charcoal (10 g) was packed into column and 1000 mL of water samples were passed through the column. The flow rates of samples were adjusted by 22 drops in 1 min. The filtrate was collected in a 500 mL beaker and then it was passed through again. The process was carried out for three weeks and the physicochemical properties of the resulting filtrate were determined after treatment with activated rice husk charcoal. Lead content of the resulting filtrate after treatment with activated rice husk charcoal was determined weekly for three weeks by EDTA titrimetric method.

Determination of Lead from Water Samples after Treatment for One Week, Two Weeks and Three Weeks by Using Filtration Method

The resulting filtrate by filtration through the activated rice husk charcoal was titrated with 0.001 M EDTA solution. The procedure was the same as that described above.

Results and Discussion

The Physicochemical Properties of Water Samples from Site-1, Site-2, Site-3

The physical and chemical properties of water samples from Mone Chaung Stream before and after treatment with the prepared activated rice husk charcoal powder were studied.

The Physical Properties of Water Samples

The physical properties of all water samples such as total dissolved solid, pH, conductivity and turbidity were examined. The results are tabulated in Table 1.

Table 1: Comparison of Physical Properties of Water Samples from Site-1, Site-2 and Site-3 in Mon Chaung Stream

No.	Test	Site 1	Site 2	Site 3	WHO Standard*	
					Highest desirable level (mg/L)	Maximum permissible level (mg/L)
1	Total Dissolved Solid (mg/L)	460	502	445	500	1500
2	pH	7.5	7.8	7.5	7-8.5	6.5-9.2
3	Conductivity (µs/cm)	582	795	728	800	4000
4	Turbidity(NTU)	6.15	6.38	6.23	5	25

*WHO, 2008

The total dissolved solid was found to be 460 mg/L, 502 mg/L and 445mg/L in Site-1, Site-2 and Site-3 respectively. These values were lower than the maximum permissible level of 1500 mg/L (WHO, 2008) but total dissolved solid value of Site-2 was found to be slightly higher than the highest desirable level of WHO standard. pH values were in the range of 7.5-7.8 and these values were within the range of the highest desirable level of WHO standard. Conductivity values of the water sample were found to be lower than the highest desirable level of 800 µS/cm (WHO, 2008). Turbidity values of water samples were in the range of 6.15 NTU to 6.38 NTU and found to be slightly higher than the highest desirable level of WHO standard (5 NTU) but lower than the maximum permissible level of 25 NTU. According to these data, total dissolved solid, pH, turbidity and conductivity values were found to be highest at Site-2.

The Chemical Properties of Water Samples

The chemical properties of all water samples such as total hardness, total alkalinity, sulphate content and chloride content were examined. The results are tabulated in Table 2.

Table 2: Comparison of Chemical Properties of Water Samples from Site-1, Site-2 and Site-3

No	Test	Site 1	Site 2	Site 3	W.H.O Standard*	
					Highest desirable level (mg/L)	Maximum permissible level (mg/L)
1	Total Hardness (mg/L)	120	130	105	100	500
2	Total Alkalinity (mg/L)	300	350	330	600	950
3	Sulphate (mg/L)	58	60	55	200	400
4	Chloride (mg/L)	60	70	60	200	600

*WHO , 2008

The total hardness values of water samples in Site-1, Site-2 and Site-3 were 120 mg/L, 130 mg/L, 105 mg/L respectively, and these values were found to be higher than the highest desirable level of WHO standard but lower than the maximum permissible level of 500 mg/L. However, total alkalinity, sulphate and chloride values were lower than the respective highest desirable level of WHO standard.

Determination of DO, BOD, COD of Water Samples from Site-1, Site-2 and Site-3

DO, BOD and COD of water samples from three sites in Mone Chaung Stream were also determined. The results are shown in Table 3.

Table 3: Comparison of DO, BOD and COD of Water Samples from Site-1, Site-2 and Site-3 in January, 2018

No.	Test	Site-1	Site-2	Site-3	CPCB Standard*
1	DO (mg/L)	0.34	0.31	0.33	-
2	BOD (mg/L)	92	115	102	<30
3	COD (mg/L)	210	248	236	<250

*CPCB, 1995

DO values were 0.34 mg/L, 0.31 mg/L and 0.33 mg/L in Sites -1, 2 and 3, respectively, and found to be comparable. BOD values were higher than CPCB standard of < 30 mg/L. COD values in all sites were in the range of 210-248 mg/L and found to be lower than CPCB standard of 250 mg/L. According to this table, the highest value of DO was observed in water sample of Site-1 and the highest value of BOD and COD were observed in water sample of Site-2.

The Physicochemical Properties of Water Samples after Treatment

The physical and chemical properties of all water samples after treatment with activated rice husk charcoal were also examined. The results of these properties were compared with the results obtained before treatment. The comparison of physical properties of water samples is shown in Table 4.

Table 4: Comparison of Physical Properties of Water samples from Site-1, Site-2, Site-3 before and after Treatment

No.	Test	Site-1		Site-2		Site-3	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
1	Total Dissolved Solid (mg/L)	460	390	502	428	445	382
2	pH	7.5	7.4	7.8	7.6	7.5	7.3
3	Conductivity (μS/cm)	582	245	795	375	728	325
4	Turbidity (NTU)	6.15	3.05	6.38	3.24	6.23	3.15

The physical properties, total dissolved solid, pH, conductivity and turbidity of water samples from Site-1, Site-2 and Site-3, were reduced after treatment.

The comparison of chemical properties of water samples is shown in Table 5. These values were lower than their respective highest desirable level of WHO standard.

Table 5: Comparison of Chemical Properties of Water Samples from Site-1, Site-2, Site-3 before and after Treatment

No.	Test	Site-1		Site-2		Site-3	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
1	Total Hardness (mg/L)	120	90	130	90	105	80
2	Total Alkalinity (mg/L)	300	280	350	325	330	310
3	Sulphate (mg/L)	58	50	60	55	55	47
4	Chloride (mg/L)	60	50	70	62	60	51

Before treatment total hardness values of water samples were higher than the highest desirable level of WHO standard of 100 mg/L. However, after treatment with activated rice husk charcoal the hardness values were found to be in the range of 80-90 mg/L and lower than the highest desirable level of WHO standard. Total alkalinity, sulphate and chloride values of water samples were lower than the WHO standard before treatment. After treatment with activated rice husk charcoal these values were found to decrease.

DO, BOD and COD of Water Samples after Treatment

The chemical properties such as dissolved oxygen, biochemical oxygen demand and chemical oxygen demand after treatment were also determined. The results are shown in Table 6.

Table 6: Comparison of DO, BOD and COD of Water Samples from Site-1, Site-2 and Site-3 before and after Treatment

No.	Test	Site-1		Site-2		Site-3	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
1	DO (mg/L)	0.34	4.45	0.31	4.92	0.33	4.05
2	BOD (mg/L)	92	27	115	35	102	30
3	COD (mg/L)	210	93	248	122	236	112

After treatment of all water samples with activated rice husk charcoal, the DO of treatment water increased and BOD and COD values decreased. Although, BOD values before treatment (92-115 mg/L) were higher than CPCB standard value of < 30 mg/L these values were found to decrease except Site-2 (35 mg/L) after treatment.

Percent Removal of Lead from Water Sample (Site-1) after Treatment with Activated Rice Husk Charcoal

After treating with activated rice husk charcoal, the percent removal of lead from water sample of the sampling Site-1 was studied. The results are shown in Table 7 and Figure 6.

Table 7: Percent Removal of Lead from Water Sample Site-1 after Treatment with Activated Rice Husk Charcoal

No.	Time of filtration (week)	Initial weight of Pb (mg)	Weight of Pb after treatment with activated charcoal (mg)	Percent removal of Pb (%)
1	1	1.7198	1.2639	26.51
2	2	1.7198	0.7667	55.42
3	3	1.7198	0.2694	84.34

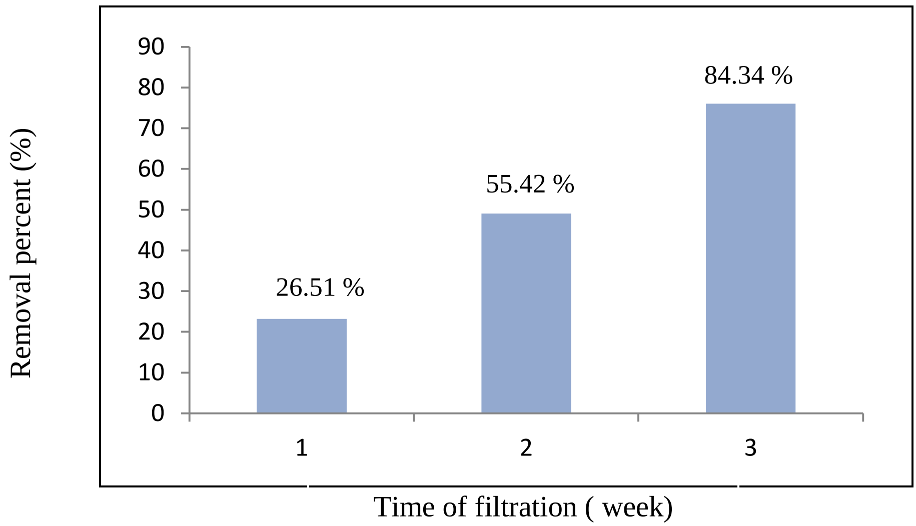

Figure 6: Plot of percent removal of lead vs time of filtration by using activated rice husk charcoal (Site -1)

In Site-1, the removal percent of Pb was 26.51 % after treatment with activated rice husk charcoal for 1 week. After 2 weeks the removal percent of Pb increased to 55.42 % and after 3 weeks the percent removal was 84.34 %.

Percent Removal of Lead from Water Sample of Sampling Site-2 after Treatment with Activated Rice Husk Charcoal

After treating with activated rice husk charcoal, the percent removal of Pb from water sample of the sampling Site-2 was studied and the results are shown in Table 8 and Figure 7.

Table 8: Percent Removal of Lead from Water Sample (Site-2) after Treatment with Activated Rice Husk Charcoal

No.	Time of filtration (week)	Original weight of Pb (mg)	Weight of Lead after treatment with activated charcoal (mg)	Percent removal of Pb (%)
1	1	1.7613	1.3054	25.88
2	2	1.7613	0.8081	54.12
3	3	1.7613	0.3108	82.35

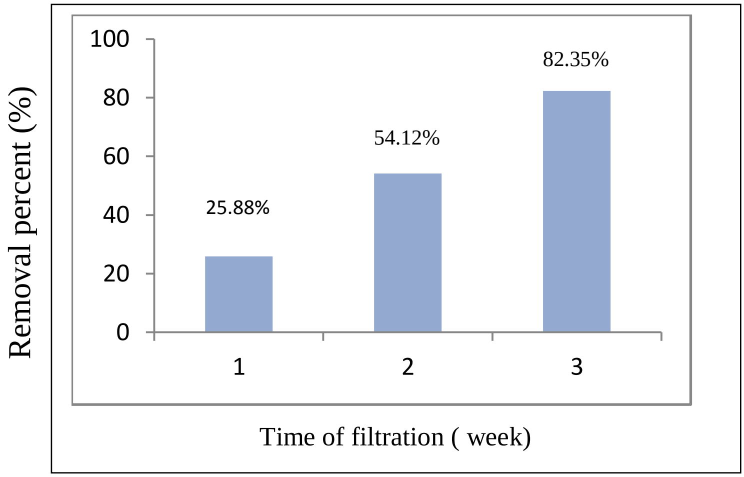

Figure 7: The plot of percent removal of lead vs time of filtration by using activated rice husk charcoal (Site -2)

In Site-2, the removal percent of Pb was 25.88 % after treatment with activated rice husk charcoal for 1 week. After 2 weeks the removal percent of Pb increased to 54.12 % and after 3 weeks the percent removal was 82.35 %.

Percent Removal of Lead from Water Sample (Site-3) after Treatment with Activated Rice Husk Charcoal

After treating with activated rice husk charcoal, the percent removal of lead from water sample at Site-3 was studied and the results are shown in Table 9 and Figure 8.

Table 9: Percent Removal of Lead from Water Sample Site-3 after Treatment with Activated Rice Husk Charcoal

No.	Time of filtration (week)	Original weight of Pb (mg)	Weight of Lead after treatment with activated charcoal (mg)	Percent removal of Pb (%)
1	1	1.6784	1.2225	27.16
2	2	1.6784	0.7045	58.03
3	3	1.6784	0.2279	86.42

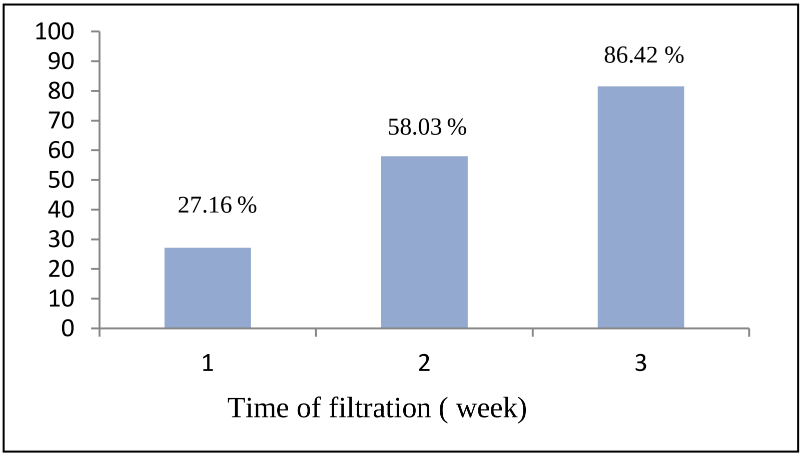

Figure 8: The plot of percent removal of lead vs time of filtration by using activated rice husk charcoal (Site-3)

In Site-3, the removal percent of Pb was 27.16 % after treatment with activated rice husk charcoal for 1 week. After 2 weeks the removal percent of Pb increased to 58.03 % and after 3 weeks the percent removal was 86.42 %.

After treatment with activated rice husk charcoal for 3 weeks the removal percent of Pb in water samples from Site-1, 2 and 3 were found to increase greater than 82 %.

Conclusion

In this research work, investigation of water quality of Mone Chaung Stream (Site-1, Site-2 and Site-3) was conducted to determine its physicochemical properties and toxic metal lead content in the water. By comparing these parameters, the water sample at Site-2 was found to be slightly polluted than other sites. According to the experimental data of DO, BOD and COD, more organic contaminants were found at Site-2 among study sites. In the study of heavy toxic metal (lead), the amount of lead percent of the water sample was slightly higher at Site-2 than other sites.

Treatment of water samples were carried out by adsorption method with activated rice husk charcoal. It was found to be observed that contaminants in all water samples were reduced after treatment. Moreover, the amount of heavy toxic metal, lead was found to be reduced to after treatment with activated rice husk charcoal.

From the study, it can be concluded that the rice husk charcoal is suitable for removal of contaminants and heavy toxic metal from water in term of low cost, natural and effective method.

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