Elemental Analysis and Removal of Lead by Using *Samanea Saman* (Jacq.) Merr. Leaves Ash

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Abstract

In this research, the leaves of *Samanea saman* (Jacq.) Merr. were collected from Mandalay University Campus, Mandalay Region. Firstly, the collected leaves sample were dried under the sunlight and it were burned until the ash. The resulted ash was sieved to 60 and 80 mesh sizes. The mineral contents in ash of *Samanea saman* (Jacq.) Merr. were determined by Energy Dispersive X-Ray Fluorescence (EDXRF) method. Moreover, the amount of trace elements was determined by using Atomic Absorption Spectrophotometric (AAS) method. In addition, moisture content and ash content in leaves sample were also determined. Ash of *Samanea saman* (Jacq.) Merr. leaves were used as the adsorbent to remove lead. The removal percentage of lead ion was determined by using complexometric titration. The effect of various sample weight on the adsorption of lead was studied by using shaking method. Finally, the adsorption effect on fixed sample weight was also determined with different shaking time.

Keywords: mineral contents, EDXRF, AAS, complexometric titration, adsorption, lead

Introduction

Heavy metals naturally occur in the environment are vital for survival, but they may become hazardous when they accumulate in organisms. A few of the most frequent heavy metals that contaminate the environment include mercury, cadmium, arsenic, chromium, nickel, copper, and lead (Saikat Mitra et al., 2019). Out of the several toxic heavy metal ions, lead is one of the most common contaminants in water from industries. (Sata Vani Yadla et al., 2012)

Atmospheric lead levels are increasing continuously because of the human activities including manufacturing, mining, and fossil fuel burning. Lead is toxic to the human body when exposed to amounts greater than the optimum. Children are at higher risk of lead poisoning; when they come into contact with dust laden with environmental lead, the severity of poisoning increases (Loh et al., 2016). A number of methods have been examined for the removal of lead from water, such as: precipitation and coagulation, sedimentation, adsorption, osmosis, filtration, ultrafiltration, ion exchange etc. Among all of these methods, adsorption process is better than other methods because of conveniences, easy operating and lower operating cost for the removal of heavy metals. (Sata Vani Yadla et al., 2012)

In this research, *Samanea saman* (Jacq.) Merr. leaves ash was used for the removal of lead ion from lead II nitrate solution.

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Botanical Description

Family name : Fabaceae
Scientific name : *Samanea saman* (Jacq.) Merr
Myanmar name : Thinbaw Kokko
English name : Rain Tree
Part of use : Leaves

Figure 1. The Plant and Leaves of *Samanea saman* (Jacq.) Merr.

Materials and Methods

Sample Collection

The leaves of *Samanea saman* (Jacq.) Merr. were collected from, Mandalay University Campus, Mandalay Region. The collected sample was dried under the sunlight and the dried leaves were burned until ash. The ash sample was sieved to 60 and 80 mesh sizes. The resulted ash sample was stored in the plastic bottle and used throughout the research work.

Figure 2. S*amanea saman* (Jacq.) Merr. dried leaves and leaves Ash

Determination of Moisture Content in the Leaves of *Samanea saman* (Jacq.) Merr.

The moisture content of leaves sample was determined by oven-drying method. The sample 1 g was placed in pre-weighed porcelain crucible. Then, it was kept in an oven at 100° C for 30 min. It was cooled in desiccator and weighed again.

The processes of heating, cooling and weighing were repeated until a constant weight was obtained.

Determination of Ash Content in the Leaves of *Samanea saman* (Jacq.) Merr.

The dried sample 2 g was placed into the pre-weighed crucible. The crucible was carefully heated in the furnace at 550° C for 2 hours, burned off without flaming or until all the carbon was eliminated. When sample were converted to white ash

powder, the crucible was cooled in a desiccator and weighed again. Heating, cooling and weighing were repeated until the constant weight was obtained.

Determination of Mineral Content in the Leaves of *Samanea saman* (Jacq.) Merr.

Mineral contents in the leaves of *Samanea saman* (Jacq.) Merr. were measured at the Department of Physics, University of Mandalay by using EDXRF (Energy Dispersive X-Ray Fluorescence Spectroscopy) method.

Quantitative Determination of Trace elements in the Leaves of *Samanea saman* (Jacq.) Merr.

The amount of trace elements in the leaves of *Samanea saman* (Jacq.) Merr. were measured at the Department of Chemistry, University of Mandalay by using Atomic Absorption Spectrophotometric (AAS) method.

Removal of Lead by Using Ash Sample (60 mesh) and (80 mesh) with various dosage

0.1 g of ash sample was mixed with 50 mL of 0.00 3 M lead (II) nitrate solution and shaken for 30 minutes at room temperature with 180 rpm. After shaking, it was filtered by using filter paper. And then, 10 mL of filtrate was used for titration to determine the remaining content of lead in the solution.

1 drop of xylenol orange indicator was added into 10 mL of filtrate in the conical flask. The color was changed from colorless to wine red and then 1 drop of 1 M HNO_3 was added to this conical flask and the color turned from wine red to yellow. In this solution, a few amount of hexamine powder was added and the color was changed from yellow to orange red. Finally, this solution was titrated with 0.0027 M EDTA, the color of the solution was changed to yellow and the end point was reached. Various dosages of 0.2 g, 0.3 g, 0.4 g and 0.5 g for ash sample (60 mesh) and (80 mesh) were carried out by using the same procedure.

Removal of Lead by Using Ash (60 mesh) and (80 mesh) with different shaking time

0.1 g of ash sample was mixed with 50 mL of 0.003 M lead (II) nitrate solution and shaken for 30 minutes at room temperature with 180 rpm. After shaking, it was filtered by using filter paper. And then, 10 mL of filtrate was used for titration to determine the remaining content of lead in the solution.

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RESULTS AND DISCUSSION

Moisture Content in Leaves of *Samanea saman* (Jacq.) Merr.

The moisture content in leaves of *Samanea saman* (Jacq.) Merr. was determined and the results were presented in table 1.

Table 1. Moisture Content in Leaves of *Samanea saman* (Jacq.) Merr.

No.	Wt. of sample (g)	Wt. of loss(g)	Moisture (%)
1.	1.00	0.52	52
2.	1.00	0.49	49
3.	1.00	0.49	49

According to this table, moisture content in leaves of *Samanea saman* (Jacq.) Merr. is 49%.

Ash Content in Leaves of *Samanea saman* (Jacq.) Merr.

The ash content in leaves of *Samanea saman* (Jacq.) Merr. was determined and the results were presented in table 2.

Table 2. Ash Content in Leaves of *Samanea saman* (Jacq.) Merr.

No	Wt. of sample (g)	Wt. of loss (g)	Ash (%)
1	2.00	0.06	3
2	2.00	0.08	4
3	2.00	0.08	4

According to table 2, the ash content in leaves of *Samanea saman* (Jacq.) Merr. is 4%.

Mineral Contents in the Ash of *Samanea saman* (Jacq.) Merr.

The mineral contents in the ash of *Samanea saman* (Jacq.) Merr. was determined by using EDXRF method and the results were presented in table 3.

Table 3. Mineral Contents in Ash of *Samanea saman* (Jacq.) Merr. Leaves

No.	Elements	Symbols	Result (Mass %)
1.	Potassium	K	25.440
2.	Chlorine	Cl	9.179
3.	Calcium	Ca	7.962
4.	Phosphorus	P	3.057
5.	Iron	Fe	1.120
6.	Silicon	Si	1.056
7.	Aluminum	Al	0.687
8.	Sulfur	S	0.403
9.	Lead	Pb	0.006

Table 3. shows some of elements K, Cl, Ca, P, Fe, Si, Al, S, and Pb were found in the ash of *Samanea saman* (Jacq.) Merr. Among them, potassium percent is the highest amount in the ash sample whereas lead percent is lowest.

Amount of Trace elements in the Ash of *Samanea saman* (Jacq.) Merr. Leaves

Amount of trace elements in the ash of *Samanea saman* (Jacq.) Merr. was determined by using Atomic Absorption Spectrophotometric (AAS) method and the results were presented in table 4.

Table 4. Amount of Trace elements in the Ash of *Samanea saman* (Jacq.) Merr. Leaves

No	Element	Symbol	Concentration (mg/L)
1	Potassium	K	873.6
2	Calcium	Ca	511.1
3	Iron	Fe	78.44
4	Lead	Pb	0.649

Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (60 mesh) with Various Weight of Sample

The effect of sample weight on the adsorption of lead by shaking method was studied and the results were shown in Table 5 and Figure 3.

Table 5. Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (60 mesh) with various weight of sample

No	Weight of sample (g)	Initial Weight of Lead (mg/50mL)	Remaining Weight of Lead (mg/50mL)	Removal Weight of Lead (mg/50mL)	Percent Removal of Lead (%)
1	0.1	6.7136	6.3778	0.3358	5.00
2	0.2	6.7136	5.7065	0.7584	15.00
3	0.3	6.7136	5.4268	1.2868	19.17
4	0.4	6.7136	4.8114	1.9022	28.33
5	0.5	6.7136	4.0282	2.6854	39.99

Shaking Time = 30minutes, Shaking Rate = 180 rpm

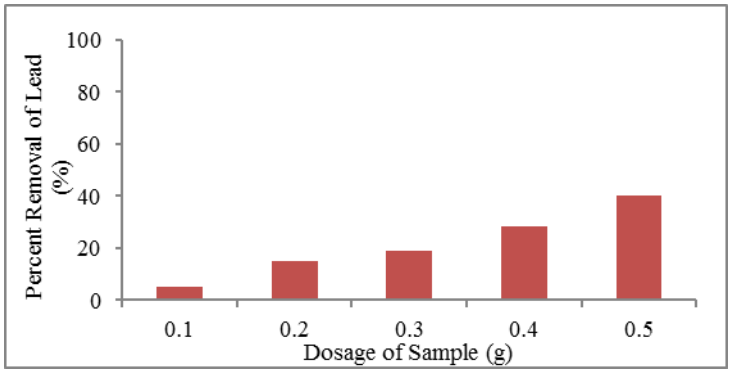

Figure 3. Plot of dosage of sample (g) Vs percent removal of lead (%)

According to Table 5 and Figure 3, it was found that the percent removal of lead was increased with increasing the dosage of sample weight (g).

Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr. Leaves (80 mesh) with Various Weight of Sample

The effect of sample weight on the adsorption of lead by shaking method was studied and the results were shown in Table 6 and Figure 4.

Table 6. Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (80 mesh) with various weight of sample

No	Weight of sample (g)	Initial Weight of Lead (mg/50mL)	Remaining Weight of Lead (mg/50mL)	Removal Weight of Lead (mg/50mL)	Percent Removal of Lead (%)
1	0.1	6.7136	5.5947	1.1189	16.66
2	0.2	6.7136	5.2030	1.5106	22.50
3	0.3	6.7136	4.9233	1.7903	26.67
4	0.4	6.7136	3.9722	2.7414	40.83
5	0.5	6.7136	3.6925	3.0211	44.99

Shaking Time = 30minutes, Shaking Rate = 180 rpm

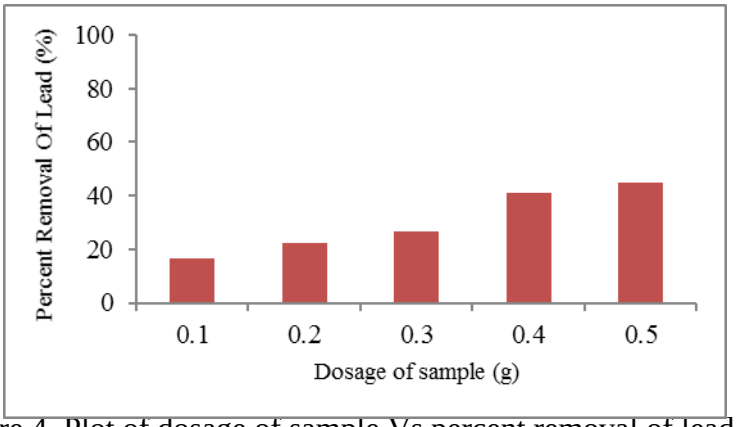

Figure 4. Plot of dosage of sample Vs percent removal of lead (%)

According to Table 7 and Figure 4, it was found that the percent removal of lead was increased with increasing the dosage of sample weight.

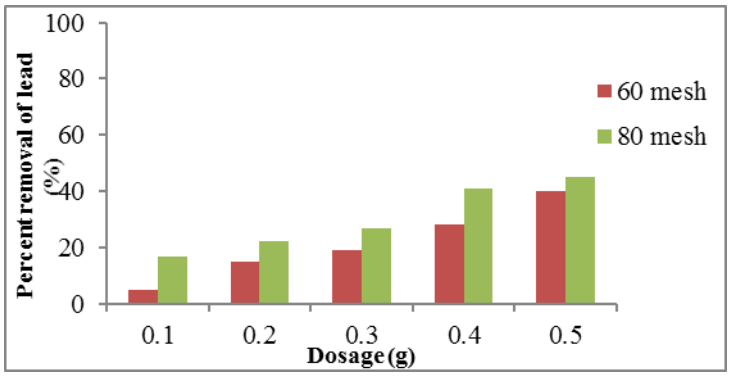

Figure 5. Comparison of percent removal of lead with different mesh sizes

According to these results, the percent removal of lead for 60 and 80 mesh sizes increased with increasing the sample weight. It was found that 80 mesh size of ash sample was better than 60 mesh size.

Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (60 mesh) with Different Shaking Time

The effect of shaking time on the adsorption of lead was studied and the results were shown in Table (7) and Figure (6).

Table 7. Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (60 mesh) with different shaking time

No	Weight of sample (g)	Shaking Time (hr)	Initial Weight of Lead (mg/50mL)	Remaining Weight of Lead (mg/50mL)	Removal Weight of Lead (mg/50mL)	Percent Removal of Lead (%)
1	0.1	00:30	6.7136	6.3778	0.3358	5.00
2	0.1	1:00	6.7136	5.6506	1.0630	15.83
3	0.1	1:30	6.7136	5.2589	1.4547	21.67
4	0.1	2:00	6.7136	4.4757	2.2379	33.33
5	0.1	2:30	6.7136	3.9722	2.7414	40.83
6	0.1	3:00	6.7136	3.5246	3.1890	47.50

Shaking Rate = 180 rpm

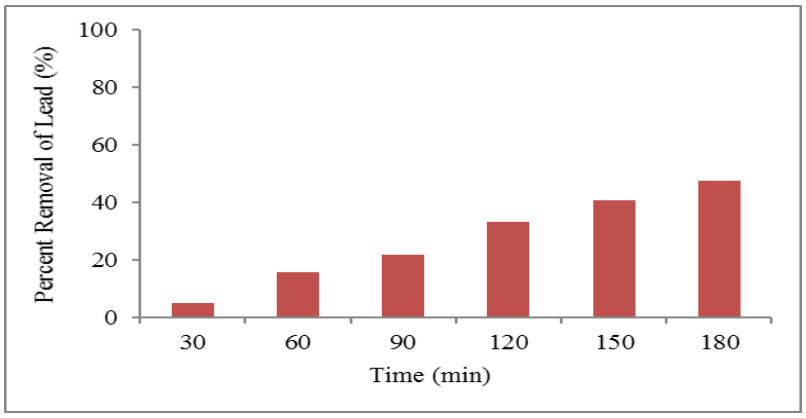

Figure 6. Plot of time (min) Vs percent removal of lead (%)

According to Table 7 and Figure 6, it was found that the percent removal of lead was increased with increasing the shaking time.

Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leave (80 mesh) with Different Shaking Time

The effect of shaking time on the adsorption of lead was studied and the results were shown in Table (8) and Figure (7).

Table 8 Removal of Lead by Using Ash of *Samanea saman* (Jacq.) Merr Leaves (80 mesh) with Different Shaking Time

No	Weight of sample (g)	Shaking Time (hr)	Initial Weight of Lead (mg/50mL)	Remaining Weight of Lead (mg/50mL)	Removal Weight of Lead (mg/50mL)	Percent Removal of Lead (%)
1	0.1	0:30	6.7136	5.5947	1.1189	16.66
2	0.1	1:00	6.7136	5.3709	1.3427	19.99
3	0.1	1:30	6.7136	4.5876	2.1260	31.67
4	0.1	2:00	6.7136	4.0281	2.6855	40.00
5	0.1	2:30	6.7136	3.6925	3.0211	44.99
6	0.1	3:00	6.7136	3.0211	3.6925	55.00

Shaking Rate = 180 rpm

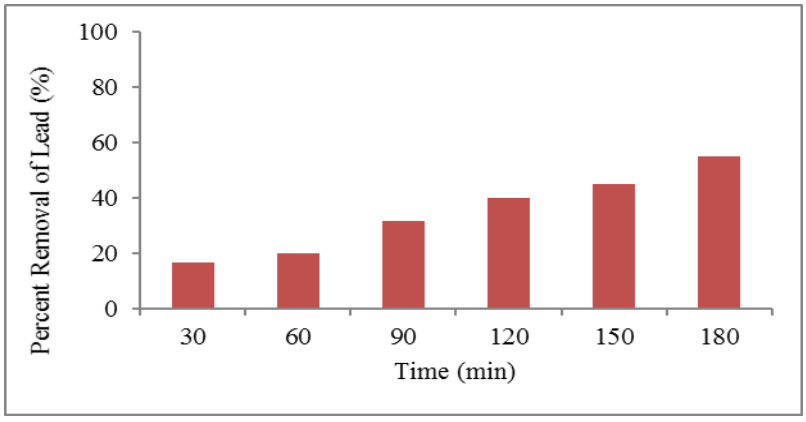

Figure 7. Plot of time (min) Vs percent removal of lead (%)

According to Table 8 and Figure 7, it was found that the percent removal of lead was increased with increasing the shaking time.

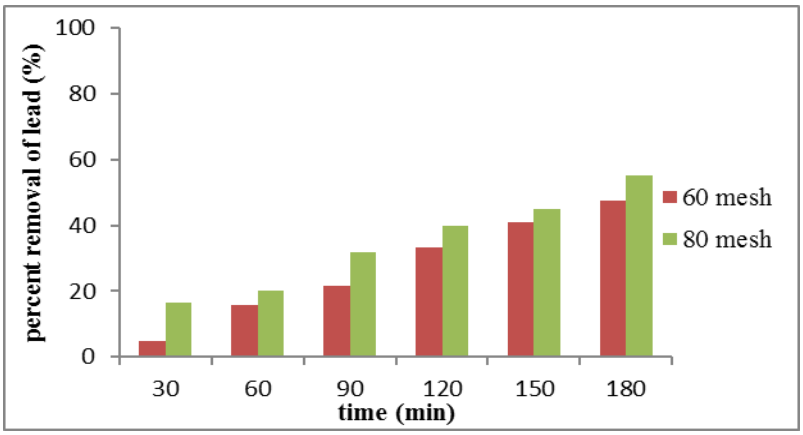

Figure 8. Comparison of percent removal of lead with different shaking time

According to these results, the percent removal of lead with 60 and 80 mesh sizes of ash sample increased with increasing shaking time. It was found that 80 mesh was better than the 60 mesh size.

Conclusion

The leaves of *Samanea saman* (Jacq.) Merr. was collected from Mandalay University campus, Mandalay Region. The collected leaves sample were dried under the sunlight and it were burned until the ash. The ash sample was sieved to obtain two different mesh sizes (60 and 80).

The elemental contents of ash were determined by EDXRF and AAS methods. According to the EDXRF and AAS results, amount of potassium is highest in ash sample whereas lead percent is the lowest. Potassium percent is 25.440 % and the amount of potassium is 873.6mg/L. Lead percent is 0.006 % and the amount of lead is 0.649 mg/L. The nutritional composition such as ash (4%) and moisture (49%) contained in the leaves sample.

The removal properties of lead ion on ash sample was carried out with various dosage and different shaking time methods for two different mesh sizes. According to experimental data, the percent removal of lead ion increased with increasing the dosage of sample and shaking time. Moreover, it was found that the smaller the size of the selected sample, the more adsorption property of lead on the surface occurred. Therefore, the percent removal of lead ion with 80 mesh size of ash sample is better than 60 mesh size.

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