Trace Elements Analysis of Sediment in Ayeyarwady River from Magway Region

AYE AYE MYINT[1], THAN THAN YEE[2], KYI WAR YI LWIN[3]
[1] *Associate Professor, Department of Physics, Kyaukse University*
[2] *Lecturer, Department of Botany, Kyaukse University*
[3] *Assistant Lecturer, Department of Botany, Pakoku University*

Abstract- ***In this research paper, Ayeyarwady River Sediments samples 1(RS-1), River Sediments sample 2(RS-2), River Sediments sample 3 (RS-3) and River Sediments sample 4 (RS-4) were collected from Magway region and analyzed to determine the elemental concentration by using Energy dispersive x-rays fluorescence (EDXRF) analysis. It was found that there are 16 element oxides such as*** Al_2O_3, SiO_2, SO_3, K_2O, CaO, TiO_2, Cr_2O_3, MnO, Fe_2O_3, NiO, CuO, ZnO, Rb_2O, SrO, ZrO_2, Y_2O_3 ***in the four River Sediment samples, The value of pH and conductivity were also measured. These result values were compared and discussed.***

Indexed Terms- ***River, Sediment, EDXRF, pH, conductivity***

I. INTRODUCTION

Most rivers are efficient conveyors of water and sediment from their headwaters to the sea, as discovered nearly 2500 years ago. The Amazon presently contributes 20 percent of all fresh water brought by rivers to the sea and carries on average approximately 1200 million tons of sediment to the Atlantic each year. Sediment is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice, or by the force of gravity action on the particles. Sediments are most often transported by water (fluvial processes), but also wind (Aeolian processes) and glaciers. Beach sands and river channel deposits are examples of fluvial transport and deposition, though sediment also often settles out of slow-moving or standing water in lakes and oceans.

Rivers draining densely populated and industrialized areas carry huge loads of heavy metals fixed to their suspended matter.

The behavior of these heavy metals in the transition from fresh water to sea water is not well understood. In the euphotic zone of the marine environment, the photosynthetic planktonic population comes into contact with some part of these solids, the composition of which again is not well yet worldwide basis. Eventually, these inorganic solids together with a proportion of the biomass settle out and are incorporated in to marine sediments. Investigations of sediments in estuaries and rivers have been stepped up in recent years in order to study mobilization and mixing effects nd to trace down the extent and distribution of heavy metal contamination.

Both with respect to environmental and geochemical problems, the suspended phase are a very important component of estuaries and oceans. Heavy metals, which are often concentrated in the particulate phase, belong doubtlessly to the most toxic pollutants in the environment.

Aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity. In the future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than for terrestrial ecosystems. Sediments form a natural buffer and filter system in the material cycles of water. Sediment in our rivers is an important habitat as well as a main nutrient source for aquatic organisms. Sediment strata serve as an important habitat for the benthic macro invertebrates whose metabolic activities contribute to aquatic productivity. Sediment is also the major site for organic matter decomposition which is largely carried out by bacteria. Important macro-nutrients are

continuously being interchanged between sediments and overlying water. Furthermore, sediment has an impact on ecological quality, because of their quality, or their quality, or both. It is observed that continuous accumulation of pollutants due to biological and geochemical mechanisms, and cause toxic effect on sediment dwelling organisms and fish, resulting in decrease survival, reduced growth, or impaired reproduction and lowered species diversity. Alkalinity may be caused by dissolved strong bases such as sodium hydroxide or potassium hydroxide (and other hydroxide containing compounds), and it may also be caused by dissolved carbonates, bicarbonates, borates and phosphates.

II. MATERIALS AND METHODS

Ayeyarwady River Sediment samples: River Sediment sample 1 (RS-1), River Sediment sample 2 (RS-2), River Sediment sample 3 (RS-3) and River Sediment sample 4 (RS-4), were collected from Magway region area. River Sediment sample 1 and sample 2 were collected from near the Myathalon pagoda, Magway Township. River Sediment sample 3 and 4 were collected from away from the Minbu Bridge, Minbu Township.

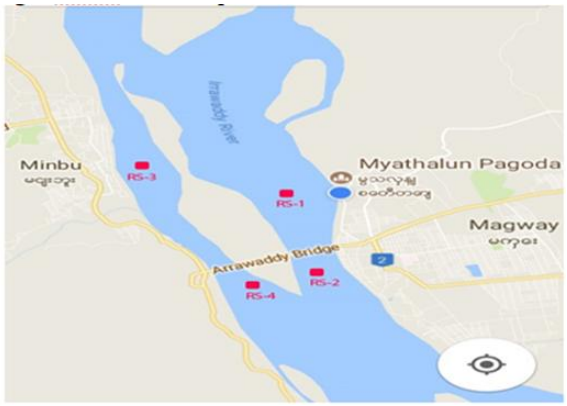

Figure (1) The photograph of samples location

River Sediment samples were collected in good quality glass container of (50) grams capacity without any air bubbles. The glass container were cleaned with nitric acid and dried. The glass container were tightly sealed after collection and labeled. Each River Sediment samples were prepared for energy dispersive X-rays fluorescence (EDXRF) analysis. The X-ray Fluorescence analysis system consist of Si (Li) detector with personal computer and X-rays analysis software and also used preamplifier and amplifier are used in experimental measurement. The value of pH and Conductivity were determined using pH meter and conductivity meter (Ecoscan Con 5) at Department of Chemistry, University of Mandalay.

III. EXPERIMENTAL RESULTS AND DISCUSSION

The concentrations of the elements of the Sediment samples were determined by EDXRF technique. The results were shown in following tables.

TABLE (1) THE ELEMENT OXIDES PRESENT IN TWO KINDS OF SAMPLES (MAGWAY)

No	Elements Oxide	Concentration (%)	
		RS-1 (Sample 1)	RS-2 (Sample 2)
1	SiO_2	79.908	73.565
2	Al_2O_3	13.232	16.870
3	Fe_2O_3	2.418	4.348
4	K_2O	1.884	1.827
5	CaO	1.128	1.516
6	SO_3	0.685	0.722
7	TiO_2	0.567	0.888
8	Cr_2O_3	0.051	0.074
9	MnO	0.045	0.083
10	ZrO_2	0.034	0.064
11	SrO	0.018	0.020
12	CuO	0.011	ND
13	Rb_2O	0.009	0.003
14	NiO	0.005	0.008
15	ZnO	0.004	0.007
16	Y_2O_3	0.002	0.004

TABLE (2) THE ELEMENT OXIDES PRESENT IN TWO KINDS OF SAMPLES (MINBU)

No	Element Oxide	Concentration (%)	
		RS-3 (Sample 3)	RS-4 (Sample 4)
1	SiO_2	67.144	67.483
2	Al_2O_3	22.133	21.365
3	Fe_2O_3	6.193	6.145
4	K_2O	1.988	2.144
5	CaO	0.918	1.102
6	SO_3	0.573	0.683

7	TiO_2	0.783	0.768
8	Cr_2O_3	0.053	0.037
9	MnO	0.130	0.125
10	ZrO_2	0.029	0.027
11	SrO	0.014	0.019
12	CuO	ND	0.016
13	Rb_2O	ND	0.013
14	NiO	0.016	0.015
15	ZnO	0.010	0.010
16	Y_2O_3	0.005	0.003
17	V_2O_5	0.030	0.030
18	Ag_2O	ND	0.013

TABLE (3) AMOUNT OF TRACE ELEMENT OXIDES IN SAMPLES (MAGWAY)

No	Elements Oxide	Concentration (%)	
		RS-1 (Sample 1)	RS-2 (Sample 2)
1	SrO	0.018	0.020
2	CuO	0.011	ND
3	Rb_2O	0.009	0.003
4	NiO	0.005	0.008
5	ZnO	0.004	0.007
6	Y_2O_3	0.002	0.004

TABLE (4) AMOUNT OF TRACE ELEMENT OXIDES IN SAMPLES (MINBU)

No	Elements Oxide	Concentration (%)	
		RS-3(Sample 3)	RS-4(Sample 4)
1	SrO	0.014	0.019
2	CuO	ND	0.016
3	Rb_2O	ND	0.013
4	NiO	0.016	0.015
5	ZnO	0.010	0.010
6	Y_2O_3	0.005	0.003
7	Ag_2O	ND	0.013

TABLE (5) AMOUNT OF TRACE TOXIC ELEMENT OXIDES IN SAMPLES (MAGWAY)

No	Element Oxide	The amount determined (%) (RS-1)	The amount determined (%) (RS-2)
1	Cr_2O_3	0.051	0.074
2	Rb_2O	0.009	0.003

TABLE (6) AMOUNT OF TRACE TOXIC ELEMENT OXIDES IN SAMPLES (MINBU)

No	Element Oxide	The amount determined (%) (RS-3)	The amount determined (%) (RS-4)
1	Cr_2O_3	0.053	0.037
2	Rb_2O	ND	0.013

TABLE (7) THE CONDUCTIVITY AND PH VALUES OF FOUR DIFFERENT SAMPLES

No	Samples code name	Conductivity (μS/cm)	pH value
1	RS-1	76.3	8.0
2	RS-2	79.6	8.2
3	RS-3	80.0	8.0
4	RS-4	84.5	8.9

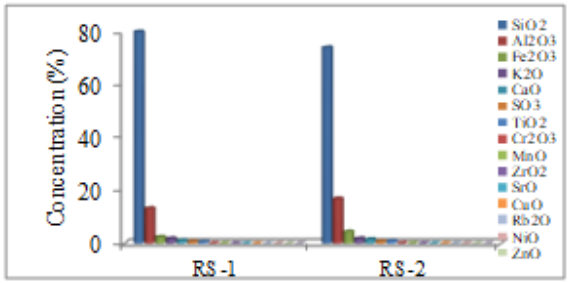

Figure (1) Concentration of element oxides in samples (Magway)

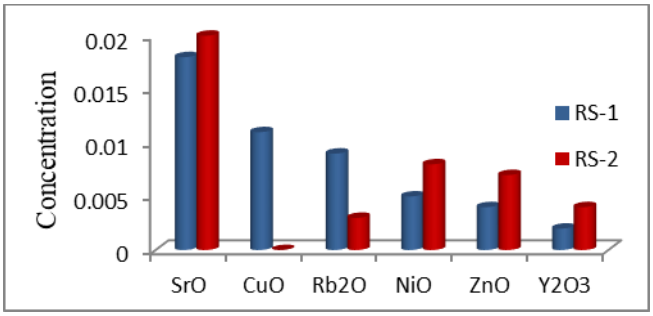

Figure (2) Concentration of trace element oxides in samples (Magway)

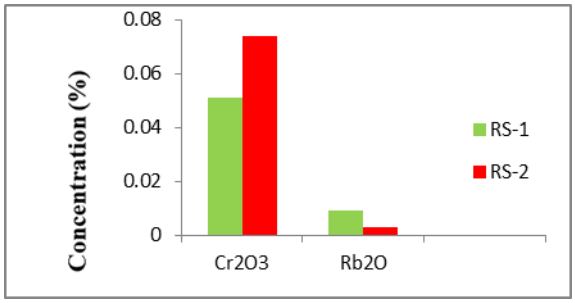

Figure (3) Concentration of trace toxic element oxides in samples (Magway)

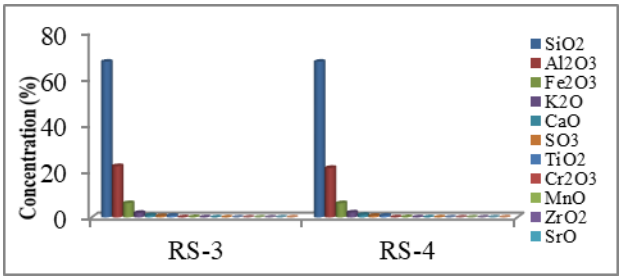

Figure (4) Concentration of element oxides in samples (Minbu)

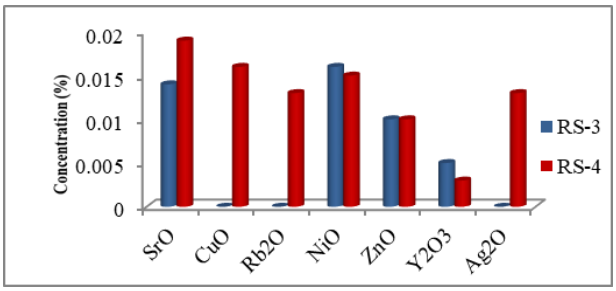

Figure (5) Concentration of trace element oxides in samples (Minbu)

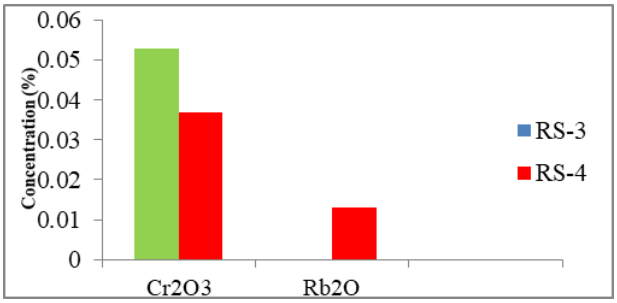

Figure (6) Concentration of toxic element oxides in samples (Minbu)

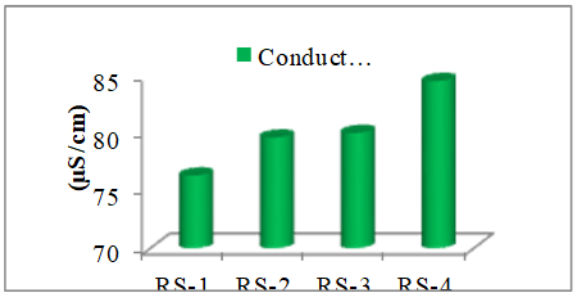

Figure (7) The Conductivity of different river sediment samples

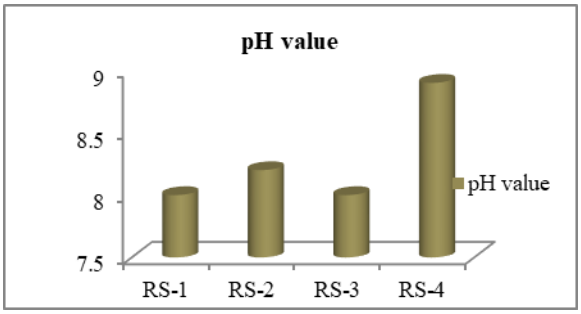

Figure (8) The pH values of different river sediment samples

Ayeyarwady River Sediment samples: River Sediment sample 1 (RS-1), River Sediment sample 2 (RS-2), River Sediment sample 3 (RS-3) and River Sediment sample 4 (RS-4), were collected from Magway region area.

The elements that contain in two kinds of samples of (Magway and Minbu) were analyzed by using Energy Dispersive X-Ray Fluorescence (EDXRF) method. Most elements can exist as element oxides in sediment. Among the elements having atomic number 11 to 92, it was found that there are 16 element oxides such as Al2O3, SiO2, SO3, K2O, CaO, TiO2, Cr2O3, MnO, Fe2O3, NiO, CuO, ZnO, Rb2O, SrO, ZrO2, Y2O3, in the River Sediment sample 1 (RS-1). However, River Sediment sample 2 (RS-2) contains 15 element oxides that are found in RS-1. CuO is not found in RS-2. The element oxides present in the samples were described in Table (1) as the order of high to low concentration.

Eighteen element oxides such as Al2O3, SiO2, SO3, K2O, CaO, TiO2, V2O5, Cr2O3, MnO, Fe2O3, NiO, CuO, ZnO, Rb2O, SrO, ZrO2, Ag2O, Y2O3 are found in the River Sediment sample 4 (RS-4). However, River Sediment sample 3 (RS-3) contains 15 element oxides that are found in RS-4. CuO, Rb2O and Ag2O are not found in RS 3. The element oxides present in the samples were described in Table (2) as the order of high to low concentration.

Trace element oxides present in samples RS-1, RS-2 of Magway were also determined. It was found that SrO, Cuo, Rb2O, NiO, ZnO and Y2O3 were present in the samples and described in Table (3) and Figure (2).

Trace element oxides present in samples RS-3, RS-4 of Minbu were also determined and it was found that SrO, Cuo, Rb2O, NiO, ZnO, Y2O3 and Ag2Owere present in the samples and described in Table (4) and Figure (5).

Some trace toxic element oxides present in samples RS-1, RS-2 of Magway were also determined and it was found that Cr2O3 and Rb2O were present in the samples and described in Table (5) and Figure (3).

Some trace toxic element oxides present in samples RS-3, RS-4 of Minbu were also determined and it was found that Cr2O3 and Rb2O were present in the samples and described in Table (6) and Figure (6).

The pH values of Ayeyarwady River Sediment samples are shown in Table(7).The pH values of River Sediment sample 1 (RS-1), River Sediment sample 2 (RS-2), River Sediment sample 3 (RS-3) and River Sediment sample 4 (RS-4) are found to be 8.0, 8.2, 8.0 and 8.9 respectively. RS-1 and RS-3 show the lowest value of pH (8.0). River Sediment sample 4 (RS-4) has the highest value of pH (8.9).

The Conductivity of Ayeyarwady River Sediment samples are presented in Table (7). Conductivity values range from 76.3-84.5mS/cm. Ayeyarwady River Sediment sample 1 (RS-1) has lowest conductivity value (76.3 mS/cm). The Ayeyarwady River Sediment sample 4 (RS-4) has highest conductivity value (84.5 mS/cm).

IV. CONCLUSION

In this paper, the quantitative data are measured by the EDX-7000 software, which is used in the calibration system with the internal standards. These data obtained in the samples were not considered on the organic compounds.

Four Ayeyarwady River Sediment samples (RS-1, RS-2, RS-3 and RS-4) were chosen for the study from Magway region area.

RS-4 sample contains eighteen element oxides such as Al2O3, SiO2, SO3, K2O, CaO, TiO2, V2O5, Cr2O3, MnO, Fe2O3, NiO, CuO, ZnO, Rb2O, SrO, ZrO2, Ag2O, Y2O3. RS-1 sample contains sixteen element oxides (except V2O5 and Ag2O). RS-2 sample contains sixteen element oxides (except CuO, V2O5 and Ag2O). RS-3 sample contains sixteen element oxides (except CuO, Rb2O and Ag2O). The elements found in four Ayeyarwady River Sediment samples are very valuable macro and micro elements for plant growth.

One of the plants' nutrient, potassium (K) in four sediment samples are 1.884%, 1.827%, 1.988% and 2.144%. This means that the selected sediment samples can supply potassium nutrient to the plants. Among the four samples, RS-4 can support more potassium than that of others.

For agriculture, maximum permissible value of soil pH is 7.5-8.5. The pH values of four Ayeyarwady River Sediment samples are found to be 8.0-8.94.

For agriculture, the suitable conductivity is 100 mS/cm. Conductivity values of Ayeyarwady River Sediment samples are found to be 76.3-84.5 mS/cm. Therefore, conductivity values of four sediments samples fall in suitable conductivity value.

In Magway region, for toxic elements, the amounts of rubidium of River Sediment sample RS-1 are higher than that of River Sediment sample RS-2. Chromium contents of River Sediment sample RS-2 are higher than that of River Sediment sample RS-1. Strontium contents, River Sediment sample RS-2 are higher than that of River Sediment sample RS-1.

In Minbu region, for toxic elements, rubidium is not found in River Sediment sample RS-3. River Sediment sample RS-4 was detected. Chromium contents of River Sediment sample RS-3 is higher than that of River Sediment sample RS-4. Strontium contents of River Sediment sample RS-4 are higher than that of River Sediment sample RS-3.

From the above data, Magway samples contain more toxic elements than Minbu township sample.

From the point of view of elemental concentration, pH and conductivity, the four selected Ayeyarwady River Sediment samples are found to be used for the suitable to grow agriculture purpose.

Among these four Ayeyarwady River Sediment samples, the quality of Ayeyarwady River Sediments sample 3 (RS-3) is better than others.

V. ACKNOWLEDGEMENT

I would like to express my special thanks to Dr Aung Khin Myint, Rector, Kyaukse University to allow to present this research. My sincere thanks are due to Dr Cherry Than, Professor and Head, Department of Physics, Kyaukse University for her kind encouragements throughout the research.

REFERENCES

[1] Agarwal, B. K., X-ray Spectroscopy: An Introduction (Heidelberg: Springer-Verlag, (1979).

[2] Biddle, M. B. et al., Nuclear Instrument and Methods in Physics Research, B 251 (2012) 117.

[3] Joshi S. K., B. D Shrivastsva & A. P. Deshpande, X-ray Spectroscopyand Allied Areas (New Youk : Narosa), (1998).

[4] Campbell, I. et al., The Use of EDXRF for Pharmaceutical Material Elemental Analysis, American Pharmaceutical review, (2012).

[5] Shimadzu 2002 User Manual of Shimadzu EDX-700 X-ray Spectrometer Universities Research Centre, Yangon University