

# Quality Assessment of Contaminated Sediments from Flooded Areas of Mrauk – U Township, Rakhine State

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**Abstract** - This research is concerned with the remediation of contaminated sediments from the flooded areas, Maheingyi Lake and Paungwa Lake of Mrauk-U Township in Rakhine State. The two sediment samples were collected in January, 2019. The investigative analyses were done in terms of distribution of some heavy metals in the sediment samples and microbiological properties of sediments. Distribution of some elements in the sediment samples were determined by EDXRF. The quantitative elemental analysis of the sediment samples were determined by AAS. Lead concentrations of the both sampling sites were not detected and those of Cadmium , Arsenic and Iron were (0.128,0.126) ppm, (0.170 , 0.344) ppm and (39.54 , 39.29 ) ppm, respectively. Microbiological properties of sediments were examined by using 3M Petri Films. Overall valuable of study areas indicated that the iron was in high level in the contaminated samples. Contaminated sediment was treated by In Situ capping method using lime amendment and sand- cap . This method has shown the significant removal percent of iron (60.17%) to (60.24%) compare with control (without amendment ) system. This remediation method can be benefit for rural area as in cost effective and locally available technique.

Keywords - contaminated sediment, flooded area, EDXRF, AAS, heavy metals, In Situ capping method, microbiological properties

## I. INTRODUCTION

The main purpose of this paper is to provide a review on the In Situ remediation technology of heavy metal in sediment (Jian-feng Peng *et al* ., 2009). Widespread accumulations of flood sediments were left behind in Mrauk-U Township after the flood waters (EPA, 2006) . The main purpose of this paper is to provide a review on the In Situ remediation technology of heavy metal in sediment (Jian-feng Peng *et al* ., 2009). The contamination of aquatic sediments with metals is a widespread environmental and human health problem (Ata Akcil *et al.*, 2015).

Heavy metals from various sources can enter a natural aquatic system after flood waters. Heavy metal contamination has become a worldwide problem through disturbing the normal functions of river and lakes. Heavy metals usually possess significant toxicity to aquatic organisms and then effect human health from food chain (Jian-feng Peng *et al* ., 2009).

Sediment, as the largest storage and resources of heavy metal, plays a rather important role in metal transformations . Heavy metals cannot fix in sediment forever. With the variation of the physical-chemical characteristics of water conditions, part of these fixed metals will re-enter the overlying water (Jian-feng Peng *et al* ., 2009).

Conventional remediation strategies include in-place sediment remediation strategies such as In Situ- capping and relocation actions are still widely applied (Ata Akcil *et al* ., 2015). This remediation technique can only reduce

the transfer rate of metal in sediment, while their immobilization effect for heavy metal is small.

## II. MATERIALS AND METHODS

### A. Collection for Flooded Sediment Samples

The study area is located at Mrauk-U Township in Rakhine State. Its geographical coordination is 20°35' 18" North Latitude and 93°35' 11" East Longitude. It is conducted in January , 2019.

The sediment samples were collected from two sampling sites at Mrauk-U Township in Rakhine State. These sites are not far from each other. They were shown in Figures (1) and (2). Maheingyi Lake are located about North Latitude 20°35' 18" and about East Longitude 93°11' 11" . Paungwa Lake are located about North Latitude 20°35' 30" and about East Longitude 93°11' 12" . These samples were taken from the depth of 10 centimeter of sediment surface in a zigzag manner by using GPS (Global Positioning System) . Then mixed thoroughly to homogenize and put it into the plastic bottle . Sediment samples were carried to the laboratory and kept in cold and dark place.



Fig 1 The photograph of Maheingyi Lake



Fig 2 The photograph of Paungwa Lake

### B. Determination of Trace Elements in Sediment Samples by Atomic Absorption Spectrometry

0.1 g of air-dried sediment sample was placed in an Erlenmeyer flask. 20 mL of extracting solution (0.05 M HCl + 0.0125 M H<sub>2</sub>SO<sub>4</sub>) was added in a mechanical shaker and shaken for 15 minutes. Then the solution was filtered into a 50 mL volumetric flask through filter paper and diluted to 50 mL with extracting solution.

The standard solution having the varying strength was sprayed into the gas flame of Atomic Absorption Spectrometer.

At least three known concentration of each standard metal solution were selected. These should be one concentration greatest and one less than that expected ppm range in the sample. Each standard solution was aspirated in turn into the gas flame and recorded the absorbance from the display. By using the calibration curve of the three standards, the concentrations of sample were read out. The results are presented in Table (2).

### C. Experimental Design for In Situ Remediation

In order to determine removal efficiency of amendment, eight beakers were prepared. The experiments were completely arranged in 8 different series (I, II, III, IV, V, VI, VII, and VIII) and three replication of each treatment. Each vessel was filled by sediment sample (50g) at the bottom. The collected water sample from respective sampling site was added into all vessels. Lime powder (10 g) was added to the four vessels (I, II, III, IV) and marked as tested sample. The other four vessels (V, VI, VII and VIII) were filled no amendment and design as control sample. All the samples were kept in cold and dark place for one week.

The sand sample, lower the release content of heavy metal, was collected from Sittway Beach near Sittway Hotel in Rakhine State. The collected sand was washing with distilled water (three times), 1% sulphuric acid, and dried under the sunlight. The obtained dry sand (10 g) was filled to cover the tested sample (I, II, III, IV) and control sample (V, VI, VII, VIII). All the samples were capped as the similar manner that is described above for one week.

After two weeks experiment, the sediment sample was collected to determine the removal percentage of Fe metal using AAS Table (4).

## III. RESULTS AND DISCUSSION

### A. Qualitative Elemental Analysis of Sediment Samples by EDXRF

Relative abundances of elements in sediment samples were determined by EDXRF spectrometer. The EDXRF spectra of sediment samples are shown in Figures (3) and (4). The results are recorded in Table (1). It can be observed that the sediment samples of Maheingyi Lake contained Si (9.642%), Al (3.437%) and Fe (1.232%), respectively. 9.245%, 3.996% and 1.107% of Si, Al and Fe were contained in the Paungwa Lake. A small amount of other elements, K, Ti, Ca, Mn,

Zr, V, Cu, Zn, Cr, Rb, Sr, Ni and Y were also found in these samples.

TABLE I  
RELATIVE ABUNDANCE OF ELEMENTS IN SEDIMENT SAMPLES BY EDXRF

No.	Element	Relative Abundance (%)	
		Maheingyi Lake	PaungwaLake
1.	Si	9.642	9.245
2.	Al	3.437	3.996
3.	Fe	1.232	1.107
4.	K	0.600	0.700
5.	Ti	0.142	0.144
6.	Ca	0.041	0.025
7.	Mn	0.013	0.012
8.	Zr	0.007	0.007
9.	V	0.006	0.006
10.	Cu	0.003	0.004
11.	Zn	0.004	0.003
12.	Cr	0.006	0.003
13.	Rb	0.003	0.003
14.	Sr	0.003	0.002
15.	Ni	0.002	0.001
16.	Y	0.001	0.001

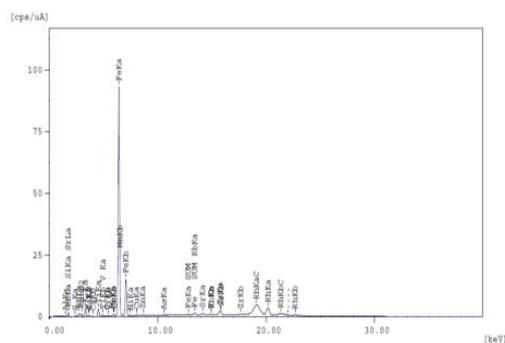


Fig 3 EDXRF spectrum of sediment sample from Maheingyi Lake

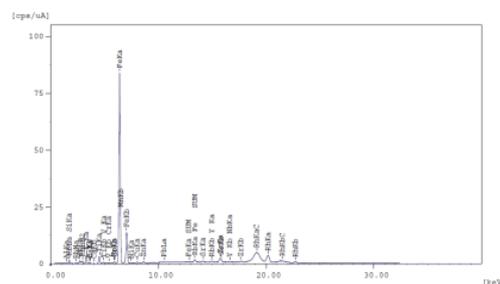


Fig 4 EDXRF spectrum of sediment sample from Paungwa Lake

### B. Determination of Heavy Metal in the Sediment Samples by Atomic Absorption Spectrophotometry

In this research, atomic absorption spectrophotometer (Perkin-Elmer) was employed for the determination of heavy metals in the collected sediment samples.

The contents of heavy metals in the collected sediment samples are shown in Table(2) and Figure (5). Lead concentrations of the both sampling sites were not detected and those of Cadmium , Arsenic and Iron were (0.128 , 0.126) ppm, (0.170,0.344) ppm and (39.54 , 39.29 ) ppm, respectively .The level of Iron in these study areas were above the permissible limit set by the World Health Organisation (1-3) ppm.

TABLE II

SOME HEAVY METAL CONTENTS OF THE COLLECTED SEDIMENT SAMPLES FROM MAHEINGYI LAKE AND PAUNGWA LAKE BY AAS

No.	Heavy Metals	Concentration (ppm)	
		Maheingyi Lake (ML)	Paungwa Lake (PL)
1	Cd	0.128	0.126
2	Pb	ND	ND
3	As	0.170	0.344
4	Fe	39.54	39.29

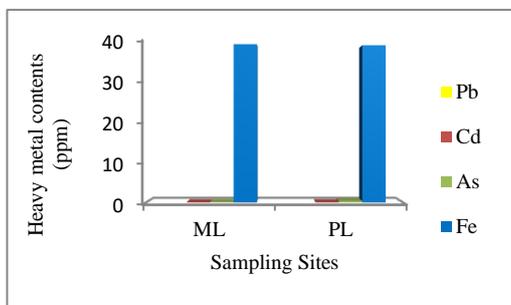


Fig 5 Diagram of some heavy metal contents of the collected sediment samples

### C. Determination of Total Coliform and E.coli in the Sediment Samples

In this research, 3 M Petri Film was used for the microbiological test of the collected sediment samples.

Total Coliform and *E.coli* contents of the collected sediment samples are shown in Table (3). Total Coliforms of ML and PL were (35, 21) cfu g<sup>-1</sup>. Total Coliforms of these two lakes were below the permissible limit of AOAC standard. However, *E.coli* was not detected in both sites.

TABLE III

COLIFORMS AND *E.COLI* CONTENTS OF THE COLLECTED SEDIMENT SAMPLES

No.	Sediment Sample	Coliform (cfu/g)	<i>E.coli</i> (cfu/g)
1	ML	35	ND
2	SL	21	ND

### D. Determination of Removal Percent of Iron in the Collected Sediment Samples by using In Situ Capping Method

In Situ capping method was used for the determination of removal percent of Iron in ML and PL.

Removal Iron percents of the two study areas are shown in Table (4) and Figure (6). Removal Iron percent of ML and PL were 60.17% and 60.24% ,respectively. Significant removal percents of Iron can be observed in these two lakes.

TABLE IV

REMOVAL IRON PERCENT OF THE COLLECTED SEDIMENT SAMPLES BY USING IN SITU CAPPING METHOD

No.	Sediment Sample	Removal Percent of Iron (%)
1	ML	60.17
2	PL	60.24

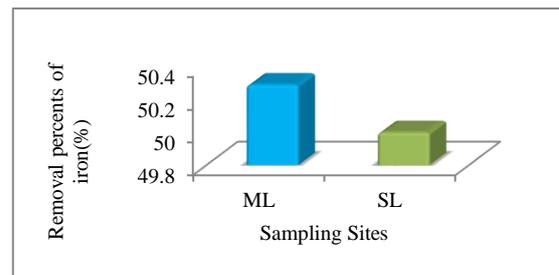


Fig 6 Diagram of removal iron percent of the collected sediment samples by using In Situ capping method

## IV . CONCLUSION

Nowadays, heavy metals pollution in river and lake sediments have gradually become a major concern worldwide. The remediation of contaminated sediment is necessary.

In this research, two lakes of flooded areas in Mrauk-U Township were used as the sampling sites. EDXRF spectra indicated that the percents of Fe(1.232%) in ML and Fe (1.107%) in PL.A small amount of other elements , K ,Ti , Ca, Mn , Zr , V ,Cu ,Zn, Cr , Rb ,Sr ,Ni and Y were also found in both sites.

From the quantitative analysis of the sediment samples, it was found that Lead concentrations of the both sampling sites were not detected and those of

Cadmium , Arsenic and Iron were (0.128 ,0.126) ppm, y(0.170,0.344) ppm and (39.54 , 39.29 ) ppm, respectively .From these data, it was found that the higher content of Fe in both sites .These data are related with EDXRF data .

From the investigation of microbiological test using 3M Petri Film, (35, 21) cfu g<sup>-1</sup> of total Coliforms were observed in ML and PL. However, *E.coli* would not be detected in both sites.

According to the results of In Situ capping method to the contaminated sediments, the concentration of Irons (60.17% and 60.24% for ML and PL) could be reduced significantly using lime amendment and sand-cap. This remediation technique code inferred the very beneficial for rural area due to their easy operation, low costs and fast remediation effect .

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#### REFERENCES

- Ata Akcil, Ceren Erust, Sevda Ozdemiroglu, Viviana Fonti and Francesca Beolchini, (2015) "A review of techniques used in aquatic contaminated sediments: metal removal and stabilization by chemical and biotechnological process" *Journal of Cleaner Production*, 86, 24-36.
- Environmental Protection Agency. (2006, August 20). Retrieved August 21, 2006, from <http://www.epa.gov/Katrina/testresults/sediments/summary.html>. (Accessed August 21, 2006)
- Jian-feng Peng, Yong-husi Song, Peng Yuan, Xiao-yu Cw and Giang-lei Qiu, (2009) "The remediation of heavy metals contaminated sediment" *Journal of Hazardous Materials*, 161, 633-640.