International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763
Issue 04, Volume 3 (April 2016) www.ijirae.com

Elemental Analysis of Soil samples of Cox's Bazar Sea-Beach Area Using PIXE Technique

Laila Zaman
Department of Physics
Jahangirnagar University
Savar,Dhaka
Bangladesh

S. M. Azharul Islam
Department of Physics
Jahangirnagar University
Savar,Dhaka
Bangladesh

Md. Joynal Abedin
A F Division
AECD
Post Box: 164, Ramna,
Dhaka-1000, Bangladesh

Md. Atiqur Rahman
Department of Physics
Jahangirnagar University
Savar, Dhaka,
Bangladesh

Corresponding author: Laila Zaman, PhD Fellow
Phone: 880 2 9101982(Res.), Mobile: 01911420093
E-mail: laila_zaman13@yahoo.com

Abstract--Due to natural disaster and industrial wastage pouring into the sea, pollution is increasing incredibly day by day. Radioactive is dangerous for living beings as well as environment. So, there should have an elemental data base and background radiation assessment record that may be helpful for the visitors and local peoples. Soil samples were collected from different distances of sea-beach area, Cox's Bazar. These samples were irradiated by 2.5 MeV proton beam and analyzed. Fe, Ca, K, Cr,Si, Mn, W, Cr, Ta, etc, were found in all the soil samples. Remarkable high concentration of Ta near sea water is projected among all other elements.

Key words- GUPIX, IBA, MAESTRO-32,MCB, PIXE,

INTRODUCTION

Cox's Bazar is one of the world's longest uninterrupted natural sandy beaches which are connected directly with sea water. Besides these, beach area is washed away twice a day by tides. So the soil of beaches may be composed of those which are the source of sea water. As a result there may be some elementary difference between normal soil and sea area soil. If the concentration of any element in the soil exceeds the essential limit, it becomes toxic and harmful for environment and as well as living being. Trace elements play very important roles in living beings. Any fluctuation like deficiency or excess in their normal level in living cells may lead to physiological disorders causing various diseases like hypertension, dental caries, goiter, cancer, heart disease, gallstones, obesity, osteoporosis, osteomalacia , arthritis, anemia, etc [1,7].It is therefore, essential to have detailed information for studies in trace elements profile of the sea shore and adjoining land mass, so that proper precautions can be taken to improve the environment of the shore areas of Bangladesh. Proton Induced X-ray Emission (PIXE)is well established technique for this purpose by which the concentration of most of the elements in different matrices can be measured accurately (in ppm range).

SAMPLING AND PELLET PREPARATION

Soil samples were collected from different locations of Cox's Bazar, (1) near sea water (2) populated areas(3)cultivated areas. Hand gloves and separate pots were used to collect the soil samples. All samples were taken from 2feet depth to protect the contamination probability. The MEMMERT Oven was run 25 days continuous at the temperature of 70^0 C to dry the soil samples completely moisture free. The samples were then grinded to make fine powder using Mortar (ebonite) grinding pot. Then 0.025gm fine powder was taken and pressed by hydraulic pellet maker for 7mm dia. and 1mm thick pellets. The pellets were mounted on 35mm slide frames with adhesive tape and set them on the sample wheeler in the Ion Beam Scattering Chamber for irradiation (5, 7).

IBA TECHNIQUE PIXE

Proton Induced X-ray emission (PIXE) is one of the most common and widely used analytical spectrometry techniques at MeV accelerators and the analysis is performed with characteristic X-rays [2,3,6,8].When charged particles with sufficient energy hit on a sample, a vacancy in the inner shells of an atom may be created. The probability of creating a vacancy is higher when the velocity of the incoming ions matches the velocity of the inner shell electrons. For MeV ions this probability for ejecting inner shell electrons is quite high. Such a vacancy can be filled in a number of ways and one of the processes may emit X-rays with the characteristic energy of that particular atomic number. In the PIXE-technique, these characteristic X-rays are detected by solid state semiconductor detector. An energy dispersive analysis of the detected signals can reveal the identity of different elements present in the sample and more importantly, by measuring the charge, i.e. the number of incoming particles, the concentration of the elements can be accurately quantified.

EXPERIMENTS AND DATA ACQUISITION

At VDG Accelerator Laboratory of Atomic Energy Centre, Dhaka (AECD), two types of sample wheeler system are available, one is for 16 samples and other is for 8 samples. For these experiments, the first one is used to set 13different soil sample slides, quartz and two IAEA standard samples ($CuS_{x,}$ soil-7). The data acquisition setup has been calibrated and standardization was done using the X-ray source [4,5,7].The soil samples were irradiated by the proton beam of 2.2 MeV and the beam current ~15nA. For each soil sample irradiation, 10 μC charges were collected through the Faraday Cup connected with the sample wheeler by copper spring. As the IAEA standard CuS_x is a thin sample, 5nA beam current was used to irradiate it and 5μC charges were collected. The X-ray photons emitted from the soil samples were detected and converted into voltage pulses by the [Si (Li)] detector (SL30165) with other associated circuitry. Mylar absorber(170 μm) was used to protect the detector from damage probability by high energetic X-rays. The spectroscopy amplifier model: 671 and Multichannel Buffer (MCB) model:919E (ORTEC) were used in data acquisition setup. The data acquisition for this research work was done using the well-established software MAESTRO-32(Ver.6.05). The collected spectrum data files were analyzed by the software GUPIX /DAN-32 and the concentration of the elements found in the samples have been projected in this paper.

RESULTS AND DISCUSSION

Soil samples collected from different locations of Cox's Bazar sea-beach area respective to the distances from the sea water, irradiated by 2.2 MeV proton beam and current ~15nA.The spectrum window with the elements found in one of the soil samples is shown below:

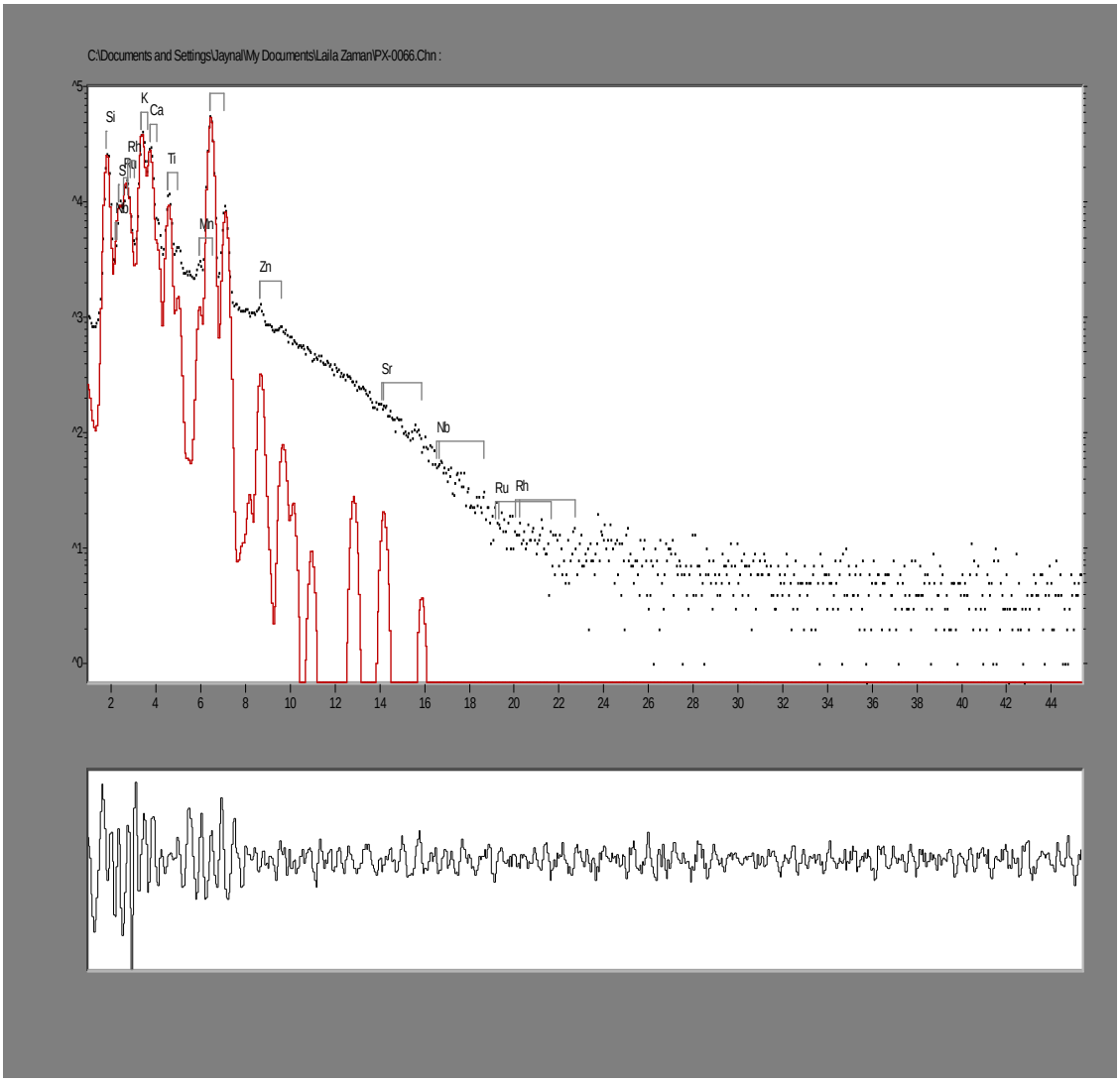

TABLE 1: Elements with their concentration of a soil sample near sea water

PX 0077				
ELEMENT	ATOMIC NUMBER	EXPERIMENTAL VALUE (µG/GM)	% ERRORS	LOD
SI	14	119358.4	2.15	6918.2
CL	17	20310.5	2.75	1320.7
K	19	108372.5	0.45	516.4
CA	20	40496.1	1.41	910.5
TI	22	13188.4	1.38	282.5
CR	24	1111.6	10.33	202.9
MN	25	4085.1	5.51	322.9
FE	26	180760.8	0.31	389.4
RU	44	36318.7	3.23	2976.5
W	74	20109.7	12.55	4540.6
TA	73	512769.3	1.30	17651.1

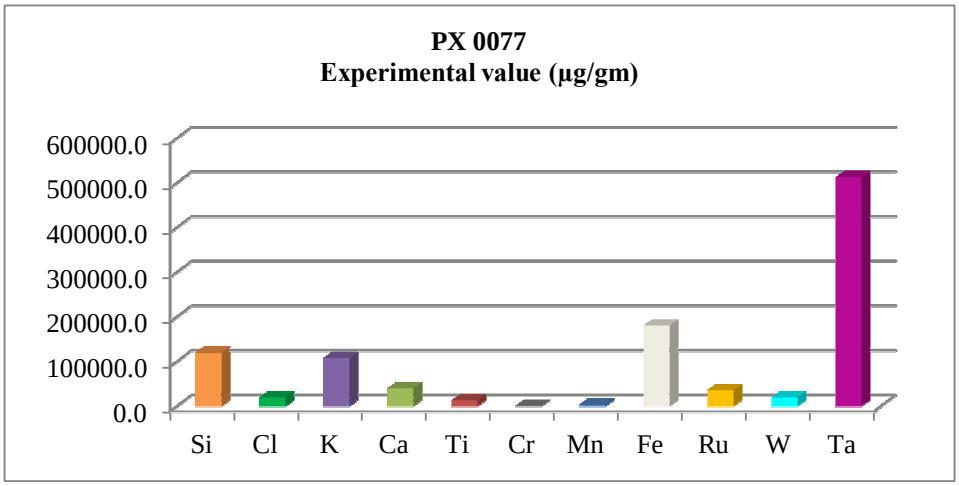

Fig 2: Graphical presentation of elements of the soil sample

TABLE 2: Elements with their concentration of a soil sample of cultivated area

PX 0079				
ELEMENT	ATOMIC NUMBER	EXPERIMENTAL VALUE (µG/GM)	% ERRORS	LOD
SI	14	40548.4	4.04	4509.9
K	19	107729.7	0.45	415.9
CA	20	50595.8	1.08	805.8
TI	22	15564.2	0.93	165.8
MN	25	2430.0	5.93	157.9
FE	26	167169.5	0.31	168.7
SR	38	1743.2	20.26	184.4
RU	44	10008.9	4.66	952.0
RH	45	5013.4	10.29	1207.9
TA	73	303695.0	1.11	7726.1

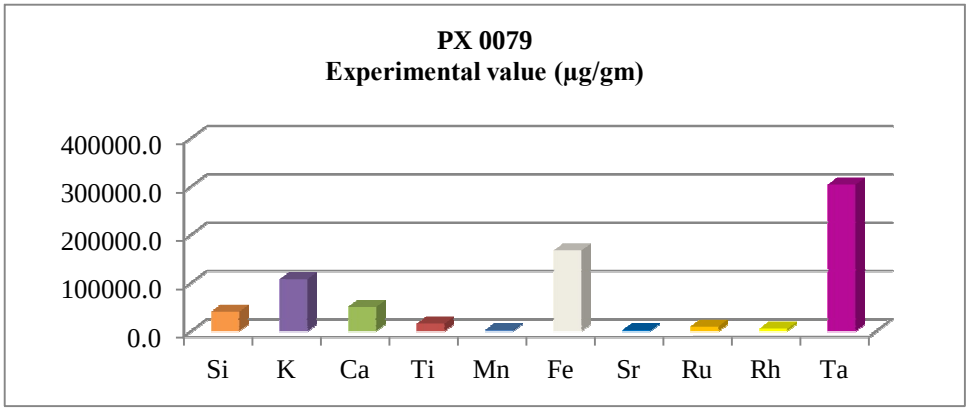

Fig 3: Graphical presentation of elements of the soil sample

TABLE 3: ELEMENTS WITH THEIR CONCENTRATION OF A SOIL SAMPLE OF POPULATED AREA

PX 0066				
ELEMENT	ATOMIC NUMBER	EXPERIMENTAL VALUE (µG/GM)	% ERRORS	LOD
SI	14	186280.4	0.43	828.0
S	16	43061.5	2.60	1806.7
K	19	160902.7	0.59	1351.3
CA	20	122803.8	1.22	2555.8
TI	22	67798.0	0.82	809.6
MN	25	9526.6	6.38	860.6
FE	26	608041.2	0.22	948.5
ZN	30	12007.2	8.95	1910.2
NB	41	25684.6	7.40	3564.1
RU	44	156186.8	1.29	3389.1
RH	45	64217.5	3.89	6251.4

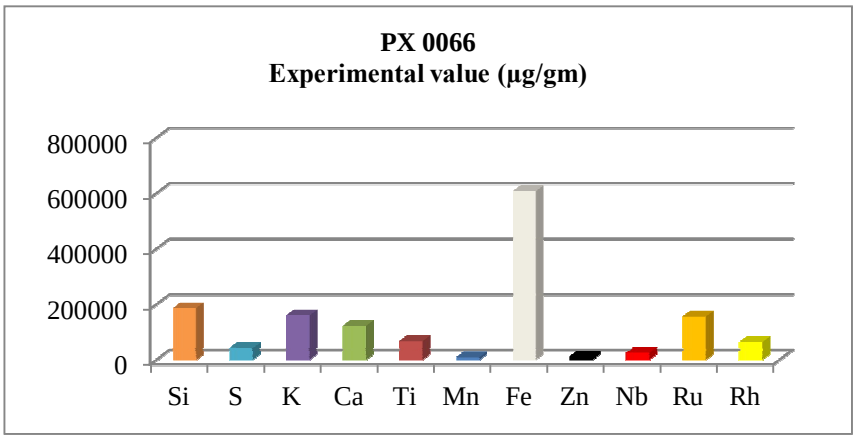

Fig 4: Graphical presentation of elements of the soil sample

CONCLUSION

Well established IBA Technique PIXE has been applied for this research work. Experimental values show that among all other elements Ta values are high within the sample collected from near sea water. Cl,W and Cr are projected comparatively high level. These data may be helpful for living beings. So, further research work should be done in this field. Concentration of Fe increases significantly with distances.

ACKNOWLEDGEMENT

The authors are deeply indebted and grateful to all staffs of Accelerator Laboratory of Atomic Energy Centre, Dhaka for facilitating all the instruments required for this research work.

REFERENCES

[1].Eric, J.U. (1971). *Trace Elements in Human and Animal Nutrition* (4th ad.)(Chapter 2,6,7,13)
[2]. Abedin,M. J. Akhter, Shirin Akhter S, and Hossain M. L.)Mar. – Apr. 2015). *Ion Beam Analytical Technique PIXE for pollution Study at Dhaka Van de Graaff Accelerator Laboratory*. IOSR Journal of Applied Physics (IOSR-JAP), 7(2 Ver.-II), 22 – 25.
[3].Govil,M.(2001).*Proton Induced X-ray Emission _A tool for non-destructive trace elementanalysis.* Current Science,80(12),1542-1549
[4]. Abedin,M.,J.,Akter,Shirin,&Arafin,S.A.K(April 2015).*Chromium Toxicity in soil around Tannery Area, Hazaribagh, Dhaka, Bangladesh, and its impacts on Environment as wellas Human Health.* International journal of Innovative Research in Advanced Engineering (IJIRAE).4(2).
[5].Hossen,.L.,Islam,S.M.A.,Abedin,M.J.,Akter,S.,Rasel,O.F.,Ahsan,M.M.,Khatun,R.,&4Monica,A.N.(2014).*Elemental profile analysis of some traditional medicinal plants of Bangladesh using PIXE technique,* Journal of Nuclear and Particle Physics,45(5),137-141.
[6].Johanson ,S.A.E& Campbell, J.L(1988).*PIXE:A novel technique for elemental analysis*. New York, John Wiley &Sons.
[7].Abedin,M.J.(2012).*Study of the effects of industrial pollutants using ion beam analytical techniques*, doctoral thesis, Jahangirnagar University, Savar, Dhaka.
[8]. Debertin, K.,&Helmer, RG.(1988).*Gamma and X-Ray Spectrometry with semiconductor Detectors.*Amsterdam: North Holland.

