

XRF STUDY OF POLLUTED SOILS NEAR CARS BATTERIES WORKSHOP LOCATED IN RESIDENTIAL AREA IN NORTH KHARTOUM STATE

Yassir E. Osman¹, Omer I. Eid^{*1,2} and Amel Abdallah Ahmed Elfaki³

¹Department of Physics, Faculty of Science, University of Khartoum, P O Box 321, 11115
Khartoum, Sudan

²Current Address: Northern Border University, Faculty of Science and Arts, P O Box 1321,
Rafha, Saudi Arabia

³Department of Physics, College of Science, Sudan University of Science and Technology,
407, Khartoum, Sudan

E-mails: ¹yeosman8@gmail.com, ²oieid@uofk.edu, ²omereid@gmail.com,
³amel17beeb@outlook.com

Abstract: In this research work, we conducted a study on cars batteries workshops that are located within residential neighborhoods in North Khartoum State in order to study the soil pollution caused by these workshops. In this study, we used the X-Ray Fluoresces (XRF) method to identify the trace elements and to calculate their concentrations. The results revealed extremely high concentration of the lead in addition to iron and copper. The mean concentration of the lead element was 9×10^5 ppm, while the study showed concentrations of iron and copper as 10^5 and 7×10^3 ppm respectively. In comparison with standard levels recommended by the United States Environmental Protection Agency one notice the very high levels of these elements concentrations.

Keywords: XRF Spectroscopy, Pollution, Lead, Iron, Copper, concentration, Peak intensity, Cars Batteries Workshops.

Introduction

Recently, industrial pollution becomes one of the most important subjects. One of the most serious type of pollution is the soil contamination because of its extended effect to the water and plants that can possibly transferred to food chain [1]. Many researches have been conducted to tackle this issue [2-6].

This research work focuses on the impact of the environment pollution in soil near some industrial workshops located within residential sites in Khartoum North state. To determine the elemental composition of the soil samples, we have employed X-Ray Fluoresce (XRF) technique in our study. Depending on the analysis of the samples collected from near certain workshops located in some residential area, one can determine the elemental composition of the soil and therefore identify the environmental pollution. Another aim of the study is to

examine the pollution limits in Khartoum North State and to compare them with the international ones.

Experimental Setup

X-Ray Fluorescence (XRF) analysis is one of the most reliable method in determining trace elements in materials. In this study we used the Energy Dispersive analysis (EDXRF). In our work we used the spectrometer available in the Applied Nuclear Science Laboratory, Department of Physics, Faculty of Science, University of Khartoum. A brief description of the spectrometer constitutes Si(Li) detector attached to a pre-amplifier and a high voltage supply, The pre-amplifier output is connected to a Multi-Channel Analyzer (MCA) through a Canberra amplifier, the data is displayed on a PC.

Sampling

The samples were collected from workshops of cars batteries that located in the residential sites, this covers the recycling in addition to the processes of extracting the lead from batteries for commercial uses. The soil samples are collected from the top thin soil layer by using a spoon metal. The distribution of the samples covered the four geographical directions away from the workshop. The first sample, in each case was taken right at the workshop fence, the second sample is 2 meters away from the first one and each other samples. Each sample is labeled and placed in a clean plastic box and then immediately taken to the laboratory. Each sample is homogeneously mixed and then specific weight is weight out to obtain a good representative of the whole sample. Each milled weighed sample is pressed in a pressing machine (to about 15 ton) to form a disc of approximately 1cm. The disc is placed on the detector. The software used in acquisition the data and analyzing the spectrum is AXIL program (Analysis of X-Ray spectra by Iterative Least square fitting) [7].

Analysis and Discussion

In Fig. 1 we show the XRF spectrum of the sample soil collected form near the batteries workshop together with the fitted spectrum. The trace elements that revealed from the spectrum are Pb, Fe and Cu.

In Table 1 we show the parameters extracted from the XRF spectrum. One notice the high concentration of the three elements especially the Pb. The results showed that the concentrations of Pb, Fe and Cu at a distance of 8 meters away from the workshop are 9×10^5 , 10^5 and 7×10^3 ppm respectively.

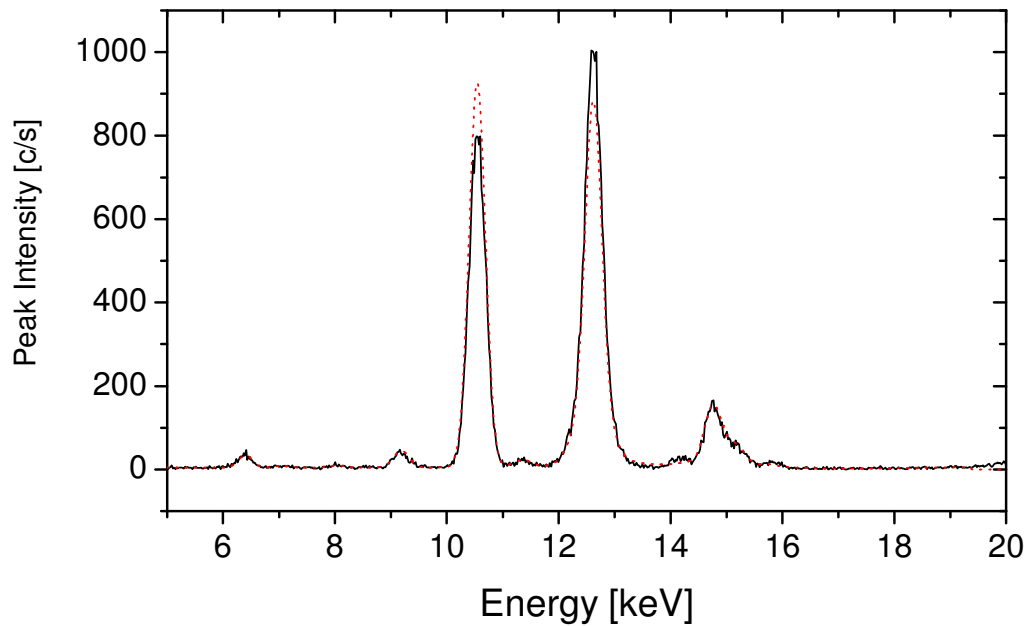


Fig. 1: The measured (solid line) and the fitted (dotted line) spectra.

These figures reflect extremely high concentrations of these elements in the soil. For instance, the international limits classified as very high-risk level as given by the United States Environmental Protection Agency (US EPA), is between 1000 and 2000 ppm for pb [8]. The concentration limits accepted by the agency for the Fe and Cu are 2.6×10^4 ppm, and 2.5×10^4 ppm respectively. While our results for these two elements are 1.4×10^5 ppm and 6.6×10^3 ppm respectively, again so much higher than the limits given by the US EPA.

It worth mentioning that in a previous study to examine the elements concentration of road side soil in Khartoum State, the results gave values for Pb between 2×10^3 and 3×10^3 ppm [9]. Still, one sees that these values are far below the values of the Pb concentration in our current. Table (1) Shows the information extracted from the XRF spectrum of the polluted elements in soil near cars batteries workshop located in residential area in Khartoum North City.

Element.	Ene keV	Int. c/s	Sen ppm ⁻¹	Enh. %	Conc. ppm	Error
Fe	6.400	0.88	2.15E+03	27.94	7.68E+04	5.47E-03
Cu	8.041	0.18	3.66E+03	30.10	6.68E+03	1.15E-03
Pb	10.540	31.06	3.76E+03	0.000	9.17E+05	3.97E-02

A comparison between our results and the data published in literature reflects an enormous difference. This could be due to the quality of the soil under study. The elements were accumulated in the soil with time, if the soil drifted from time to time on a regular frequency one except the concentration of the elements would be less than recorded.

We also did spatial analysis by graphing the averaged values of the elements concentrations as function of distance away from the workshop. This is illustrated in Fig.2. one also notes that the high intensity of Pb relative to both Fe and Cu which looks reasonable for workshop activities. The averaged values for Pb varied between 5.3×10^5 and 9.2×10^5 ppm. The Fe was in the range of 0.8×10^5 to 1.7×10^5 ppm, while for Cu it turned out to be 0.8×10^3 and 1.7×10^3 ppm.

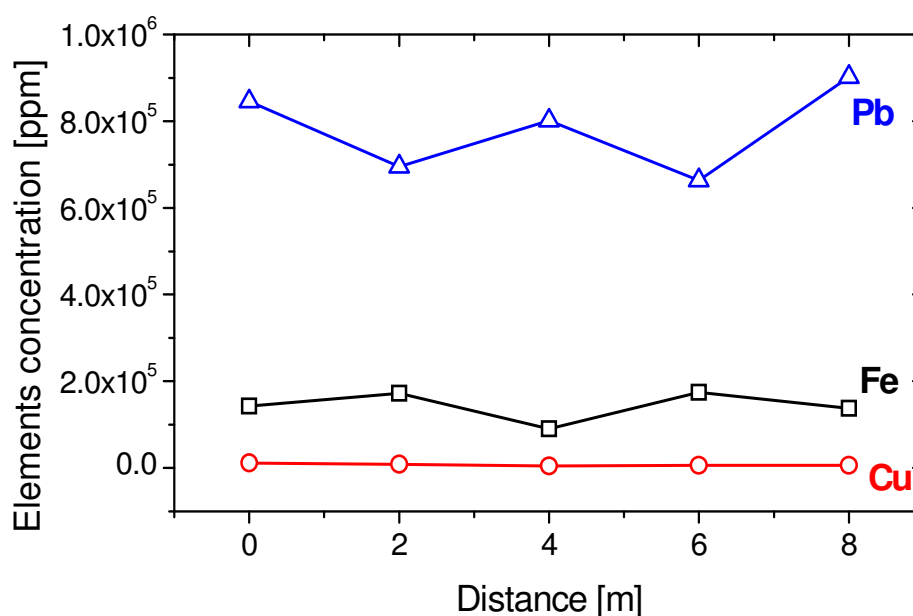


Fig. 2: Shows the averaged values of concentrations (in ppm) of the elements Pb, Fe and Cu plotted as a function of distances (in meters) from the cars batteries workshop.

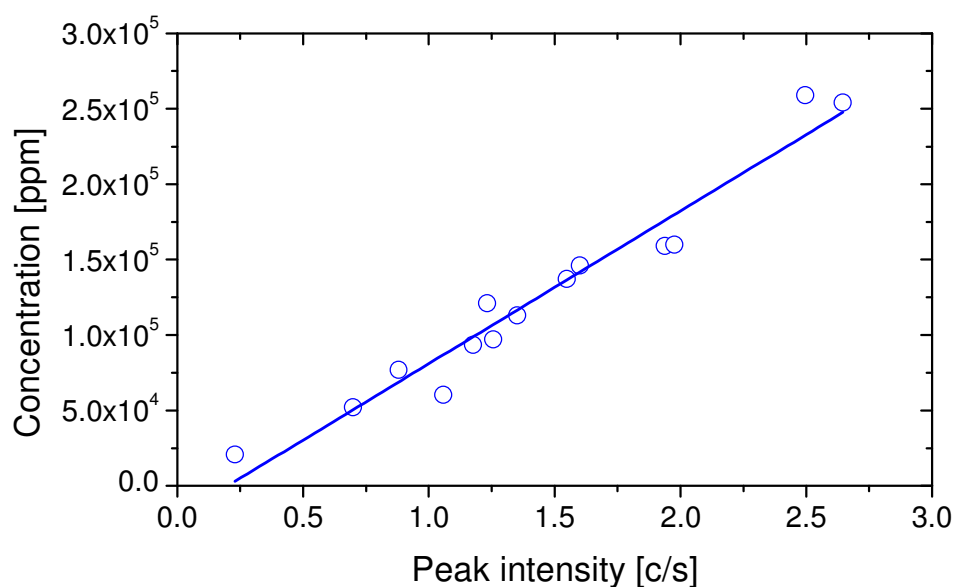


Fig. 3: Shows concentration [ppm] vs peak intensity [c/s] of Fe element.

Since the concentration of the trace element depends on the peak intensity of the XRF spectrum, we investigated the peak intensity of Fe versus its concentration. Fig. 3. shows a good correlation between the concentration of Fe and its peak intensity, moreover when the data is fitted linearly a value of 0.95 for R^2 is obtained.

Conclusion

The values of the lead concentrations in soil samples collected from a cars batteries workshop were found to be extremely high in comparison with the standard levels recommended by EPA. Since these workshops are located within residential sites this soil pollution is a health hazard to humans.

A correlation between the peak intensity of the Fe element with its concentration is obtained, supporting our results.

The workshop activities are contaminating the sites around it and hence the residential areas.

We recommend that such workshops have to be moved outside the cities and away from the communities with safe distances.

Furthermore, to create a new system that ensures the establishment of legal standards in the field of industrial safety and classification and organization of the work of workshops in accordance with international standards and preservation of our society.

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