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ASSESMENT THE COCENTRATION OF SOME RADIOACTIVE ELEMENTS (Fe, Pb and Co) OF AWAI LOCAL MINING AREA OF SOBA L.G.A. KADUNA STATE.NIGERIA

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ABSTRACT

Analysis of concentration of some Radioactive elements (Co, Pb, and Fe,) in five (5) water samples and four (4) soil samples of awai town, Soba L.G.A. Kaduna State minning area was carryout using Atomic Absorption Spectroscopy. The samples were collected from different points in the study area. The Concentration values of radionuclides

Introduction

Background of study

Water and soil are the most abundant resources in nature and most significantly used. There resources are utilize in many areas of application. Natural radioactive elements are present in very low concentration in Earth crust.They brought to the surface as a result of human activities such as oil and gas exploration or mining. Additionally they can reach earth surface through natural process like leakage of radon gas to the atmosphere, research shows that areas where the mining activities taken place there is possibility of height level of such elements naturally,people in the area used the water and the soil for domestics used as well as farming activities. Earth materials such as bedrock, sand, and gravel may naturally contain heavy metals

from the water samples range between 0.006 ± 0.008 to 0.13±0.0013, 0.23±0.0023 to 0.49±0.003,and 3.7±0.0032 to 8.6±0.0028 for Co,Pb and Fe respectively. While for the soil samples range between 0.22±0.0032 to 0.87±0.008, 0.46±0.0042to0.96±0.003 and 6.44±0.0015to14.06±0.0030 for Co,Pb and Fe respectively all the mesurements were carried out in ppm. In most of the cases, the concentration of these elements in both water and soil samples was found to be very high above the level set by world Health Organization regulation WHO (1998) of 0.002,0.015and 0.03 for water samples of Co,Pb and Fe respectively then for the soil is 8.0,0.05 and 0.2 respectively, except that of covalt (Co) of soil samples which is below the standard set by world health organization . Therefore the Water and Soil of mining area of Awai Village, due to high concentration of some radioactive elements (Co, Pb, and Fe,) is harmful to their health especial cancer as well as the kidney problems.We recommend that the government should take action by awareness the people in the area of risk of using such water and soil for domestics used as well as farming activities in order to ensure public health safety.

Keywords: Radiation, Minning, Soil, Water.

as well as radioactive materials,which may be dissolved by, and absorbed into, the water we withdraw from different sources for domestic and irrigation purposes (Zhang *et al.* 2010). Radioactive substances are ubiquitous on Earth. They contain radioactive isotopes (radionuclides), generating different types of ionising radiation in the course of nuclear transformations. Radionuclides present in the environment can be grouped into several distinct classes with respect to their origin; primordial radionuclides, cosmogenic radionuclides, radionuclides produced in natural decay series and anthropogenic radionuclides.Primordial radionuclides comprise radioactive isotopes which have been present on Earth sinceits formation. Because of their

very long half-lives, comparable with the age of the Solar system,they have not yet decayed beyond the point of their detection. The most prominent member of this group is the radioactive isotope of potassium (^{40}K), which contributes with approximately 16% to the annual effective dose received by members of the global population due to ionising radiation originating from natural radionuclides (UNSCEAR).. Cosmogenic radionuclides contribute with less than 1% to the annual mean effective dose from natural radionuclides, with radiocarbon (^{14}C) being the major contributor accounting for almost 100% of this dose (UNSCEAR).

Radionuclides belonging to the natural decay series represent the most important source of ionising radiation on Earth, contributing with approximately 83% to the total mean effective dose received by the global population from natural radionuclides (UNSCEAR). They are generated in successive decays of three primordial radioisotopes: ^{232}Th, ^{235}U and ^{238}U. The decay series involve nuclear transformations with emission of alpha or beta particles and end up with stable isotopes of lead that is ^{208}Pb, ^{207}Pb, ^{206}Pb for ^{232}Th, ^{235}U and ^{238}U decay series, respectively (Taylor 2004). The presence of gaseous isotopes of radon (^{219}Rn, ^{220}Rn, ^{222}Rn) and their progenies in natural decay series is largely responsible for their large share (approximately 50%) in the overall effective dose received by the global population from natural sources of ionising radiation. Finally, anthropogenic radionuclides, which originate mostly or exclusively from technological activities of man, are also present in the environment and contribute to the overall effective dose received by members of the global population.

Natural radioactive substances are often classified into two groups with respect to their distribution in the environment; naturally occurring radioactive materials (NORM) and techno-logically enhanced NORM. The second group comprises materials, natural or man-made, which contain elevated concentrations of radioactive elements as a result of technological transformations of various natures. Examples include fertilizer production and fossil fuel combustion. Although environmental aspects of both natural and anthropogenic radioactivity have been discussed in numerous publications, as well as in several monographs and textbooks

(Atwood, 2010), the presence of natural radioisotopes in groundwater as a hazard factor to the public has not been addressed there in sufficient detail. Growing use of groundwater resources for drinking water purposes calls for careful evaluation of this aspect of the presence of radioactive substances in the environment. Radioactive isotopes such as ^{3}H, ^{14}C, ^{36}Cl or ^{39}Ar have often been discussed in connection with groundwater, but mostly as tools for assessing timescales of groundwater flow (Kazemi, Lehr and Perrochet, 2006).

METHODOLOGY/ MATERIALS

MATERIALS

a. Digestion block and tubes
b. Beaker
c. Rubber container
d. Hot plate
e. Filter paper
f. Metre rule
g. Funnel
h. Hand gloves
i. Leather envelope
j. Distilled water
k. Nitric Acid
l. Hydrochloric acid
m. Shovel
n. Weighing balance
o. Sterile
p. Polythene bag

Instrument

Atomic Absorption Spectrophotometer (AAS)

AAS Technique

This is a spectro-analytical procedure for the quantitative determination of chemical elements using the absorption of optical radiation (light) by free atoms in the gaseous state. Atomic absorption methods measure

the amount of energy in the form of photons of light that are absorbed by the sample. A detector measures the wavelengths of light transmitted by the sample, and compares them to the wavelengths which originally passed through the sample (scintillation Detector manual, 2019).

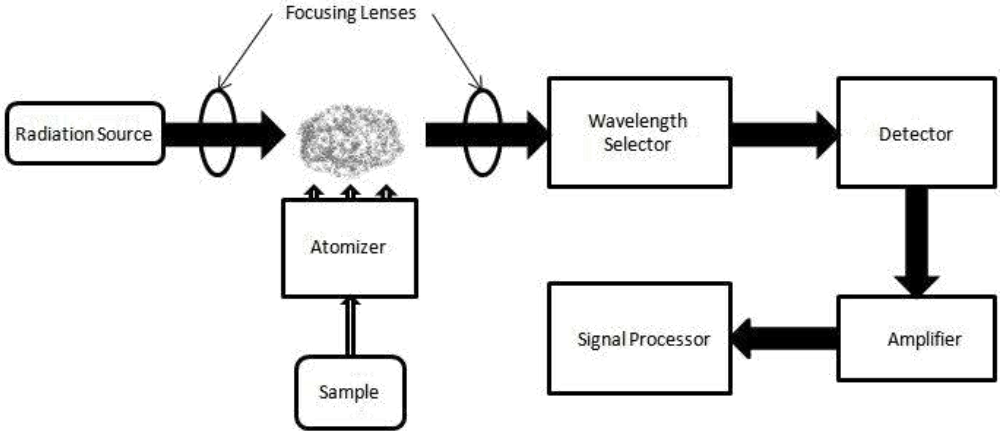


Figure 2.1 Block diagram of AAS technique (scintillation Detector manual, 2019).

Study Area

Awai town is a few kilometre from maigana Soba local government headquarter of northern part of Kaduna state,with a population of about 30000 peoples most of them are farmers.

SAMPLE COLLECTION

Soil and water samples were collected from a mining area at Awai Town Soba Local Government area Kaduna State and the samples were taken to Chemistry Department Multiuser Laboratory ABU Zaria for digestion and radioactive elemental analysis using Atomic Absorption Spectrophotometer (AAS).

The water samples were labelled A,B,C,D, while the soil samples were labelled S1,S2,S3,S4,S5

The soil sample were collected by the process of measuring 15cm from both four angles of a particular area with a metre rule of 30cm and dig down 10cm by using shovel, with the use of hand gloves, the samples were taken put into a leather envelope and the opening were closed properly.

Both the samples that is soil and water were taken in five different locations using the same procedure for taking all the number of samples needed. They were all put inside a polythene bag for the soil also clean container were used for the water sample. While taking the sample the container was covered quickly and tightly immediately after taking the sample for some radioactive element not to escape away from the container. The procedure was repeated for each other sample that was taken and all the samples were put into polythene bag and all the samples both soil and water were taken to the laboratory for preservation,preperation, digestion and radioactive elemental analysis.

SAMPLE DIGESTION

For liquid sample, 10/ml was measured from each sample of the liquid, and put into four different beakers. In each beaker, 2.5ml of hydrochloric acid (HCL) and 7.5ml of Nitric Acid (HNO3) were added to each beaker. For the soil sample, 0.5/g of the soil sample was measured using weighing balance and put into five different beakers for each beaker 2.5ml of hydrochloric acid (HCL) and 7.5ml of Nitric Acid (HNO3) were added.. All the samples (both soil and water samples) were placed on a hot plate and to the set temperature between range of 100°C – 170 ^{O}C in carbon fume. When the solutions were about to dry off to change to clear solutions or formed ppt, they were removed from the hot plate and allow to cool. Distilled water was now added and a sterile was use to sterilized thoroughly. The solution were filtered using filter paper and funnel. The filtrate were diluted to 50ml and were used for the analysis of the elements (Co, Pb and Fe) With AAS machine.

SAMPLE ANALYSIS

The samples were analysed using Atomic absorption spectrometry which is an instrumental method. It was a method adapted by Kalic *et al,*. (2003)

RESULT AND DISCUSSION

The result obtained during the determination of some radioactive element (Fe, Pb and Co) in soil and water sample is shown in table 1 below.

Table 1 METHOD: Co Water (Flame).

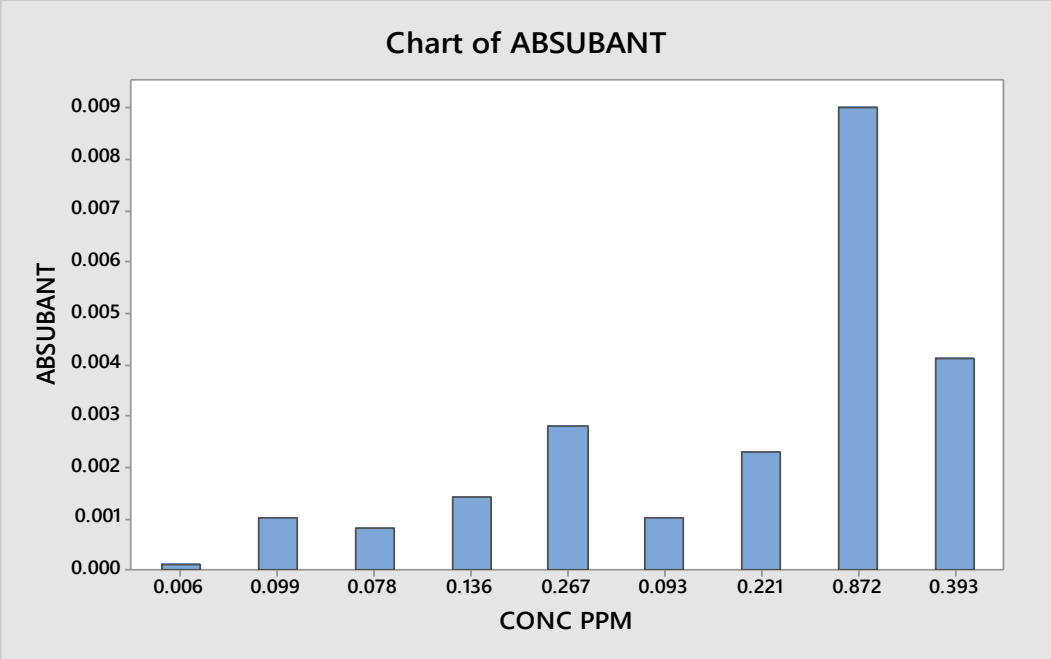
Sample ID	Conc. Ppm	SD	Mean Abs
A	0.006	0.0018	0.0001
B	0.099	0.0012	0.0010
C	0.078	0.0012	0.0008
D	0.136	0.0013	0.0014
S_1	0.267	0.0007	0.0028
S_2	0.093	0.0009	0.0010
S_3	0.221	0.0032	0.0023
S_4	0.872	0.0008	0.0090
S_5	0.393	0.0010	0.0041

The table 1 above shows the concentration in part per million (ppm) and the absorbance of cobalt (Co) in each sample.

For water samples the concentration of cobalt in all samples is above the standard level or is above the World Health Organization (WHO) standard which is 0.002ppm.

For soil samples the concentration of cobalt in all samples is below the standard set by the World Health Organization (WHO) which is 8ppm.

Below is the graphical bar chart of absorbance against concentration of cobalt (Co)



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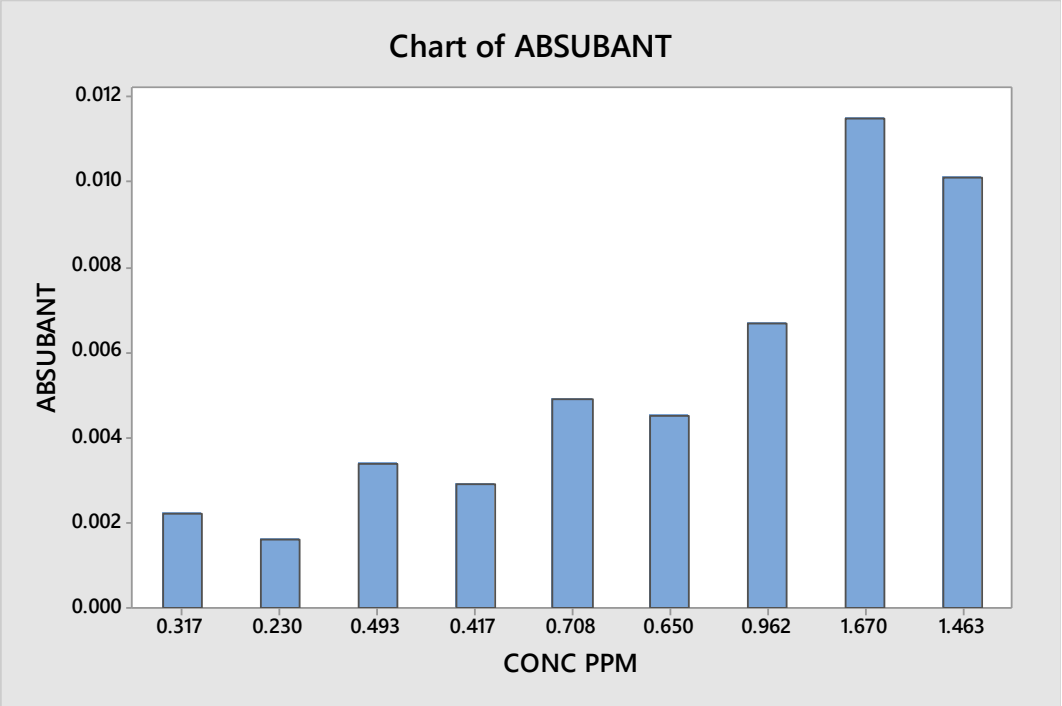
Sample A has the conc (ppm) of 0.006 ± 0.0018 and the absorbance is 0.0001.
Sample B has the conc (ppm) of 0.099 ± 0.0012 and the absorbance is 0.0010.
Sample C has the conc (ppm) of 0.078 ± 0.0012 and the absorbance is 0.0008.
Sample D has the conc (ppm) of 0.136 ± 0.0013 and the absorbance is 0.0014.
Sample S_1 has the conc (ppm) of 0.267 ± 0.0007 ant eh absorbance is 0.0001.
Sample S_2 has the conc (ppm) of 0.093 ± 0.0009 and the absorbance is 0.0010.
Sample S_3 has the conc (ppm) of 0.221 ± 0.0032 and the absorbance is 0.0023.
Sample S_4 has the conc (ppm) of 0.872 ± 0.0008 and the absorbance is 0.0090.
Sample S_5 has the conc (ppm) of 0.393 ± 0.0010 and the absorbance is 0.0041.

METHOD: Pb Water (Flame)

Sample ID	Conc. Ppm	SD	Mean Abs
A	0.317	0.0016	0.0022
B	0.230	0.0023	0.0016
C	0.493	0.0037	0.0034
D	0.417	0.417	0.0029
S_1	0.708	0.0027	0.0049
S_2	0.650	0.0009	0.0045
S_3	0.962	0.0033	0.0067
S_4	0.670	0.0012	0.0115
S_5	0.463	0.0042	0.0101

The table above shows the concentration in part per million (ppm) and absorbance of lead (Pb) in each sample.
For water sample the concentration of lead in all samples is above the standard level set by the World Health Organization (WHO) standard which is 0.015ppm.
For soil sample the concentration of lead in all samples is also above the standard level set by the World Health Organization (WHO) which is 0.05ppm.

Below is the graphical bar chart of the absorbance against concentration of lead (Pb)



Sample A has the conc (ppm) of 00.317 ± 0.0016 and the absorbance is 0.0022.

Sample B has the conc (ppm) of 0.230 ± 0.0023 and the absorbance is 0.0016.

Sample C has the conc (ppm) of 0.493 ± 0.0037and the absorbance is 0.0034.

Sample D has the conc (ppm) of 0.417 ± 0.417 and the absorbance is 0.0029.

Sample S_1 has the conc (ppm) of 0.708 ± 0.0027 and the absorbance is 0.0049.

Sample S_2 has the conc (ppm) of 0.650 ± 0.0009 and the absorbance is 0.0045.

Sample S_3 has the conc (ppm) of 0.962 ± 0.0033 and the absorbance is 0.0067.

Sample S_4 has the conc (ppm) of 0.670 ± 0.0012 and the absorbance is 0.0115.

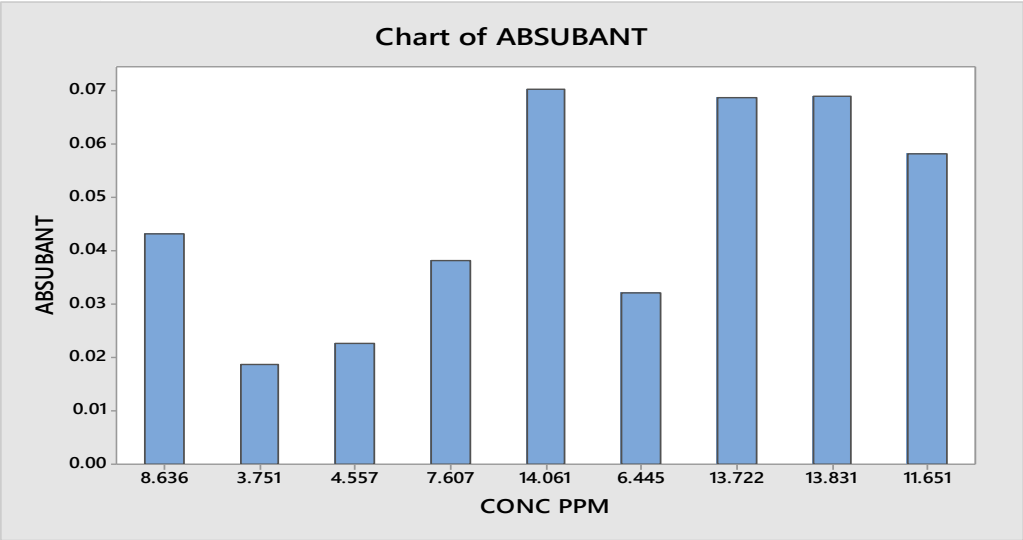
Sample S_5 has the conc (ppm) of 0.463 ± 0.0042 and the absorbance is 0.0101.

METHOD: Fe Water (Flame)

Sample ID	Conc. Ppm	SD	Mean Abs
A	8.636	0.0028	0.0431
B	3.751	0.0032	0.0187
C	4.557	0.0029	0.0227
D	7.607	0.0014	0.0380
S_1	14.061m	0.0030	0.0702
S_2	6.445m	0.0015	0.0322
S_3	13.7221m	0.0009	0.0685
S_4	13.831m	0.0044	0.0690
S_5	11.651m	0.0026	0.0581

The table above shows the concentration in part per million (ppm) and absorbance of Iron (Fe) in each sample.
For water sample the concentration of iron in all samples is above the standard level set by the World Health Organization (WHO) which is 0.03ppm.
For soil sample the concentration of iron in all samples is also is above the standard level set by the World Health Organization (WHO) which is 0.2ppm.

Below is the graphical bar chart of the absorbance against concentration of Iron (Fe)



Sample A has the conc (ppm) of 8.636 ± 0.0028 and the absorbance is 0.0431.

Sample B has the conc (ppm) of 3.751 ± 0.0032 and the absorbance is 0.0187.
Sample C has the conc (ppm) of 4.557 ± 0.0029 and the absorbance is 0.0227.
Sample D has the conc (ppm) of 7.417 ± 0.0014 and the absorbance is 0.0380.
Sample S_1 has the conc (ppm) of 14.061m ± 0.0030 and the absorbance is 0.0702.
Sample S_2 has the conc (ppm) of 6.445m ± 0.0015 and the absorbance is 0.0322.
Sample S_3 has the conc (ppm) of 13.722m ± 0.0009 and the absorbance is 0.0685.
Sample S_4 has the conc (ppm) of 13.831m ± 0.0044 and the absorbance is 0.0690.
Sample S_5 has the conc (ppm) of 11.651m ± 0.0026 and the absorbance is 0.0581.

CONCLUSION/RECOMMENDATION

The soil and water sample were collected from the mining area at Awai Town, Soba Local Government, Kaduna State. In general, the water samples were taking from four different Location around the mining area. While the soil sample were taking from five different places of the area.From the above results of some radioactive elements (Co, Pb, Fe,) indicate that the study area were the water and soil sampled are above the standard value of Concentration in ppm provide by World Health Organization (WHO) except that of cobolt in soil sample where the concentration is below the standard set by World Health Organization (WHO. Therefore most of the Water and Soil of mining area of Awai Town, due to high concentration in part per million (ppm) of some radioactive elements (Co, Pb, Fe,) is harmful to their health. We recommend that the government should take action by awareness the people in the area of risk of using such water and soil for domestics used as well as farming activities in order to ensure public health safety.

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