(28)Study of Environmental of Some Soil Samples from Kufa in Najaf city, Iraq

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Abstract

The parameters of environmental in some selected samples from Kufa in Najaf city was determined and discussed. Five soil samples were collected from:
1- Housing grouped for kufa cement factory
2- Kufa river bottom
3- Kufa bridge closeness (Kufa Environment office)
4- Kenda
5- Gazwyniha -

We implemented a laboratory apparatus based on a NaI (Tl) γ-ray spectrometer, where connect the scintillation detector with multichannel analyzer.Results showed the presence of natural radionuclide Ra^{226} in soil samples. In order to evaluate the radiological hazard of the natural radioactivity, mean resulted Dose has been calculated. Chemical analysis for concentration of NO_2^{-1}, NO_3^{-1} and PO_4^{-3} the range of values (0.701-2.246),(2.55-13.236),(0.00-0.003)ppm respectively, also carried out along with the measurement of electrical conductivity and pH of the soils samples; the values range (272-9360) μScm^{-1} and (7.51-8.11), respectively.

Keywords: Radon; Natural radioactivity; Gamma spectrometry; *NaI (Tl)*; Environmental radioactivity; Chemical analysis of soil

Introduction

Man is dependent on soils and good soils are dependent upon man and the use he makes of them. Soil is a mixture of natural bodies on the earth surface containing living matter and supporting plants. Soil consists of three-Phase system as solids, liquids and gasses (Bool et al .,1976).Soil is a collection of natural bodies on the surface of the earth ,containing living matter and supporting or capable of supporting plants (Russal,1957).Soil is a complex substance because of extreme variability in Physical and chemical composition .It contains small but significant quantities of organic and inorganic compounds, which are essential for the growth of plants. There are many types of soil depending upon the Physics and chemical composition .The soil is classified as saline, saline sodic and alkali, etc.(Brady et al., 1990;Dragovic et al.,2008).In saline soil , the concentration of salts is increased to the level at which the crop growth is adversely affected. Saline soils have a high content of natural salts and have pH generally above 7.3 and not over 8.5.Soil not only consists of organic and inorganic compounds but also radionuclides,i.e.Uranium,Thorium,Radium,Potassium-40,etc.(Zahid et al.,1999; Akhtar et al., 2004),which occur in nature as a complex of Oxides,Hydrated Oxides,Carbonates,Phosphates ,Sulphates,Vanadates and silicates. Nuclear fission in connection with atomic weapons testing provides another source of soil contamination (Akhtar et al., 2005).

Radon Rn^{222} is a radioactive, noble gas (half life 3.825d) and has been discovered, together with its two isotopes (Rn^{220}, 55.6s and Rn^{219}, 3.965) in 1900. Rn^{222} is a decay of radon in air where it diffunds from soil , is due to the Uranium contents of soils (Manic et al.,2006).Radon presents a certain health hazard , due to

its short lived progenies (Po^{218},Pb^{214},Bi^{214},Po^{214})that may deposit with in the lung (NBs,1980; Fisenne,1993;Durrani and Ilic,1997).

The main objective of this study was the chemical analysis , identify and determine natural radionuclide activity concentrations in soil samples collected from 5 regions around Njaf city.

The Radium concentration, the Radon concentration and the resulted dose from the inhalation of radon gas were determined for all the analyzed soil samples.

Experimental procedure and experimental settings

1-Collections the samples

Soil sampling was carried out in the months of May-Jun in 2009 ,five samples of soil were collected from Kufa in Najaf city in Iraq, as seen in the map (fig.1), and these regions are :

1-Gezwyniha -
2-Kenda -
3-Kufa bridge closeness -
٤-Kufa river bottom -
5-Housing grouped for kufa cement factory -

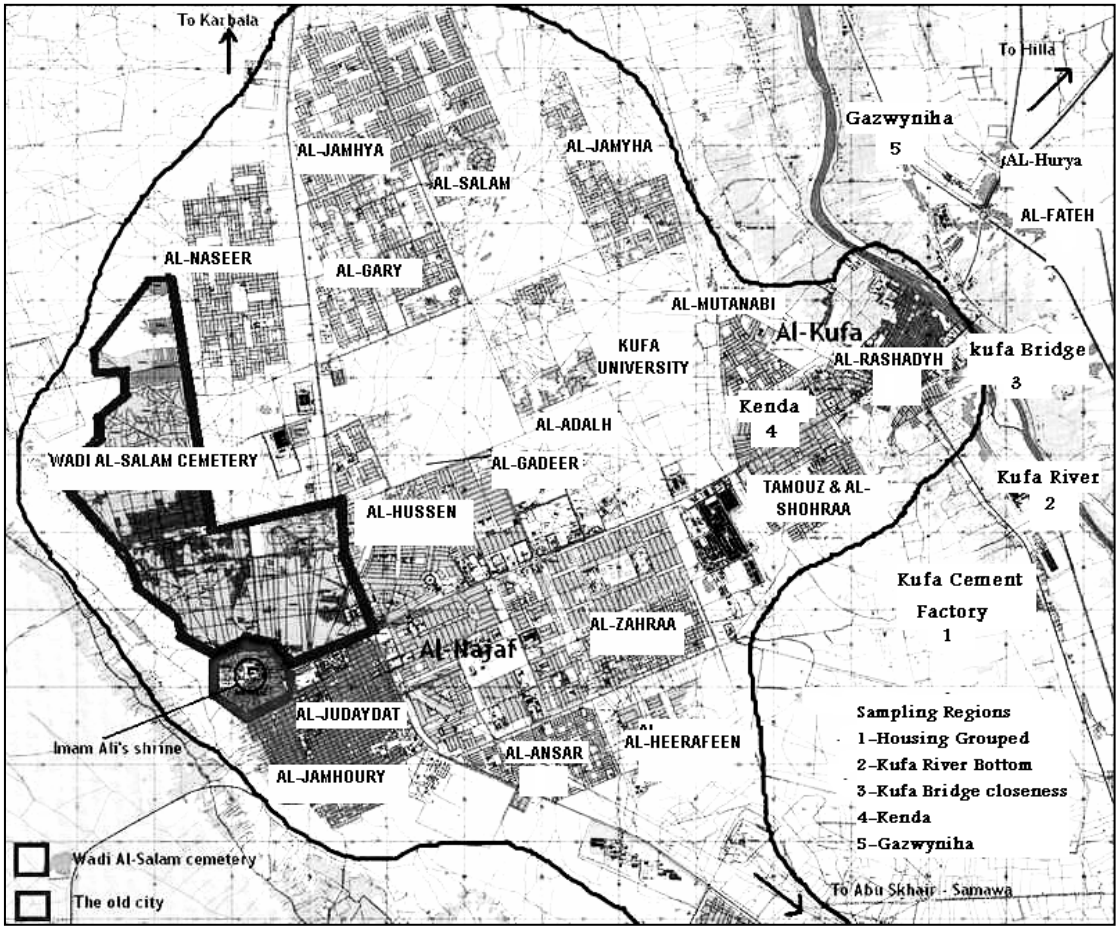

Figure (1)

The administrative Najaf city map

The collected samples were weighted and homogenized. The homogenized samples, each having a weight of 1000g, were put into bags milestone. Soil samples were transferred to Marinelli beaker of 1000 ml.

2- Chemical analysis

The chemical analysis of the soil samples was performed for the measurement of pH, and electrical conductivity , and concentration of NO_2^{-1}, NO_3^{-1} and PO_4^{-3} ions. The salt concentration of the soil was measured by a conductivity meter, 340i W-T-W ,Germany. In this method the extract from saturated soil solution gave an indication of salt level. Electrical conductivity (EC) was measured μScm^{-1} at $28C^{\circ}$.

The soil samples were checked for alkalinity and acidity by a pH meter , pH-720, W-T- Germany .In this method a sensing glass electrode is inserted into extract of soil solution .The difference between H^+ ion activities in the wet soil and electrode gave rise to electrometric potential difference that was related to the pH of the soil solution. The concentrations of NO_2^{-1}, NO_3^{-1} and PO_4^{-3} were determined by spectroPhotometer UV-VIS (wood et.al,1967),(srichland,parson)respectively.

3- Radiometric analysis

The Gamma spectroscopy system was used for the quantitative and qualitative determination of radionuclides .Gamma spectroscopic measurement was performed using a NaI (Tl) detector (diameter 1.76" & thickness 1.56"), a SPECTECH multi channel analyzer with model (UCS 30) 4k ADC and gain =1 were used for the measurements. The detector was shield in a 5 cm thickness lead well.

Energy calibration and efficiency calibration of the gamma spectrometer were carried out using (Co-60, Cs-137, Na-22, Am-241and Ra-226) calibration sources in 1000ml Marinelli beaker covering the energy range from 25 to 2500 Kev.The counting time for each sample , as well as for background, was 1 hour.

Calculation of Specific Radioactivity

The activity level for Ra^{226} in the measured samples was computed using the following equation (Ibrahim, 1999)

$$A=\frac{C}{\varepsilon PW}(BqKg^{-1}) \ldots\ldots\ldots\ldots\ldots (1)$$

Where A is the activity level of a certain radionuclide expressed in $BqKg^{-1}$ dry weight,C is the net counting rate of sample subtracted from background (count per seconds), ε is the counting efficiency of the used detector, P is the absolute transition probability of gamma decay (Fireston et al.,1998), and W is the dried sample weight expressed in Kg.

The Radon concentration in the soil was calculated according to (UNSCEAR, 1993):

$$C_{Soil} = F_r x \rho x C_{Ra} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where's:

C_{Ra} = The radium concentration (Bq/Kg)

ρ = The density of soil ($1800Kgm^{-3}$)

F_r = The Emission rate (0.1)

C_{Soil} = The Radon concentration in the soil (Bq/m^3)

The radon concentration in the air was calculated according to the equation:

$$C_{Air} = C_{Soil}\sqrt{\frac{D_{Soil}}{D_{Air}}} \ldots\ldots\ldots\ldots\ldots (3)$$

Where's:

C_{Air} = The concentration of radon in the air (Bq/m^3)

D_{Soil} = Proliferation constant in the soil ($0.5x10^{-4}$ m^2/sec)

D_{Air} = Steady proliferation in the air (5 m^2/sec)

The resulted dose by Radon gas inhalation was calculated according to by (UNSCEAR,1988):

$$H_p = IC_p x I_P x D_{CE} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where's:

IC_P = The concentration of radon in the air

I_p = Amount of consumption of the air outside the home ($1600m^3$/y)

D_{CE} = Conversion factor of radon gas in units ($1.3x10^{-9}$ Sv/Bq)

Results and discussion

The results of the chemical analyses of the soil samples under investigation are give in Table .

Table 1.Chemical analysis of the soil samples from Kufa, Najaf

LOCATION	PH	ELECTRICAL CONDUCTIVITY (μSCM^{-1})	NO_2^- [1](PPM)	NO_3^- [1](PPM)	PO_4^{-3}(PPM)
Gazwyniha	8.11	1164	2.132	13.236	0.003
Kenda	7.84	1760	2.246	2.55	0.00
Kufa bridge closeness	7.65	566	0.816	9.331	0.026

Kufa river bottom	7.51	275	0.701	4.027	0.037
Housing grouped for kufa cement factory	8.01	9360	0.820	6.147	0.010

The concentration of chemical elements in the soil solution depends on soil moisture, pH, cation exchange capacity (CEC), redox potential, quantity of organic matter, microbial activity and fertilizer application. Mass flow and diffusion of chemical elements into plants depend on soil structure and porosity (Carini ,2001; Golmakani,2008)

The soil pH is perhaps the single most important aspect of soil chemistry .Strictly speaking , soil pH ,or soil reaction is a measure of the number of hydrogen ion (H^+) present in a soil solution .In more common terms, it is a measure of alkalinity and acidity .The pH scale runs from 0-14 and 7 is for the neutral .Human activities that increase soil acidity include fertilization with ammonium containing fertilizers which ultimately enter the soil via rainfall .Irrigating with water having higher bicarbonates gradually increases soil pH and can lead to alkaline conditions .Slightly alkaline soil is not harmful to many plants .As seen from Table 1,the values are within (7.51-8.11) range, which shows that it is a slightly alkaline soil.

Electrical conductivity is a measure of salts present in the soils samples .The lowest value of electrical conductivity is 275 μScm^{-1} and highest equal to 9360μScm^{-1} at Kufa river bottom and housing grouped for kufa cement factory, respectively (Table 1).It shows that due to regular irrigation the salts have been leach down. calcium, Magnesium and Potassium are cation nutrients ,meaning they are available to plants in a form with a positive charge, these nutrients adsorb to soil particles ,especially clay particles. Soil high in clay or organic matter have cation exchange capacity (ECE).These soils act as reservoirs for these nutrients and plants growing in them seldom are deficient in the cation nutrients.

The measured values of concentrations of NO_2^{-1}, NO_3^{-1} and PO_4^{-3} ions are also given in Table 1.The concentration values of (NO_2^{-1}, NO_3^{-1} and PO_4^{-3}) lie in the range of (0.701-2.246) ,(2.55-13.236) and (0.00-0.003) , respectively.

The radium concentration in the soil samples are shown in table 2..The concentration of Ra^{226} in housing grouped for kufa cement factory location was elevated compared to Kenda location.

Therefore, the concentrations found in samples can be ordered as Housing grouped for kufa cement factory> Kufa bridge closeness > Kufa river bottom > Gazwyniha> Kenda (table 2).

The radon concentration have calculated in the air and the soil (see table 3)

The resulted dose has calculated from the inhalation of Radon gas (see table 4).

Table (2) The radium concentration in soil samples

LOCATION	CONCENTRATION(BQ/KG)
Gazwyniha	319.02±27.21
Kenda	221.89±22.14
Kufa bridge closeness	269.16±16.01

Kufa river bottom	165.57±28.85
Housing grouped for kufa cement factory	201.06±22.09

Table (3) Concentration of radon in soil samples and air

LOCATION	CONCENTRATION OF RADON IN SOIL $(BQ/M^3)X10^3$	CONCENTRATION OF RADON IN AIR(BQ/M^3)
Gazwyniha	٣٦.١٩	١١٤.٤٤
Kenda	٢٩.٨٠	٩٤.٢٣
Kufa bridge closeness	٤٨.٤٤	١٥٣.١٨
Kufa river bottom	٣٩.٩٤	١٢٦.٣٠
Housing grouped for kufa cement factory	57.42	١٨١.٥٧

Table (4) Caused dose by the Radon gas inhalation

LOCATION	RESULTED DOSE (MSV/Y)
Gazwyniha	٠.٢٣
Kenda	٠.١٩
Kufa bridge closeness	٠.٣١
Kufa river bottom	0.26
Housing grouped for kufa cement factory	0.37

Conclusions

1-The chemical analyses of the samples under investigation show that the electrical conductivity was high in the housing grouped for kufa cement factory location compared to those in the Kufa river bottom because the salts.

2-Mean resulted Dose of ٠.394 mSv/y was obtained for the air .These results is lower than the International Commission on Radiological Protection (ICRP) maximum permitted limit and therefore , have no significance radiological health burden on the environmental and the populace.

3 – The results were compared with the permissible limits of radiation exposure dose, which is (1mSev) (IAEA,1996),where found it (0.37) mSv/y ,and it's low value.

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