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The Measurements of Natural Radioactivity, (Radon and Gamma concentrations), around the old fertilizer factory in Basrah/Iraq

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ABSTRACT

Radon concentration, exhalation rate, annual effective dose, radium activity, thorium, uranium potassium and radium equivalent have been measured in the present investigation for soil in the area around the old fertilizer factory in southern of Basrah Governorate. The measurements based on CR39 track detector for passive method, RAD7 for active method and NaI(Tl) for gamma concentration measurements. Average values for radon concentration in soil were 112.04±10.76 Bq/m^3 using passive technique and 104.56±6.05 Bq/m^3 using RAD7. From the result of the passive technique, area and mass exhalation rates and the annual effective dose were calculated. Gamma ray spectroscopy for the soil samples were performed and found that the average concentrations of ^{226}Ra, ^{232}Th and ^{40}K were 50.89 Bq/kg, 21.74 Bq/kg and 640.4 Bq/kg respectively. Gamma ray hazard indices were calculated and found they are within the world average.

Keywords

Radon; CR39; RAD7; NaI(Tl); gamma concentration; effective dose

Academic Discipline And Sub-Disciplines

Physics

TYPE (METHOD/APPROACH)

Radon and Gamma measurements using SSNTD and NaI(Tl)

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1. INTRODUCTION

It is widely known that, high radon concentration and its daughters are dangerous to human health. Radon is an odourless, colourless and tasteless gas and it is the second cause of lung cancer after smoking. The assessment of radon in soil and building materials helps to understand and minimized such effects. Soil is the prime source of radium ($t_{1/2}$=1600y), parents of radon gas. The natural abundance of radon gas consists mainly two isotopes; ^{222}Rn $t_{1/2}$=3.82 d and ^{220}Rn $t_{1/2}$=56s. The concentration of radon is soil varies in different quantities according to geological structure of the place, because radon is chemically unreactive, it freely to moves between particles and rocks. In some cases radon trapped in certain places and creates area of highly concentration of radon gas, called radon prone area [1]. The radon exposure is considered mostly as internal exposure, because it is dynamic gas. Gamma radiation from natural radionuclides and cosmic rays constitute as external exposure to humans. The radionuclides of concern in terrestrial environment are mainly potassium ^{40}K, radium ^{226,228} Ra, uranium ^{238}U and ^{232}Th[2-5]. Natural radio activities is widely spread in the earth's environment and depends primarily on the geological and geographical condition, and appear at different level in the soil of each region of the world [UNSCEAR 2000].

In the present work, sealed can technique is used for radon measurements, together with NaI(Tl) for gamma ray measurement.

2. MATERIALS AND METHODS

2.1. RADON GAS MEASUREMENTS

A. PASSIVE RECHNIQUE

Fifty two soil samples were collected from different location in the selected study area shown in Figure 1. Sealed can, 30 cm x 7.5 cm, technique was used for passive measurements[6]. The cans, with CR39 detectors stuck on the bottom of the tope cover, have been stored for 3

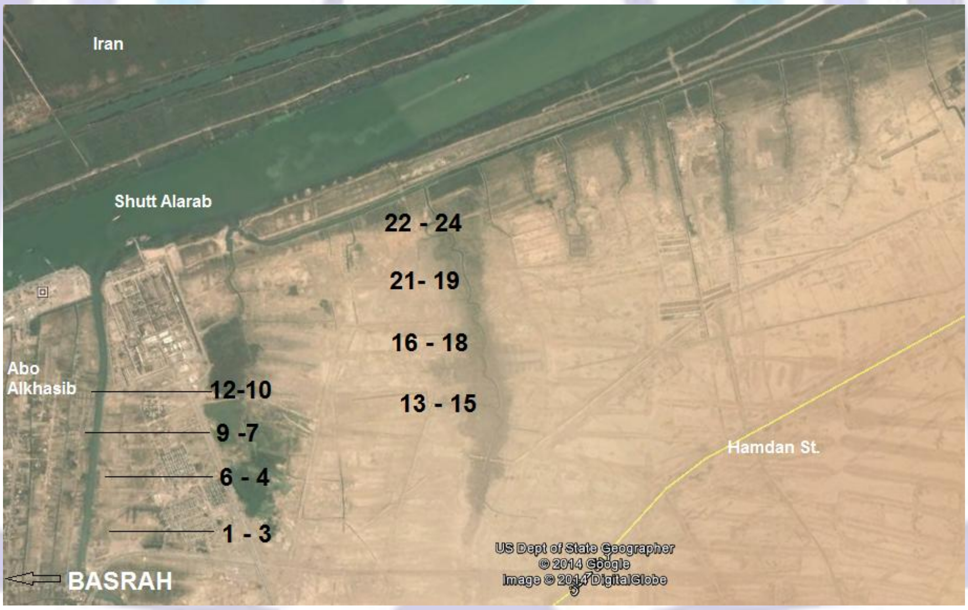

Figure 1 area of study around the fertilizer factory

months for irradiation process. The tracks were observed after etching and counted by using microscope with a magnification of 400x. The etching conditions were: 6.25N sodium hydroxide at 70^{0}C for 8 hours. The track density and radon gas activity was obtained through calibration factor of K=0.2857±0.01431 Tr cm^{-2} d^{-1} per Bq m^{-3} according to the relation [6]

Radongasconcentrationis givenby [7];

$$A_{Rn} = \frac{\rho}{tK} \quad (1)$$

whereρ is track density in Tr/cm^2 , t exposure time in day and K the calibration factor in Tr/cm^2.day / Bq.m^{-3}. At the equilibrium state, final activity of radon exhalation from each sample inside the can is given by [8-9]

$$E_{ex} = \frac{ATV\lambda /S}{T+\lambda^{-1}(e^{-\lambda T}-1)} \quad (2)$$

where E_x is exhalation rate in unit Bq m^{-2}.h^{-1}, A is radon concentration measured by CR39 detector in unit Bq m^{-3} , λ is radon decay constant, T is the exposure time, V the volume of the can and S is the surface area of the sample.

The radon exhalation rate in terms of mass is calculated from the relation;