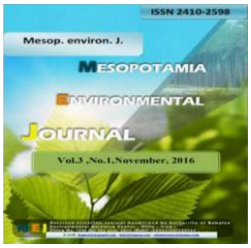
Mesopo. Environ. j., Special Issue E :192-198, 2018
ISSN 2410-2598
proceeding of 2nd International conference of science and Art
University of Babylon and Liverpool John Moores
University, UK
Mesopotemia Environmental journal
journal homepage:www.bumej.com



Measurement of Natural Radioactivity Levels of Construction Materials at Hillah City

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To cite this article:

Mekhalif . Ali T, Defiery Mahammed E., Abad Al-Kareem Iqbal H. , Kehawish . Ahmed R., Measurement of Natural Radioactivity Levels of Construction Materials at Hillah City, *Mesop. environ. j*., 2018, Special Issue E:192-198.

Abstract:

Natural radiation of construction materials is the major source of population dose and its importance as a widespread substance that can be found everywhere in the residential and work areas. The aim of this study is to measure the level of radioactivity into construction materials at Hillah city by using device Radiation Alert (Inspector 33290), the adapted measurement unit is (µSv/hr). The measuring process was done at month of December – 2017 with three replicates per samples test. The results show that the levels of cements, bricks and other construction materials are varying according to the natural structure and source of these materials. It was fuond that the radioactivity of construction materials ranged from 0.005 to 0.024 µSv/hr and the plaster of paris has the less value of radioactivity (0.005 µSv/hr), while granite has registered the highest value of radioctivity (0.024 µSv/hr). In general, the radioactivity for these construction materials is within the permissible limits.

Key words: Radiation. construction materials. Hillah city.

Mesopotamia Environmental Journal
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Mesop. environ. j. 2018, Special Issue E.;192-198
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Introduction

The radioactive elements such as, potassium, uranium and thorium are exist in residues into the earth's layer and are defuse more or less equivalently over the coating. These elements emanate nuclear radiations, which can threats for human lives. Hence the observing of any emitting radioactivity to the atmosphere is essential for environmental security. The study of natural radioactivity are needed not only because of their radiological effect, but also awing to they doing as distinguished biochemical and geochemical remnant in the environment [1]. The understanding of the natural radioactivity of building materials like rocks and soils is significant for characterization of population exposure to radiations, where most of the neighborhood spend about 80% of their time in indoor. Construction materials contribute to natural radiation exposure in two patterns. First, by gamma radiation emanate, from ^{238}U, ^{232}Th, ^{40}K and their decay yields to an outer entire body dose exposure, and secondly by radon expiration to an internal dose exposure due to deposition of radon decay products in the human respiratory tract [2]. Respiratory tract is typically awing to inhalation of radon and its strain that emit alpha particles release from construction materials inside room air [3]. In addition, taking in both thorium and uranium are permanently present into soil, their gamma radiation causes external exposures with the resulting absorbed doses [4]. The European recommendations building materials are categorized as appropriate for use by organizing a maximum exterior radiation exposure limit to 0.1 mSv y^{-1} [5,6]. Furthermore high levels of natural radionuclides in such materials might bring about doses in the rank of several mSvy^{-1} [7]. The major radioactive nuclides ^{226}Ra, ^{232}Th and ^{40}K can be found nearly within all kinds of rocks, granite, sand, cement and gypsum from which building materials are manufactured [8]. There are many studies have been acheaved that related to the health proplems in population caused by radiation levels of natural materials. So, many researchers have measured the radioactivity levels of building materials in various countries [9,10]. Thus, the goal of study is to estimate the level of radioactivity into building materials that commonly utilized in building processes at Hillah city, also to assess the radiation levels in comperation with the permmissble limits of radiation dose.

2. Material and Method

2-1 Study area

This study was carried out for the whole city of Hillah, which lies to the north of Baghdad.

Study area has many shops and sites of construction materials such as cement, sand, bricks, thermo stone, granite..etc, generally most of these shops are spread within urban city center. The basic source that usually used in construction process is bricks, which manufacture by pure clay from which soil's Hillah city had been formed. Cement is one of more significant building material for dwellings and infrastructure in each of city center and its surroundings. Moreover cement commonly used in the block industry and concrete installation as well as in covering the buildings walls that ordinarily built from bricks.

2-2 Construction Materials Preparation

Several of construction materials usually used in building processes and commonly available at local markets in Hillah city, these materials subjected to measuring the level of radioactivity in order to assess the radiation levels in comperation with the permmissble limits of radiation dose. These measurements were done directly by using the device Radiation Alert (Inspector 33290), these measured materials are: cement, stone, brick, plaster of paris (gypsum), granaite, flooring clay-tiles, juss, sub-base, sand river, washed sand, gravel (coarse size) gravel (fine size), thermostone and marble. The measuring process was randomly achieved, and each material was subjected to average of three repetitions per samples test, moreover the distance between the device and measured material was (30cm). The adapted measuring unit is sievert (Sv) as 1Sv = 1 joul / kg, used to measuer the helth effects of ionizing radition (usually low doses internal). Sievert is the special name for the Standared International (SI) unit of dose equivalent (H), equivalent dose (HT), effective dose (E).

2-3 Cumulative Annual Effect

In order to calculate the amount of annual dose of radioactivity within building materials, it was calculated by multiplying the hours of day by numbers of days in the year and by the value of radioactivity of building materials.

$$Rv = Hr * Y * R$$

Rv: Average Activity Radiation. Hr: Hours of the Day (24 hours).

Y: Total Days of the Years (360 days). R: Radiation Activity of Material.

3. Results and Discussions

The measuerd building materials are cement, sand, brick, gypsum, gravel, stone, granite, flooring clay-tiles, juss, sub-base, sand river, washed sand, gravel (coarse size), gravel (fine size), thermo stone

and marble, which are the dominant building materials in study aria. Constructing materials are a major sources of internal radioactivity because the naturally occurring of radionuclides inside them. There are two patterns of exposures of radiation dose: internal and external by which move into human beings from building materials. There is a considerable average concentrations around the warld of thorium, uranium and potassium in the earth's crust are about 40 Bq/kg,40 Bq/kg and 400 Bq/kg, respectively (UNSCEAR, 2000) [11]. Radon is the most widespread in the environment because its half-life of 3.825 days makes its propagation more appropriate from its origin point towards the atmosphere. On the other hand uranium is essential source of radon and radium, which is the decay product of uranium exist in radioactive series just after the radium. Radon is an inert gas therefor it is can expand over the soil and enter the atmosphere [12]. Moreover, the decay of radon isotopes of polonium, lead and bismuth that are heavy metals and chemically active [13]. The release from the ground surface and from the building materials of clay houses causes the high amount of radon and thoron within room [14]. Where the soil is a significant source of inner radon and emersion of radon is also higher from the ground surface of the house [15]. Many research has been done that deal with the activity concentration of natural radionuclides, in different countries and areas of the world such as Pakistan [16,17], Syria [18], Kuwait[19], China[20], Egypt [21,22] and Cyprus [23]. The values of radioactivity levels of some classes of cement are shown in the Table (1)**.** The results show, there is a slightly closed in values of radioactivity for each of type of cement. The highest value was registered in the (Turkey white-cement) with (0.016 μSv/hr), and the lowest value was (0.006 μSv/hr) registered in the (Turkey bazian- cement). In addition, all measurements of radioactivity amounts are within the permissible levels so, this types of cement are save for using in building processes. Table (2) illustrates the values of radioactivity levels of several types of construction materials. It was found that, the highest value of radioactivity was registered into the granite nevertheless, the lowest value was registered into the Iraqi plaster of paris. It was noted that each of Gravel (coarse size) and Marble have the same value of radioactivity (0.006 μSv/hr). Generally, all the values of radioactivity of the mentioned materials were nearly closed. It should be noted, that the values of measured materials are within the allowable limits which defined by the OECD criterion (Organization for Economic Cooperation and Development).

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Table 1: The radioactivity levels of some types of cement.

Material	Radioactivity Levels μSv/hr	Material	Radioactivity Levels μSv/hr
Cement Turkey bazian	0.006	Cement Najaf	0.007 kar
Cement Turkey white	0.016 adana	Cement Kufa Assad	0.011
Cement Karbala Bridge	0.013	Cement Iranian white	0.012
Cement Karbala krast	0.008		

Table 2: The radioactivity levels of some types of construction materials.

Material	Radioactivity Levels μSv/hr	Material	Radioactivity Levels μSv/hr
Granite	0.024	Marble	0.006
Limestone powder	0.011	Flooring Clay tiles	0.009
Stone	0.007	Thermostone Iraqi (Nagaf)	0.012
Brick of ALnahrawan	0.013	Thermostone Kwaitian	0.008
Brick of ALkifel	0.010	Thermostone of United Arab Emiraites	0.008
Birck of ALdiwaniya	0.018	washed Sand	0.008
Brick of ALshowmily	0.013	Sand river	0.006
Plaster of Paris of Karbala	0.012	Sand of Karbala	0.015
Plaster of Paris of Iraqi Abomalage	0.007	Sub-base of Karbala	0.011
Iraqi Plaster of Paris (Mezan)	0.005	Plaster of paris of Najaf	0.014
Plaster of Paris	0.013 Dorsa	Gravel (fine size)	0.009
Gravel(coarse size)	0.006		

4. Conclusions

The samples of building materials were prepared from several locations as well as some of shops within urban city center. The results show that, the radioactivity of construction materials ranged from (0.005 to 0.024 μSv/hr) and the plaster of paris was less radioactive (0.005 μSv/hr), while granite was recorded the highest radiation activity (0.024 μSv/hr). It was fund that each of gravel (coarse size) and marble had the same value of radioactivity (0.006 μSv/hr), and these values within the permissible limits.

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