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Original Article

The Relationship Between Granite Stone and Lung Cancer in Iranian Homes Kitchen

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ABSTRACT

Radon is a radioactive noble gas that can be produced from the decay of radium and detected by special devices. In the air, radon compounds stick to the dust particles and other suspended particles and enter into the human body through breathing. Granite is suitable for covering the interior spaces of kitchens due to its beauty, hardness and high strength. On the other hand, radon emission and the increased risk of lung cancer due to the use of granite have created serious concerns. Therefore, in this study the radon emission rate by these stones has been investigated. Results obtained using CR-39 detector and PRASSI device show that the excessive use of granite in the kitchen without proper ventilation will increase residents' lung cancer rates.

Keywords: Radioactivity, Radon, Lung cancer, Granite.

Introduction

Ores and decorative stones in kitchens and other parts of the house have been used as elegant and resistant coverings since many years ago. (Fig. 1). In fact, the natural beauty and strength of stones have placed them at the center of attention rather than the other coatings. The studies between the years 2001 to 2007 in Iran's housing market showed the 5% increased demand of using processed ores in houses. An increase of 30% is expected in the use of decorative stones by increasing the trend of new construction and modernization of housing by 2020. There are 1265 mines of decorative stones in Iran, of which 926 mines are active (3.73 percent), 275 mines are inactive (7.21%) and 64 mines are under construction (5 percent). Accordingly, Iran is among the first five listed countries of decorative stones manufacturer. Stones are extracted from the earth's crust, and are used in buildings after the processing {2, 3}. Lung cancer is one of the most common cancers in Iran, and one of its most important causes is smoking and then radon gas [4]. If the concentration of radon gas in is high in houses, it can cause lung cancer. For the experiments in this study, four samples of granite that have the largest market share for sale were chosen. The stones used in this study have a dimension of 25 × 25 cm

(upper and lower surface is polished) and also the thickness of 4 and 3 cm.

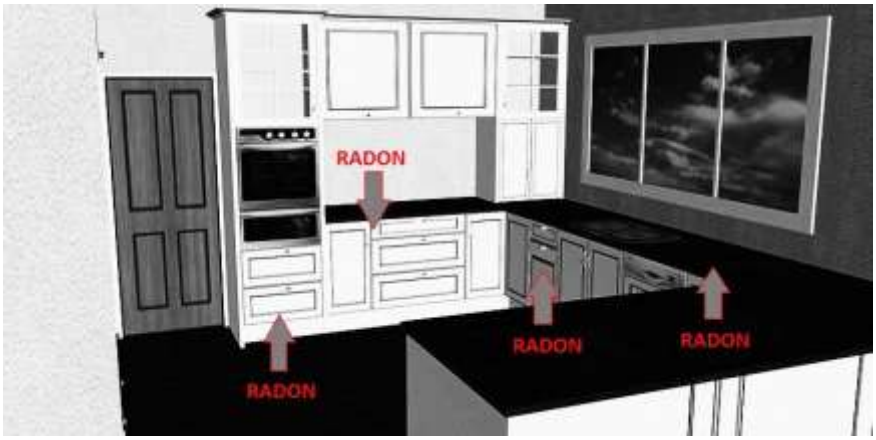

Figure 1. Modern kitchens and the increasing use of ores and granite

The study of radon

Radon is a gas that is created naturally due to the radioactive effort of radium element. This is a spontaneous radioactive process that is a part of attempt chain of uranium - 238 with a half - life of 4.47×10^9. The half – life of ^{238}Ra is equal to 1602 years, ^{238}Rn is 3/823 days, ^{218}Po is 3/05 minutes, ^{214}Pb is 26/8 minutes and ^{214}Bi is 19/7 minutes. (Fig. 2) [7]. Most rocks of the earth's crust as well as soil and material eroded from the earth's crust contain uranium. About 99/3 % of this uranium is of type ^{238}U that leads to stable isotopes ^{206}Pb due to 14 efforts. Geologically, the uranium-bearing minerals, especially monazite in granitic rocks are of the main origins of radon in rocks, soils and groundwater.

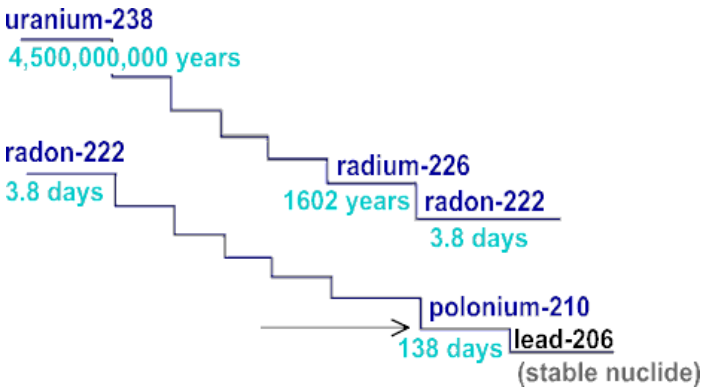

Figure 2. The half-life of radon and uranium

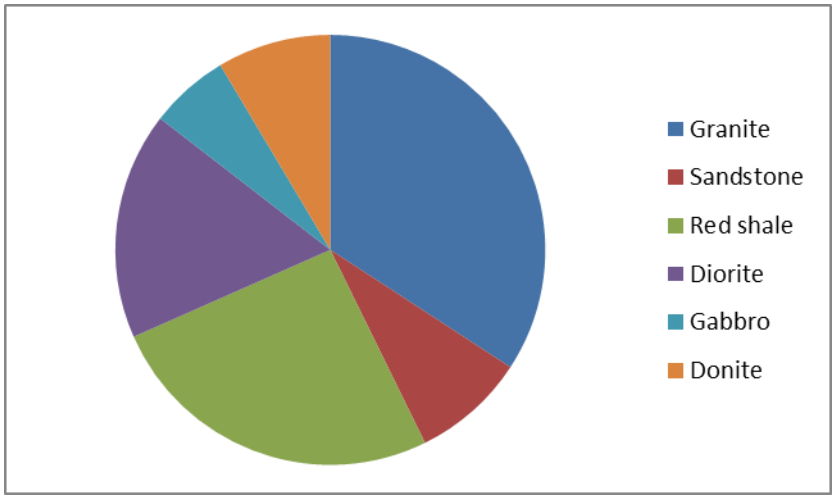

Figure 3. The average amount of uranium (measured in grams per ton) in different stones (Granite has the highest rate)

Petrology (granite*)*

Granitic rocks are the most frequent igneous rocks after basalts. Granite is mainly composed of potassium feldspar, potassium plagioclase and quartz. Among the natural factors, soil and rocks have the main role in natural radiation and among the sediments and soil; granitic rocks have a high radiation due to having uranium, thorium and potassium (Fig. 3). In addition, some iron and magnesium minerals such as biotite and amphibole of the type hornblende are found in granite. Some of these stones may also contain muscovite. Crystalline minerals are all visible in granite and can easily recognize from their apparent specifications. The granite crystals often do not show a regular geometric shape unlike other mafic rocks. The samples are shown in figures (4), (5), (6) and (7).

Figure 4. Toyserkan Black Granite

Figure 5. Zahedan White Granite

Figure 6. Nehbandan Orange Granite

Figure 7. Khoramdareh Golden Granite

Study of radon gas emissions

In order to examine the radon emissions, the stones used for each sample are connected to each other separately by a rod with a diameter of 3 cm and then we have put them inside a polyethylene barrel. Using PRASSI 5s with high sensitivity, high-capacity memory, short response time and a large digital display, radon levels have been measured in the barrel. Measurements were started without delay at 15:30 in 05.18.2011. Radon flux rate is more than the polished part in vertical section and the connecting rod due to surface roughness, therefore all samples were placed in a barrel in the same manner and the reading operation was done within fifteen days for each sample. Actual results of this two-month investigation are shown in Table 1. Radon activity per each barrel is based on the following equation (1):

$$A_t = A_0\left(1 - e^{-\lambda t}\right) \quad (1)$$

Where λ is the decay constant of ^{222}Rn 0/1813 days, A_0 and A_t are the Initial and final values of radon activity and t is the spent time.

Table 1. Results of radon measurements in the samples to Pico Curies per liter

Stone sample	Measurement time	(Pci/L)4 pieces	(Pci/L)3 pieces	(Pci/L)2 pieces
Black granite	15:30at2011/5/18 in	51.0	35.0	20.0
White granite	14:30at 2011/6/10 in	201.	05.1	500.
Orange granite	13:00at2011/6/26 in	250.	1	450.
Golden granite	14:00at2011/7/25 in	02.2	2	75.0

Results obtained by CR-39 detector

The amount of radon in some kitchens of Hamedan City that have used granite for decorating walls and cabinets is equal to $167\ ^{bq}/_{m^3}$

Table 2. The amount of radon in some kitchens of Hamedan City

Address	Radon gas rate per bq/m^3	Number (type of used stone)
Farhangian town	69.138	Kitchen 1 (black granite)
Taleghani Street	.24166	Kitchen 2 (orange granite)
Pastor Street	56.179	Kitchen 3 (white granite)
Madani town	.15187	Kitchen 4 (golden granite)
Mirzade Eshghi Street	99.162	Kitchen 5 (white granite)
	167	mean

Conclusion

The study of radon gas emissions processed ores and decorative stones were only performed for a situation where the granite is used as a decorative stone in the kitchen. The Permissible levels of radon in homes are defined as 4Pci/L based on the recommendation of EPA that should be more limited According to the results obtained for golden granite. But the other three types of radon gas output are at the standard level. The most important output of granite is due to the black and brown minerals named biotite that contains uranium, and the Radon emissions is negligible due to the white to gray quartz and orthoclase minerals. Radon concentration in kitchens is high due to the lack of natural or artificial ventilation and also due to be closed doors and windows. As a result, high concentrations of radon can cause lung cancer.

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