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The Relationship between Granite Stones and Lung Cancer in Iranian homes kitchen (Case Study: City of Hamedan)

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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, Hamedan City, Kitchen

I. INTRODUCTION

Radon is a radioactive gas released from the normal decay of the elements uranium, thorium, and radium in rocks and soil. It is an invisible, odourless, tasteless gas that seeps up through the ground and diffuses into the air. In a few areas, depending on local geology, radon dissolves into ground water and can be released into the air when the water is used. Radon gas usually exists at very low levels outdoors. However, in areas without adequate ventilation, such as underground mines, radon can accumulate to levels that substantially increase the risk of lung cancer [1].

Radon was identified as a health problem when scientists noted that underground uranium miners who were exposed to it died of lung cancer at high rates. The results of miner studies have been confirmed by experimental animal studies, which show higher rates of lung tumours among rodents exposed to high radon levels [1].

Scientists agree that radon causes lung cancer in humans. Recent research has focused on specifying the effect of residential radon on lung cancer risk. In these studies, scientists measure radon levels in the homes of people who have lung cancer and compare them to the levels of radon in the homes of people who have not developed lung cancer [1].

Researchers have combined and analysed data from all radon studies conducted in Canada and the United States. By combining the data from these studies, scientists were able to analyse data from thousands of people. The results of this analysis demonstrated a slightly increased risk of lung cancer for individuals with elevated exposure to household radon. This increased risk was consistent with the estimated level of risk based on studies of underground miners [1].

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

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strength of stones have placed them at the centre 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%), 275 mines are inactive (7.21%) and 64 mines are under construction (5%). 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 [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 [5]. If the concentration of radon gas in is high in houses, it can cause lung cancer [4]. 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 35 × 35 cm (upper and lower surface is polished) and also the thickness of 4 and 3 cm.

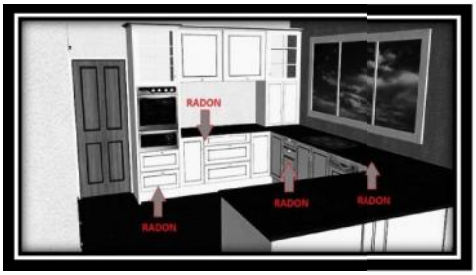

Fig.1Modern kitchens and the increasing use of stones and granite

II. 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 of4.47×10^9. 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.

Fig. 2 The half-life of radon and uranium [9]

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

III. 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 [9].

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).

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Fig.4 Toyserkan Black Granite

Fig. 5 Zahedan White Granite

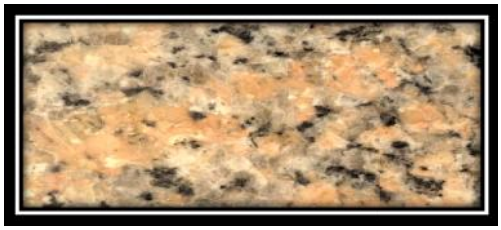

Fig.6 Nehbandan Orange Granite

Fig.7 Khoramdareh Golden Granite

IV. 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 2011.05.18. 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 are the spent time.

Table I: Results of radon measurements in the samples to Pico Curies per liter

Stone Sample	Measurement Times	4 pieces(Pci/L)	3 pieces(Pci/L)	2 pieces(Pci/L)
Black Granite	15:30(2011.5.18)	0.51	0.35	0.20
White Granite	14:30(2011.6.10)	1.20	1.05	0.50
Orange Granite	13:00(2011.6.26)	0.25	1	0.45
Golden Granite	14:01(2011.7.25)	2.02	2	0.75

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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 II

The amount of radon in some kitchens of Hamedan City

Address	Number (type of used stone)	Radon gas rate per Bq/m^3
Farhangian Town	Kitchen 1 (black granite)	138.69
Taleghani Street	Kitchen 2 (orange granite)	166.24
Pastor Street	Kitchen 3 (white granite)	179.56
Madani Town	Kitchen 4 (golden granite)	187.15
Mirzade Eshghi Street	Kitchen 5 (white granite)	162.99
Mean	167	

VI. CONCLUSIONS

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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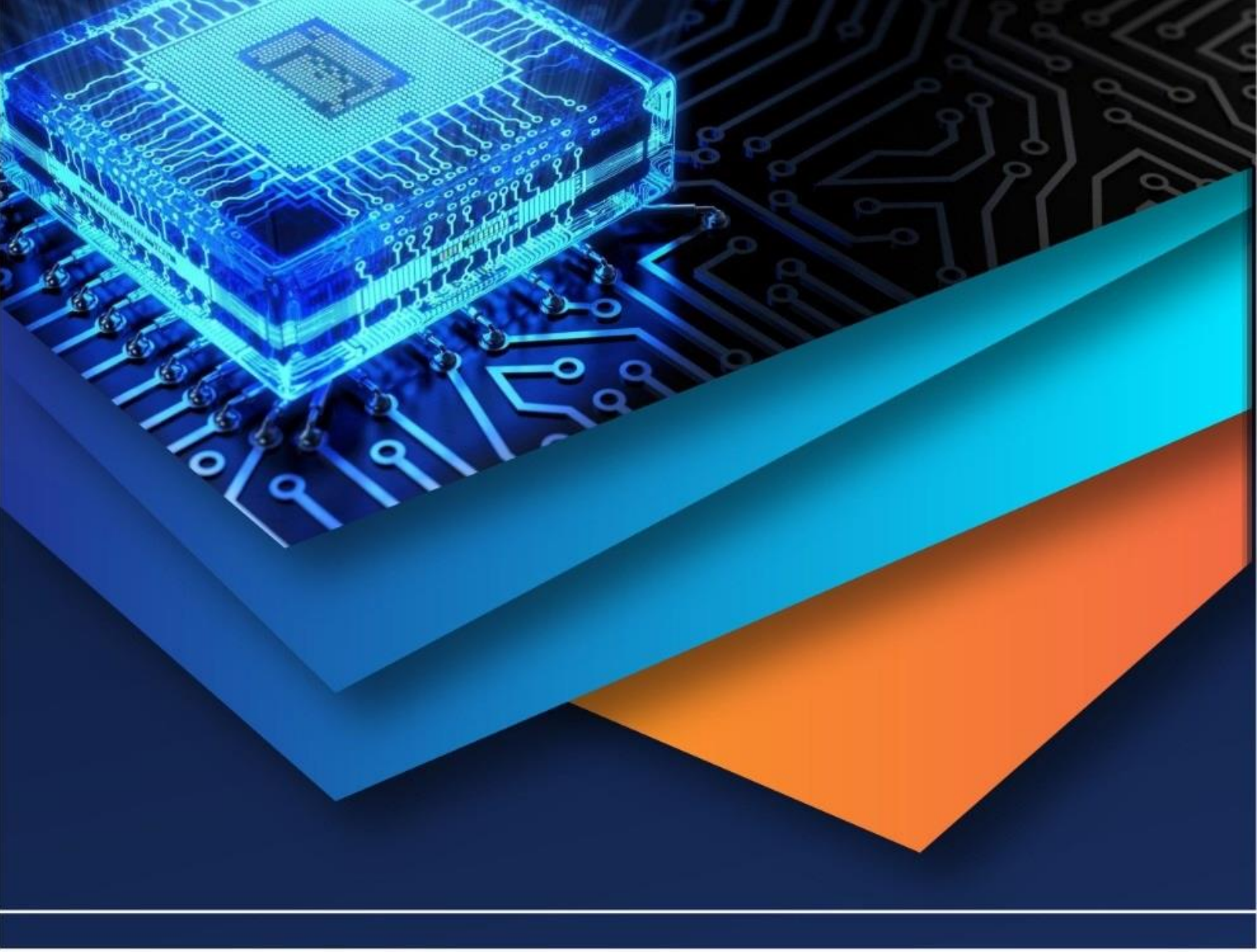

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