STUDY OF RADON-222 LEVELS IN FOAMED LIGHT CONCRETE

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ABSTRACT

The purpose of this study is to measure and monitor the radon concentration from fabricated foamed light concrete, made of Portland cement, mine sand and granite. The concentration of radon released was measured using Radon Monitor Model 1027 from Sun Nuclear. The results of this research showed that the avearge radon concentration from foamed light concrete was 2.2 $pCiL^{-1}$ L. Higher radon concentrations were detected after three days of measurements. Environment Protection Agency stated in its guidelines that radon concentration must lower than 4 $pCiL^{-1}$ for a healthy environment. Thus, the use of foamed light concrete can be one of the alternatives to reduce radon concentration levels in human environment.

ABSTRAK

Kajian ini dilakukan bagi mengukur dan memantau kepekatan radon yang berpunca daripada konkrit ringan berbusa, yang diperbuat daripada simen Portland, pasir lombong dan granit. Kepekatan radon yang terbebas ditentukan dengan menggunakan Monitor Radon Model 1027 Sun Nuclear. Hasil kajian ini menunjukkan bahawa kepekatan radon yang berpunca dari konkrit ringan berbusa ialah 2.2 $pCiL^{-1}$. Kepekatan radon dikesan lebih tinggi selepas tiga hari pembilangan dilakukan. Environment Protection Agency (EPA) telah menetapkan garis panduan bahawa kepekatan radon mestilah lebih rendah dari 4 $pCiL^{-1}$ bagi persekitaran yang sihat. Oleh itu, penggunaan konkrit ringan berbusa boleh dijadikan sebagai salah satu alternatif untuk mengurangkan aras kepekatan radon dalam persekitaran manusia.

Keywords: Radon-222

INTRODUCTION

Radon (Rn), a naturally occurring radioactive inert gases, come from the radioactive decay of uranium. It is radioactive with a short half-life of 3.8 days, decaying in successive steps by the emission of α-radiation to polonium, bismuth, and lead (radon progeny/daughters).

The two isotopes of the element radon that are important in health protection are Rn-222 and Rn-220 which are part of the decay series originating from U-238 and Th-232 respectively. Rn-222 which is generally referred to as Rn, is the first decay product of the naturally occurring element Ra-226. The potential health hazard is primarily attributed to the α-emitting Rn progeny. According to

BEIR VI report (US Environment Protection Agency, 2002) and a study led by researchers at the University of Iowa College of Public Health (Residential Radon and Lung Cancer Case-Control Study, 2000), long term exposure to radon in the home is associated with lung cancer risk and present a significant environmental health hazard.

As an inert gas, radon simply goes in and out of our lungs as we breathe without causing any harm, but the radon daughters (being basically solid and sometimes electrically charged) can stick to the surface of our bronchial tubes. The radon daughters also attach themselves to microscopic dust particles, which are then inhaled down into the deepest parts of the lung. This puts them right where they can do the most harm, for the cells lining our bronchial tubes are among the cell in our body most sensitive to radiation-induced cancer. The α-radiation emitted in the decay of radon daughters, can reach those sensitive cells because they are deposited so close to them.

Source of Radon and how it enters homes

The existing of radon gas normally is associated with rock with high concentration of uranium (U-238), however the concentration of U-238 in rock and soil varies significantly. The actual amount of radon that reaches the surface of earth is related to the concentration of uranium in the rock and soil as well as the efficiency of the transfer processes from the rock or soil to soil-water and soil-gas. The soil composition under and around, and the material used for a house affect indoors radon levels and the ease which radon migrates toward a house. These are three major pathways have been identified by which radon gas enters homes:

a. As a gas that migrates up from soil and rock
b. In groundwater pumped into wells
c. In construction materials

Among those three major pathways, the third factor is the main concern as most of the building materials used are direct or indirectly originated from granite rocks. When building materials with a high radium concentration are being used, the radon progeny in ordinary buildings may increase the radiation exposure of the public to unacceptable levels.

METHODS

To evaluate the contributions from building materials to indoor Rn concentrations, the most important factor is the exhalation rate of Rn from the material. The method used for evaluating the exhalation rate involves placing a normal sized sample of foamed light concrete in a specially designed closed container. The building material used was fabricated in the School of Housing, Building and Planning, USM. Portland cement, mine sand and granite were used in making foamed light concrete.

The build-up of Rn inside the container was measured for 5 consecutive days using a Sun Nuclear digital radon monitor Model 1027. Data acquired includes the average and current radon concentration ($pCiL^{-1}$), temperature (°C), pressure (mbar), relative humidity (%) and the time of sampling.

RESULTS AND DISCUSSION

Figure 1 below shows the emission rate measured from foamed light concrete mentioned. Table 1 and Figure 2 of this research showed that the current Rn concentrations varies from the lowest value of 1.7 $pCiL^{-1}$to the highest value of 3. $pCiL^{-1}$ throughout the said period, with variations in temperatures between 28.0 °C and 32 °C and relative humidity between 78.0% and 83.0%. Higher radon concentrations were detected after three days of measurements. The results obtained show that the current radon concentration was proportional to temperature and inversely proportional to humidity.

The average Rn concentration in foamed light concrete was 2.2 $pCiL^{-1}$. The average value is obviously much lower as compared to concrete sample (made of a combination of granite aggregates, sand, cement, and sand brick), where the value measured is between 5.8 and 8.4 $pCiL^{-1}$ (Jaafar *et al*, 2002). The Environment Protection Agency guidelines (Residential Radon and Lung Cancer Case-Control Study,2000) specified the value of Rn concentration at below 4 $pCiL^{-1}$ exposure for a healthy environment.

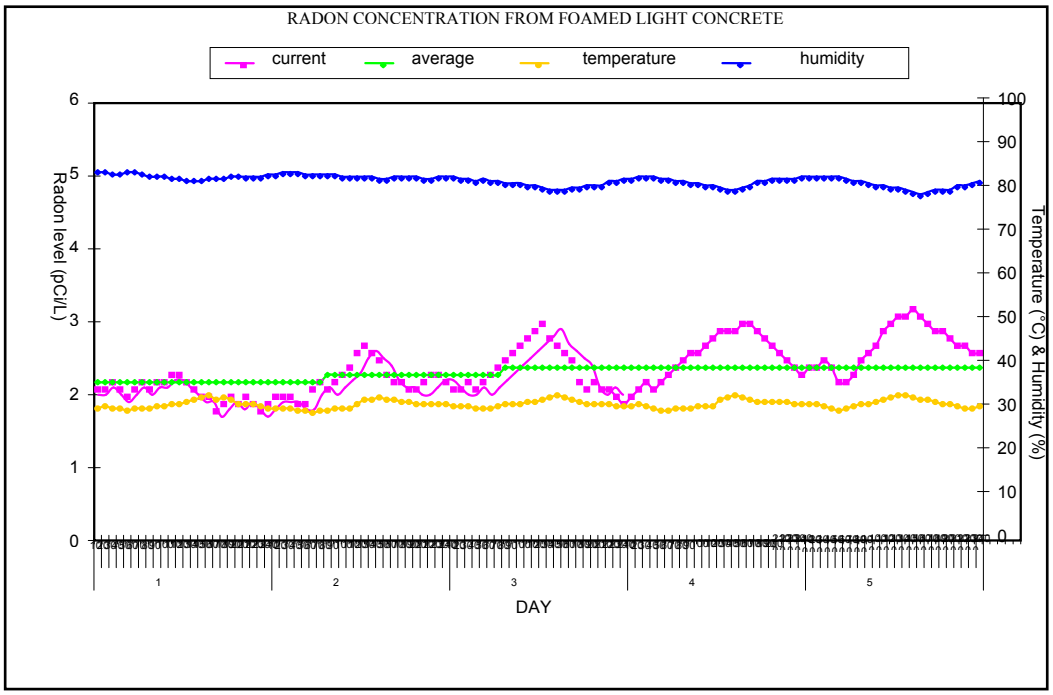

Figure 1: Radon level for a week of observation

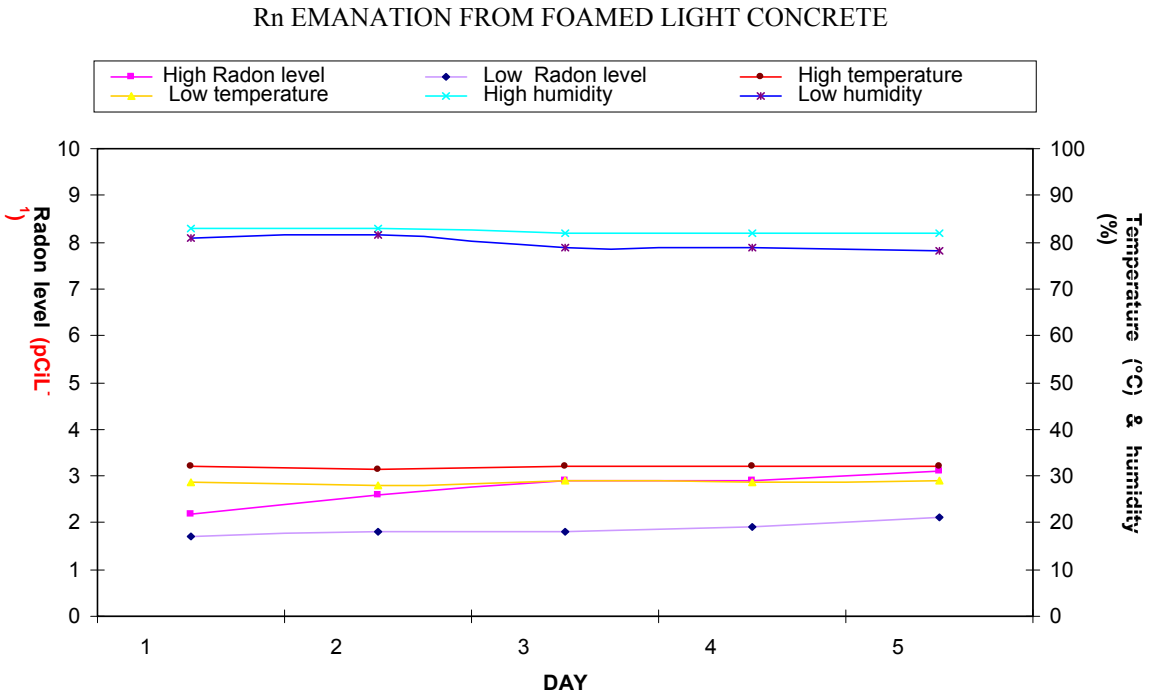

Figure 2: Rn EMANATION FROM FOAMED LIGHT CONCRETE

Table 1: Radon levels for several days of observation

Day	Radon Level ($pCiL^{-1}$)		Temperature (°C)		Humidity (%)	
	High	Low	High	Low	High	Low
1	2.2	1.7	32.0	28.5	83.0	81.0
2	2.6	1.8	31.5	28.0	83.0	81.5
3	2.9	1.8	32.0	29.0	82.0	79.0
4	2.9	1.9	32.0	28.5	82.0	79.0
5	3.1	2.1	32.0	29.0	82.0	78.0

CONCLUSION

Exposures in the range of about 4 $pCiL^{-1}$ or lower is considered average or slightly above average for residential structures. Although exposures in the range do present some risk of lung cancer, in general, reduction of level this low may be difficult, and sometimes impossible, to achieve.

However, the fabricated foamed light concrete as a building material, made with certain proportions of its constituents, can effectively reduced the Rn concentration as compared to concrete sample.

FUTURE WORK

Future work on Rn study will embark on other building materials, manipulating and covering exposed building materials of significant radon emanation, and study on the ventilation system in which natural or forced ventilation can be increased in order to diminish indoor levels of radon gas.

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