

Radiation in Building Materials

Report

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Department of Earth Atmospheric & Planetary Sciences

Massachusetts Institute of Technology, Cambridge, MA

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Katharine Chu

Introduction:

After years of studies and experiments scientists know that Radon is everywhere but found in high concentrations particularly in rocks and soil enriched in uranium. Many of these rocks and soils are treated and compacted to create everyday building materials that are found in homes in which we live and work. A new generation of studies has been developed to try and calculate how much and what type of radiation people are exposed to in their homes when certain building materials are used and the materials people can use to lower their exposure to radiation.

How to Measure Radiation:

Research is currently being pursued by scientists all over the world on the amount of radiation people are exposed to living in certain situations. Since this research is being pursued by scientists all over the world and the conditions are different from person to person, room to room, house to house, city to city, and country to country, several precautions have to be taken when interpreting such

data. One of the easiest ways to measure and interpret the data is by measuring the amount of radiation that is just in the surrounding background and using that information as a baseline. Then subtracting the radiation baseline you are able to see how much radiation is actually found in a house using certain radioactive materials and compare that figure to a house that uses normal building materials. The size of each room created must be extremely accurate and the amount of pressure in case must also be the same. The building materials must be used in the same way as the way the building materials will be used by builders. All of these factors will contribute greatly to the findings of each experiment.

Zircon Glazed Tiles:

Many tiles are glazed with a material called zircon which contains Ra-226 and Th-232. Zircon glazed tiles contains 17,500 Bg/kg which is over 106 times the amount of radiation from normal building materials. The dose rate of gamma radiation is measured at a distance of 5cm away from zircon and sand piles. After comparing this data with the baseline, scientists determined that rooms with zircon glazed tiles created 1.5 times as much ionizing radiation as rooms without the zircon glazing. It is now believed that beta radiation given off from zircon glazing is one of the leading reasons as to why the general public is now exposed to more and more ionizing radiation everyday.

Radon Dose from Clay Bricks:

Scientists measured the Radon-222 dose from clay bricks by using cellulose nitrate films to measure radiation activity inside houses. Unlike certain granite

bricks which emanate radiation from the inside of the material, scientists found that clay bricks emanate radiation only from the surface layers. After multiple measurements scientists have found that the average radiation for a room built with clay brick ranges around 22 mBq and a closed vessel made out of clay brick is around 40 mBq.

Radon Emanation from Building Materials:

Small scale experiments have been used to find out how much radon is emanated from popular building materials such as red brick, clay brick, granite, and sand brick. From this experiment, scientists determined that back scatter was very important in determining the amount of radiation a person is exposed to because certain rooms had a smaller amount of measurable radiation than the initial emanation of radiation from the building material. By finding the initial emanation rate and multiplying it by a diffusion coefficient determined by the geometry of the room, scientists were able to find how much radiation was emanated from each material in different sized and shaped rooms.

Radon Transport in Concrete in Relation to Moisture

After many experiments, scientists have determined that radon transport in concrete depends on moisture in the environment. Radon release rates seemed to increase linearly with moisture rates from 50-60%. However the moisture reached a maximum at 70-80%, and the transport rates decreased dramatically afterwards when applied to a slab of concrete 20cm thick. This experiment gives critical information to builders to see how thick of concrete to use in different

climates to prevent radon gas from seeping through the concrete and entering the house.

Conclusion:

All of these experiments provide critical information to different builders and home buyers by educating them about choices they can make to create a safer living environment for themselves. Other factors should be taken into consideration such as how much time people spend indoors and how much of a benefit there is to using certain materials and whether or not it outweighs the dangers of using certain radioactive materials. As technology becomes more and more advanced and more information is uncovered about radiation, producers and consumers will be able to create a better and safer world for us all.

References:

- 1) Radioactivity in zircon building tiles,
Deng W. Tian K. Zhang Y.,
Health. Phys. 1997 Aug. 73(2): 369-72.
- 2) A study of radon emitted from building materials using plastic alpha-track Detectors,
Abu-Jarad, F., Fremlin, J. H., Bull, R.,
Phys. Med. Biol. 1980 Jul; 25(4):683-94.
- 3) Radon emanation of building material--impact of back diffusion and difference between one-dimensional and three-dimensional tests,
Chao, C.Y., Tung, T.C.,
Health Phys. 1999 Jun;76(6):675-81.
- 4) Moisture dependence of radon transport in concrete: Measurements and modeling.
Cozmuta I. Van der Graaf ER. de Meiter RJ.
Health Phys. 2003 Oct; 85(4): 438-56