Available online at www.sciencedirect.com
ScienceDirect
Radiation Measurements 43 (2008) 1458–1462
Radiation Measurements
www.elsevier.com/locate/radmeas

Short communication

Radon exhalation and its dependence on moisture content from samples of soil and building materials

Munazza Faheem[a], Matiullah[b,*]

[a]Pakistan Institute of Engineering and Applied Sciences (PIEAS), Nilore, Islamabad, Pakistan
[b]Physics Division, PINSTECH, Nilore, Islamabad, Pakistan

Received 10 July 2007; received in revised form 7 February 2008; accepted 23 February 2008

Abstract

Indoor radon has long been recognized as a potential health hazard for mankind. Building materials are considered as one of the major sources of radon in the indoor environment. To study radon exhalation rate and its dependence on moisture content, samples of soil and some common types of building materials (sand, cement, bricks and marble) were collected from Gujranwala, Gujrat, Hafizabad, Sialkot, Mandibahauddin and Narowal districts of the Punjab province (Pakistan). After processing, samples of 200 g each were placed in plastic vessels. CR-39 based NRPB detector were placed at the top of these vessels and were then hermetically sealed. After exposing to radon for 30 days within the closed vessels, the CR-39 detectors were processed. Radon exhalation rate was found to vary from 122 ± 19 to $681 \pm 10\,\mathrm{mBq\,m^{-2}\,h^{-1}}$ with an average of $376 \pm 147\,\mathrm{mBq\,m^{-2}\,h^{-1}}$ in the soil samples whereas an average of 212 ± 34, 195 ± 25, 231 ± 30 and $292 \pm 35\,\mathrm{mBq\,m^{-2}\,h^{-1}}$ was observed in bricks, sand, cement and marble samples, respectively. Dependence of exhalation on moisture content has also been studied. Radon exhalation rate was found to increase with an increase in moisture, reached its maximum value and then decreased with further increase in the water content.
© 2008 Elsevier Ltd. All rights reserved.

Keywords: Closed vessel technique; Indoor radon; Health hazards; Soil; Bricks; Sand; Cement; Marble samples

1. Introduction

Radon (^{222}Rn) is a noble gas and is formed by the decay of ^{226}Ra, which is one of the nuclides formed in the disintegration series from ^{238}U. In principle, the amount of radon formed in rocks and soils depends on their uranium content. However, this alone is not decisive in determining the radon concentration in air, it is also determined by the extent to which the radon atoms formed actually emanates from the mineral grains and whether radon can leave the pore space either by diffusion or together with a flow of air or water. In addition, radon concentration in the soil air is significantly affected by the occurrence of moisture/water in the pores. Besides soil, construction materials may also significantly contribute toward the indoor radon (Durrani and Ilic, 1997). Permeability of the soil is a main factor affecting radon levels in dwellings. As the measurement of soil permeability is difficult, the exhalation rate, which is the number of radon atoms leaving the soil per unit surface area per unit time from the ground, is thought to be a better indicator of radon risk.

Contribution of radon and its progeny to the total effective dose has been reported to be more than 50% (UNSCEAR, 2000). It is a major contributor toward an increased lung cancer risk in the population (Field et al., 2001). ^{222}Rn and its decay products due to their health hazards have been a cause of concern, as these radionuclides may reach quite high levels in buildings with lack of adequate ventilation or strong sources of radon. In this regard, radon measurements are being pursued all over the world as well as at national level and extensive data are available in the open literature (Nazaroff and Nero, 1988; Tufail et al., 1988; Matiullah et al., 1991, 1993; Mansour et al., 2005; Bochicchio et al., 2005; Rehman et al., 2006a; Rahman et al., 2007).

* Corresponding author.
E-mail addresses: matiullah@pieas.edu.pk, dr_matiullah@yahoo.com (Matiullah).

1350-4487/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.radmeas.2008.02.023

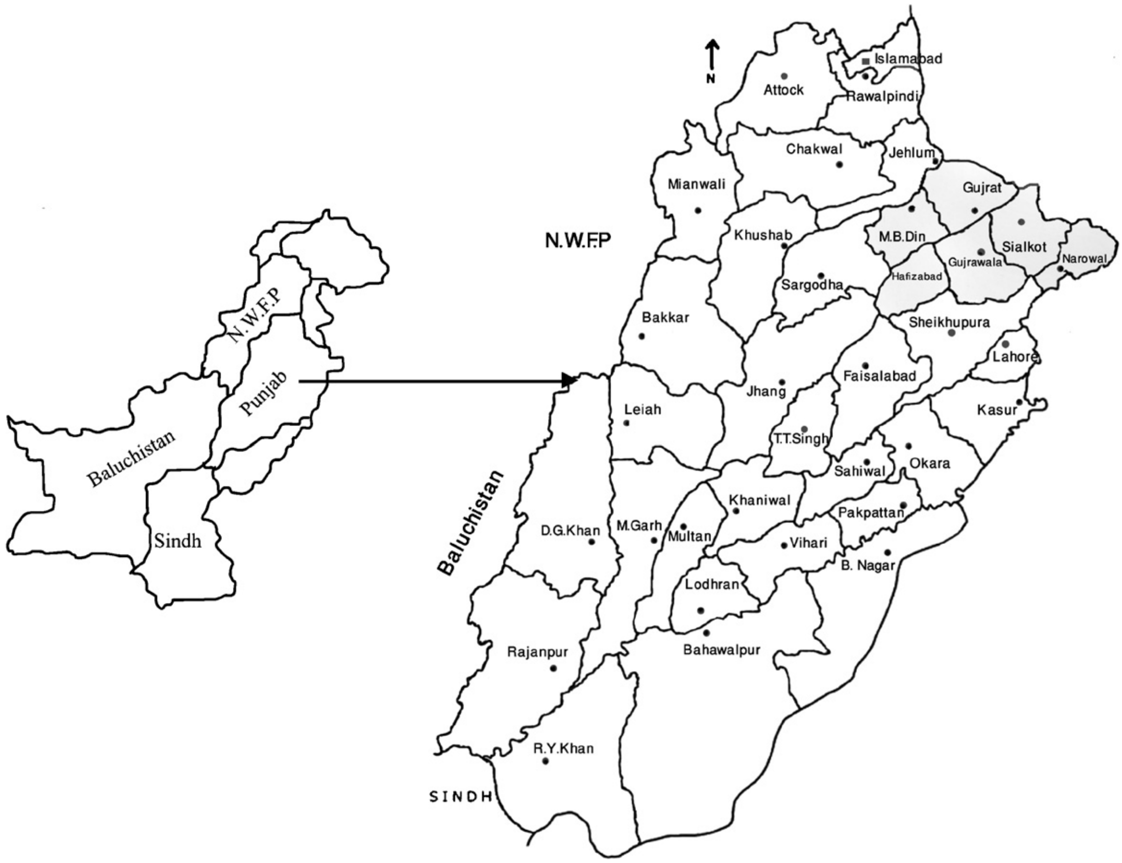

Fig. 1. Map of Pakistan and Punjab province showing the six districts understudy.

In this study, we present our data concerning measurement of the radon exhalation rate and its dependence on moisture contents in soil/building material samples collected from Gujranwala, Gujrat, Sialkot, Hafizabad, Mandibahauddin and Narowal districts in the Punjab province in Pakistan using close vessel technique. The location of these districts is shown in Fig. 1. Houses in these districts are mainly constructed from soil, bricks, cement, sand and marble. These districts are located in the northeastern part of the Punjab province of Pakistan. The area, where the samples were collected, receives frequent heavy showers in the monsoon season (i.e. July–August) whereas substantial rainfall is also received in the winter season (i.e. December–January). Therefore, it would be informative to study the effect of moisture on the radon exhalation rate. Geologically, these areas are a part of the Indo Gangetic plain formed in front of the rising Himalayas. Sedimentary rocks dominate Punjab's geology and most of the soil in these areas has developed on the extensive fluviatile deposits of five rivers.

2. Material and methods

From each district understudy (i.e. Gujranwala, Gujrat, Hafizabad, Sialkot, Mandibahauddin and Narowal), eight representative soil samples were collected. In addition to these samples 14 bricks, 10 marble, 7 cement and 10 sand samples were also collected from different dealers/suppliers of the above-mentioned districts wherefrom most of the people of that area purchase the building materials. The samples of building materials were ground, sieved and then dried in oven at 110 °C for 24 h to evaporate all the moisture contents. After drying, 200 g of each sample was placed in a plastic container of volume $5.286 \times 10^{-3}\,m^3$ with sample surface area of $0.02\,m^2$ as shown in Fig. 2. CR-39 based NRPB radon dosimeters were then placed in these plastic vessels at a distance of 25 cm from the surface of the sample so as to count only the contribution of ^{222}Rn, to evade the role of thoron from the surface of soil samples (Durrani and Ilic, 1997; Howarth and Miles, 2003;

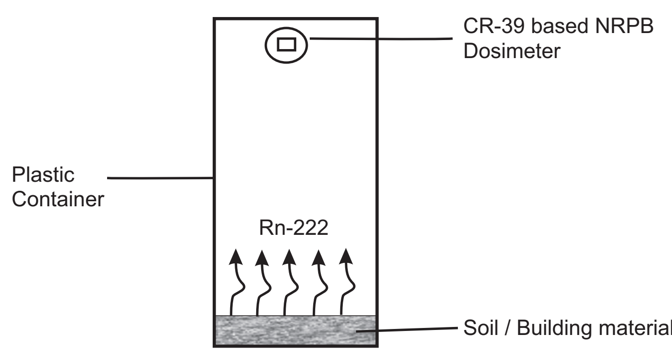

Fig. 2. Experimental setup for the measurement of radon exhalation rate of soil/building material.

Download English Version:

https://daneshyari.com/en/article/1888726

Download Persian Version:

https://daneshyari.com/article/1888726

Daneshyari.com