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Rajan Jakhu, Rohit Mehra, Pargin Bangotra, Kirandeep Kaur, H.M. Mittal

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Estimation of Terrestrial radionuclide concentration and effect of soil parameters on exhalation and emanation rate of radon

Rajan Jakhu[1]; Rohit Mehra*[1]; Pargin Bangotra[1]; Kirandeep Kaur[1]; H. M. Mittal[1]

[1]Department of Physics, Dr B R Ambedkar NIT Jalandhar

Abstract

The Soil samples collected from the different locations of the Jaipur and Ajmer districts of Rajasthan have been analysed for ^{232}Th, ^{226}Ra and ^{40}K content using gamma spectrometry. The average concentration of the ^{232}Th, ^{226}Ra and ^{40}K in soil samples comes out to be 69, 55 and 884 Bq kg^{-1}. The Emanation and Exhalation rate of the ^{222}Rn, ^{220}Rn from the collected soil samples have been measured. As the ^{222}Rn and ^{220}Rn originates from the solid grains of the medium and migrate through its pore space, it is expected to get affected by various soil parameters. An attempt has been made to see the effect of physical soil parameters on the Exhalation and Emanation rate of the ^{222}Rn and ^{220}Rn. The results of the present study show the dominance of the soil parameters on the ^{222}Rn, ^{220}Rn emanation and migration through the medium.

Keywords: ^{226}Ra, ^{232}Th, ^{40}K, Exhalation and Emanation rate, Soil parameters.

1. Introduction

Uranium, Thorium and their decay product radionuclides are predominate part of the environmental radioactivity. Due to the presence in all three natural decay series, high mobility in the natural environment and bone seeking properties of radium, it require particular attention (Fesenko et al., 2009). The concentration of the natural radionuclides in the soil depends mainly upon the parent rock properties and also on the soil parameters. Soil is formed from the rocks due to various environmental phenomenon such as weathering, change in temperature etc. The weathering of the rocks causes the radionuclides to deposits in the soil or to reach the air and water medium (Iyengar, 1990).

The rocks and soil under or surrounding the homes are the main sources of indoor radon and thoron (Nazaroff et al., 1988a). Therefore indoor concentration of radon, thoron depends upon their parent radionuclide concentration in the soil or rock and on the access of the radon/thoron gases to indoor dwellings. The second largest contribution of the radon and thoron in the indoor environment is the building material used in the construction of the dwellings (Nazaroff et al., 1988a; Stranden, 1988; UNSCEAR, 2000). Other sources of the indoor radon and thoron are the groundwater, natural gases and outdoor air but the contribution of these three is negligible for an average home (UNSCEAR, 2000; Nero, 1988; Nazaroff et al., 1988b).

The soil and the building material consist of the solid and porus fraction. The solid fraction consists mainly of mineral grain and organic matter but the porus fraction usually consists of the water and gas. The radon and thoron concentration in the rock or soil present around the dwellings is 10^3 to 10^4 times higher than the indoor air. This results in a permanent concentration gradient, which is maintained by the long lived decay products of the uranium and thorium series. Radium and radon are the daughter products formed by the radioactive decay of uranium. Each atom of radium decays by ejecting from its nucleus an alpha particle. As the alpha particle is ejected, the newly formed radon atom recoils in the