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PHYSICS

A COMPARATIVE STUDY OF ENVIRONMENTAL INDOOR RADON AND THORON IN SHAHJAHANPUR AND HARDOI DISTRICT OF CENTRAL UTTAR PRADESH

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Abstract
The measurement of indoor radon, thoron and their daughter products was carried out in about fifty houses of dist. Shahjahanpur and Hardoi of Central Uttar Pradesh, India using LR-115 plastic track detectors. The measurements were made in residential houses from June 2008 to May 2009 hanging twin cup radon dosimeter at a height of 1.5-2m from ground level. The twin cup radon dosimeter can record the values of radon, thoron and their decay products separately. The graphs were plotted for radon concentration versus number of houses, thoron concentration versus number of houses and dose rate versus number of houses for different seasons. The resulting dose rates due to radon, thoron varied from 0.04 to 1.46 μSv/h. The observed radon and thoron concentration inside the houses of central Uttar Pradesh were found to be lower than the ICRP recommended value of 200 Bqm^{-3} and thus are within safe limits.

Keywords: Radon; Thoron; Uttar Pradesh; Environment

Introduction

Radon and its short-lived decay products in the environment play the most important role to human exposure from natural sources of radiation. Radon is a naturally available radioactive gas, which is the decay product of radium. The possibility of cancer induction due to indoor radon has been attracting attention in the scientific community during the past decades. It is now widely recognized that indoor radon is a largest single source of exposure to ionizing radiation in the environment. For the population as a whole, the average effective radiation dose from radon is estimated to be greater than the dose from all other natural sources of radiation combined, greater than the dose from industrial activities including nuclear power and the dose from medical treatments including x-ray.

The contribution of indoor thoron concentration is generally considered negligible because of its short half-life. It is well known that inhalation of the short-lived decay products of radon and, to a lesser extent, the decay products of thoron and their subsequent deposition along the walls of the various airways of the bronchial tree, provides the main pathway for radiation exposure to the lungs (ICRP, 1993; UNSCEAR, 1993). Studies from deferent parts of the world show that well-planned and systematic measurements of indoor radon activity concentrations for all seasons during a calendar year are necessary to calculate the actual dose due to exposure to indoor radon. The activity concentrations of indoor radon/thoron and their progeny are largely influenced by factors such as topography, type of house construction, building materials, temperature, pressure, humidity, ventilation, wind speed, and even the life style of the people living in the house (Jonassen, 1975; Martz et al., 1991; Nazaro. and Doyle, 1985; Ramola et al., 1987, 1992, 1998, 2000; Segovia and Cejudo, 1984; Subba Ramu et al., 1988). To estimate the annual average equivalent dose, a number of indoor radon surveys have been carried out around the world (UNSCEAR, 1993) .Due to recent surveys in Dehradun and nearby towns of U.P. suggest a little higher concentration of radon than the normal one, hence radon concentration survey was required for different regions of the state. So Shahjahanpur & Hardoi district of central Uttar Pradesh are chosen as study area. The aim of proposed investigation is to carry out the systematic study of radon and their daughter products in relation to their application in radiation protection.

Study area

The measurements of indoor radon, thoron and their progeny were made in houses of Shahjahanpur and Hardoi district of central Uttar Pradesh. The houses in study area are well, as well as poorly ventilated. Buildings are constructed of concrete, cement, bricks and blocks. Some houses, having glass doors and glass windows are also included in study.

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Experimental method

The radon/thoron and their daughter products in environment were measured in 50 houses of the Shahjahanpur & Hardoi district of central Uttar Pradesh using alpha sensitive LR-115 type II plastic track detectors. It is a 12 micrometer thick film red dyed cellulose nitrate emulsion coated on inert polyester base of 100 micrometers thickness and has maximum sensitivity for alpha particles. The small Pieces of detector film of 2.5 cm x 2.5 cm. will be fixed in a twin cup radon dosimeter having three different mode holders' namely bare mode, filter mode and membrane mode. The bare mode detector registers track due to radon, thoron gases and their progeny concentrations while the filter made detector records tracks due to the radon and thoron gases, membrane made records tracks only by radon gas. The dosimeters fitted with LR-115 plastic track detector are suspended inside the selected houses in field area at a height of about two meters from the ground floor. When alpha particles strikes on LR-115 film it creates narrow trails called Tracks. The detectors were exposed for about three months and, after retrieval, were etched and scanned in the laboratory for the track density using spark counter. The measured track densities for indoor radon and progeny were then converted into working levels(WL) and activity concentrations (Bq m^{-3}) using the following calibration factors.

125 tracks cm^{-2} d^{-1}=1WL
3.12x10^{-2} tracks cm^{-2} d^{-1}=1 Bqm^{-3}

Measured track densities for thoron and progeny were converted into appropriate units using the calibration factor obtained in the form of a computer programme developed by the Environmental Assessment Division of Bhabha Atomic Reseach Centre, Mumbai, for the use of various Indian radon research group under collaborated research programme of the Department of atomic Energy (Ramola et al., 1996;Ramachandran, 1998).

Fig -1

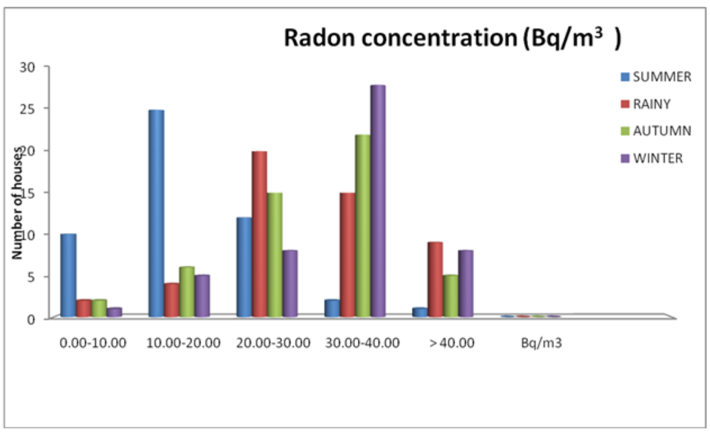


Fig-2

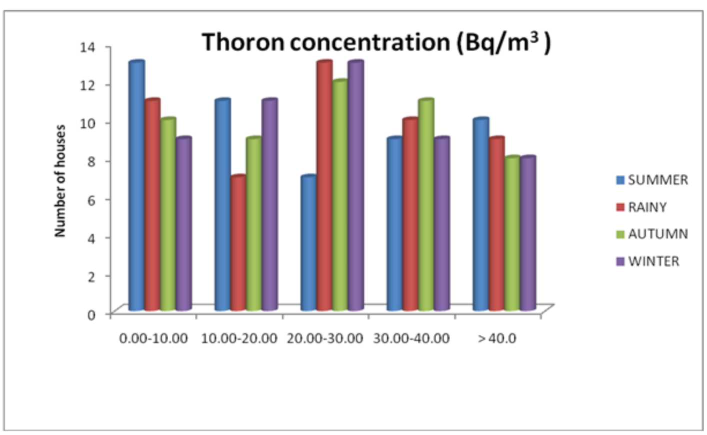
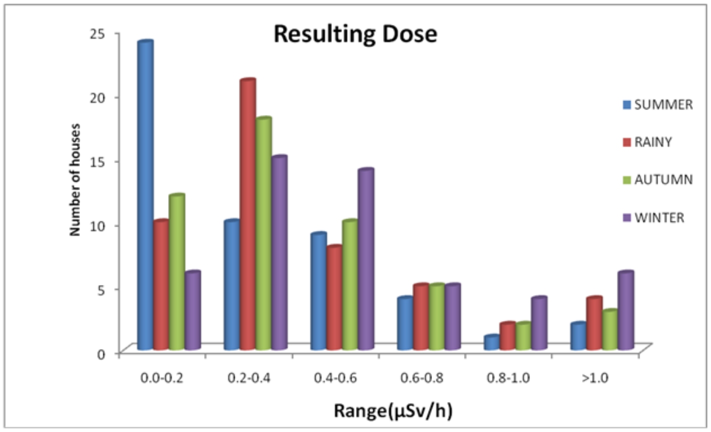


Fig-3



Results and Discussion

Measured values of radon and thoron for four different seasons of a calendar year are shown in Figs. 1 and 2. Radon concentrations were found to be highest in winter and lowest in summer. In winter most of the values observed were between 30 and 40 Bq/m3 while in summer maximum values were between 10 and 20 Bq/m3. This may be due to ventilation condition in summer and winters are quite different. However, no systematic seasonal variation was observed for thoron concentrations (Fig. 2) which were found to be evenly distributed within different ranges for all seasons.

The resulting estimates of dose due to the presence of radon and thoron are shown in Fig. 3. Most of the values observed are between 0.2 and 0.6 μSv/h with high values in winter and low in summer. A large variation in the activity concentrations of radon and its progeny was observed for different seasons of the year. Since the area remains cold during winter, doors and windows are kept closed to conserve energy, thus allowing an accumulation of radon, thoron and progeny inside the houses. However, the recorded values of radon, thoron and progeny and resulting doses are well below internationally recommended levels (ICRP, 1993). This clearly indicates that the houses in areas in central uttar pradesh are quite safe from the radiation protection point of view.

Conclusions

Based on the results obtained from the study area, the activity concentrations of Radon and thoron in the houses of the Shahjahanpur & Hardoi district of central Uttar Pradesh is studied for all four seasons. The resulting doses were found to be well below internationally recommended levels and are within the safe limit from the radiation protection point of view.

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