Concentration of Radon and its Progeny Levels in Air in the Dwellings of Moradabad of Western U.P

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Abstract
This study assesses the indoor radon and its progeny in some dwelling in Moradabad of Western Uttar Pradesh by using LR-115 plastic track detector. The measurements were made in 66 residential houses from January 2012 to December 2012 hanging twin cup radon dosimeter at a height of 1.5-2.0 m from ground level. The twin cup radon dosimeter can record the values of radon, and its decay products separately. The graphs were plotted for radon concentration versus number of houses for different seasons. The resulting radon concentration level due to radon varied from 18.14 $Bq.m^{-3}$ to 22.62 $Bq.m^{-3}$. The observed radon concentration inside the houses of Moradabad were found to be lower than the ICRP recommended value of 200 $Bq.m^{-3}$ and thus are within safe limits.

Keywords: Radon; LR-115 plastic track detector; Twin cup dosimeter.

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 an important natural source and is the largest contributor to the effective dose received from natural sources. It has been estimated that radon and its progeny contribute 75% of the annual effective dose received by human beings from natural terrestrial sources and are responsible for about half of the dose from all the sources. Indoor inhalation dose due to 222Rn, 220Rn and their progeny is to be estimated about 1.2 $mSv.y^{-1}$ of the total 2.4 $mSv.y^{-1}$ background dose [1]. The possibility of cancer induction due to indoor radon has been attracting attention in the scientific community during the past decades The U.S. Environmental Protection Agency (EPA) and the U.S. Surgeon General acknowledge radon as the second leading cause of lung cancer overall and the number one cause of lung cancer among non-smokers. Residential radon is attributed to 21,000 (13.4%) annual lung cancer deaths in the United States, 2,900 of which are among non-smokers [2] It is demonstrated that radon is a human lung carcinogen even at concentrations commonly encountered in the residential setting. Because of the significant health risks related to residential radon exposure, the World Health Organization (WHO) instituted an international initiative in 2005, the International Radon Project, to reduce indoor radon risks.[3] It is well known that inhalation of the short lived decay products of radon 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 .[4] 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. Maps of radon prone areas showing different potential radon emission levels are very helpful to assist the authority in identifying populations with a higher risk of indoor radon gas exposure. [5]The activity concentrations of indoor radon and its 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 .A model is developed according to these parameters for calculation of the radon concentration in indoor air.[6] The 222Rn and 220Rn levels have been measured using solid state nuclear track detectors in various types of houses at 10 different locations around Bangalore city, India. 220Rn levels observed were higher than the global average of 10 $Bq.m^{-3}$.[7] Due to recent surveys in Dehradun [8] and nearby towns of U.P [9] suggest a little higher concentration of radon than the normal one, hence radon concentration survey was required for different regions of the

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state. So Moradabad district of western 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 and its progeny were made in houses of Moradabad district of western 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.

Experimental method

The radon and its daughter products in environment were measured in 66 houses of the Moradabad district of central Uttar Pradesh using alpha sensitive LR-115 type II plastic track detectors. [10] 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 gas and their progeny concentrations while the filter made detector records tracks due to the radon and gas, 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 $cm^{-2}.d^{-1}$=1 WL

3.12x 10^{-2} tracks cm^{-2} d^{-1} = 1 $Bq.m^{-3}$

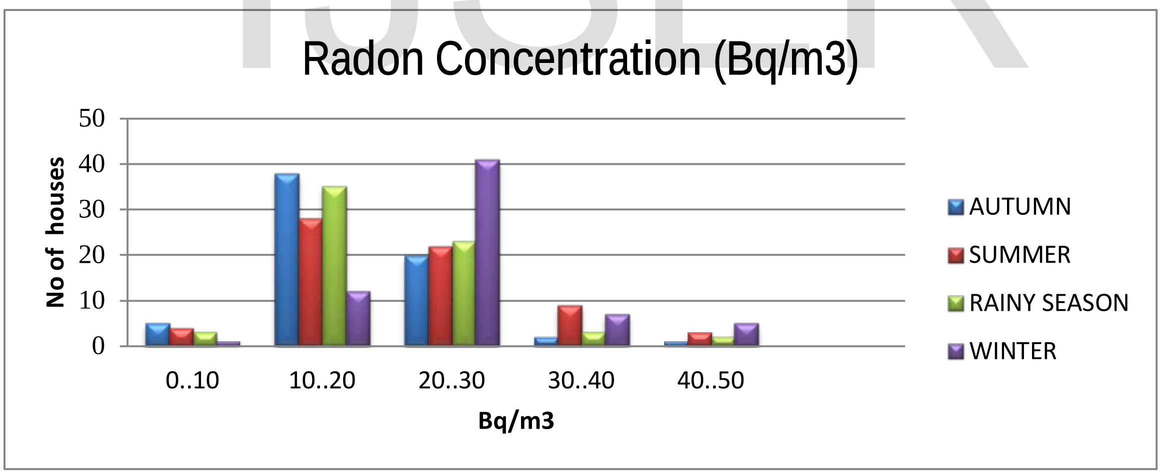

Fig.1

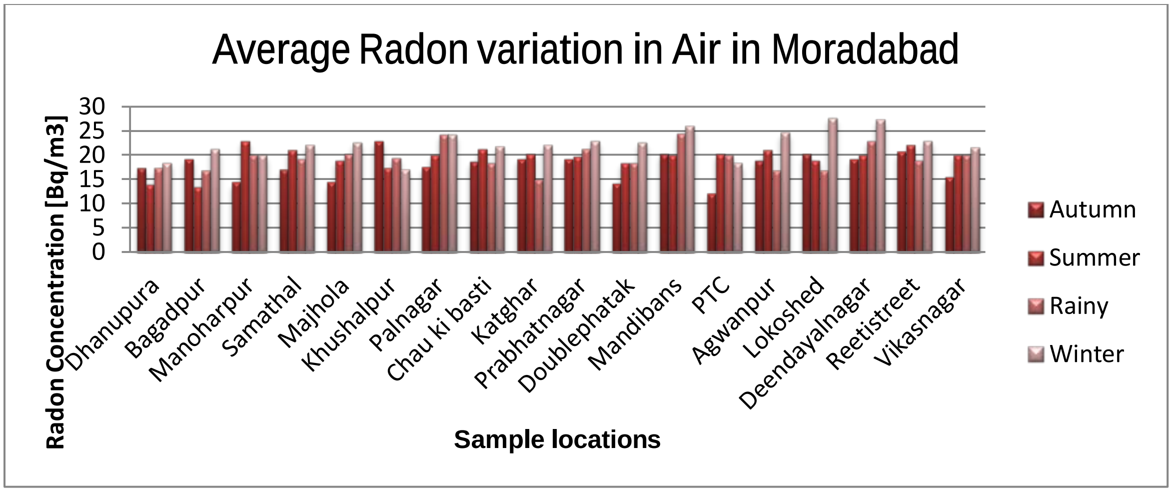

Fig.2

Results and Discussion

Measured values of radon for four different seasons of a calendar year are shown in Fig.1, Radon concentrations were found to be highest in winter and lowest in summer. In winter most of the values observed were between 20 and 30 $Bq.m^{-3}$ while in summer maximum values were between 10 and 20 $Bq.m^{-3}$. This may be due to ventilation condition in summer and winters are quite different.

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 and progeny inside the houses. However, the recorded values of radon and progeny and resulting doses are well below internationally recommended levels (ICRP, 1993). This clearly indicates that the houses in areas in Moradabad district of 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 in the houses of Moradabad district of 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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