

Radon in natural environment and its impact on Human Health (Index No. - 120/16/Phys./24)

Abstract

Radiation is an inherent component of the natural environment, with human exposure stemming from various natural and manmade radionuclides. Among these radionuclides, particular attention is accorded to radon (^{222}Rn) which is the only radioactive gas can be present everywhere. It can cause substantial human exposure through ingestion and inhalation pathways and thus enhancing the risk of malignancy in human beings.

In view of the health risk associated with radon, worldwide studies on radon concentration measurement in various mediums and materials are increasing rapidly. Not only in abroad but also in India these studies are now undertaken very seriously for the sake of human health.

While radon poses health risks, it also serves positive purposes. Environmental radon can play important role in other fields for the benefit of mankind like: identifying resources like uranium, oil and geothermal energy reservoirs; study of active geological faults; forecasting earthquakes and conducting research on volcanic activities.

The present thesis work has been carried out with the following major objectives:

- a) Assessing water radon concentrations in three regions of West Bengal: Bakreswar and Tantloi geothermal area, Susunia hill area, and Ajodhya hill area. The goal is to identify potential reasons for spatial variations of radon activity and to develop a water radon map for the entire region.
- b) Estimating the radon dose received by local residents in the study areas due to waterborne radon, with a focus on evaluating potential health risks.
- c) Investigating the seasonal variations of water radon.
- d) Measuring radon levels in indoor air, specifically in basements within the Kolkata Municipal Corporation area, where basements are utilized for various purposes.

e) Studying soil radon emissions and assessing the influence of factors on these emissions. This research aims to support those working on identifying reliable soil radon fluctuation signals for earthquake prediction eliminating fluctuation influenced by non-seismic reasons.

The thesis has been organized in the following way:

In Chapter 1, the thesis outlines its motivation and major objectives while detailing its organizational structure.

Chapter 2 delves into fundamental aspects of environmental radioactivity, covering the discovery of radioactivity, radiation types, and their impacts on human health.

Chapter 3 presents a literature survey of global and Indian studies on environmental radioactivity, with a focus on radon.

Chapter 4 introduces the experimental setups for radon concentration measurement, utilizing Alpha Guard for air and water and Barasol probe for soil.

Chapter 5 discusses air radon exposure in basements and sub-ways of Kolkata, West Bengal, India. In this chapter we have also calculated annual effective doses.

Chapters 6,7 and 8 explore radon concentration in water in Bakreswar and Tantloi geothermal region, Susunia hill area and Ajodhya hill area. In these chapters we have also performed several correlation studies to know the possible reasons behind the high radon concentrations. Surface plots are given to know the radon-prone zone areas clearly. Also, we have estimated the annual effective doses for assessing the possible health risks. We have also proposed how to mitigate or minimize the radon levels in the drinking water.

Chapter 8 analyzes seasonal variations in drinking water radon levels of Susunia hill area. In this chapter we have estimated the monthly radon dose values.

Chapter 10 investigates the impact of meteorological parameters on soil radon in Kolkata, West Bengal, India utilizing machine learning techniques.

Finally, Chapter 11 concludes the thesis and suggests future research directions.

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