Environmental Radon, Thoron and Their Health Consequences

R.C. Ramola  
Department of Physics, H.N.B. Garhwal University, Badshahi Thaul Campus, Tehri Garhwal – 249199, India, E-Mail: rcramola@sancharnet.in

Radon ($^{222}$Rn) is a decay product from the $^{238}$U decay series. It is an inert gas having half-life of 3.8 days, which is long enough for it to enter the human environment. Another member of radon isotope family is thoron, $^{220}$Rn, having half life of 56 second and chemical properties same as that of radon. The decay products of radon and thoron are solid and behave as airborne particles. The behavior is easily influenced by circumstances. Initially, decay products are free atoms in the air and "unattached" to other aerosol particles. But these decay products are so small that they easily attach to aerosol particles. The fraction that attach depends strongly on the size and concentration of carrier aerosol particles.

Radon ($^{222}$Rn and $^{220}$Rn) is a ubiquitous indoor air pollutant that is found worldwide. Its sources are soil, building materials, and groundwater. Radon and its decay products are the most important contributors to human radiation exposure from natural sources. About half the natural radiation doses to humans is due to radon and its decay products only. A major contribution of dose is due to $^{222}$Rn and its progeny and to certain extends, due to $^{220}$Rn and its progeny. It is well known that exposure to high levels of radon causes lung cancer, but as yet there is little data on the effects of long-term exposure to low levels of environmental radon. The external dose from radon and its airborne progeny is a very small fraction of the natural external radiation dose received by individuals. However, inhalation of radon and its daughters may be followed by deposition of potentially large amounts of energy, i.e. absorbed dose in the tracheobronchial epithelium from the short-lived $\alpha$ and $\beta$ particle emitting decay products, primarily from Po-218, Pb-214, Bi-214, and Po-214 (radon progeny) and Po-216, Pb-212, Bi-212 and Po-212 (thoron progeny). The contribution of each nuclide to radiation exposure is quite different when half-life, radiation type, and physical form are considered. The dose from radon and its decay products depends not only on the radon concentration, but also on the size of particles to which the radon decay products are attached.

There are several detectors to measure the radon ($^{222}$Rn), thoron ($^{220}$Rn) and their progeny in the environment. Solid state nuclear track detectors are low cost and more convenient detectors for long term measurements of radon, thoron and their progeny in the environment. The radon and thoron data obtained in Garhwal and Kumaun Himalayas by using solid state nuclear track detectors are discussed in details. The results of nationwide indoor radon and thoron survey, carried out under a coordinated research programme of Department of Atomic Energy, Government of India, are also presented in this paper. A detail analysis on the exposure and dose due to environmental radon is discussed. The estimated risk of environmental radon and thoron by using both the dosimetric and epidemiological approaches are discussed in details.