

# GAMMA-RAY SPECTROSCOPY FOR THE MEASUREMENT OF THE RADON EMANATION RATES FROM SAND CONTAINING HEAVY MINERALS

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Radon gas emanating from minerals containing uranium diffuses through the overburden and reaches the atmosphere. The rate of diffusion can be measured and mapped and can provide information regarding both the underlying formations and characteristics of the overburden such as porosity and depth. A measurement of the  $^{222}\text{Rn}$  loss rate can relate the radon fluxes to such factors as the  $^{226}\text{Ra}$  concentrations of the overburden, the soil type, the moisture content and the vegetation. The results of radon monitoring can therefore provide useful information for geological, mineralogical and environmental interpretation.

This paper describes a method for the determination of radon loss that was originally developed to monitor the rate of radon emission from tailings dumps produced as by-products in the extraction of heavy minerals from sand deposits. Although this project had the objective of protecting the public and the environment from radioactive exposure, the methods are widely applicable to the study of overburden and underlying rock as was described above.

The present study is part of a research programme aimed at addressing these important questions in the case of an environmental study. It sought to answer the following questions:

- a) The nature and composition of the radioactive by-products produced.
- b) The potential hazard of the radon emanation.
- c) Ways of reducing the rate of production of the radon.

d) In particular what is the emanation rate of radon and hence the emanation index.

The procedure to be described involves the determination of radon adsorbed on activated charcoal using a container in the shape of a marinelli beaker. The radon gas from the sample is allowed to build up for a set period of time in this container. The activity of the decay products of the  $^{222}\text{Rn}$  was then measured using both a NaI(Tl) detector and a Ge detector.

A layer of silica gel is used to reduce the effects of humidity on the adsorption. A space between the charcoal and the surface produces a fixed volume that is sampled by the charcoal. The radon activity is measured by means of the gamma-ray activity from the radon daughter products  $^{214}\text{Pb}$  and  $^{214}\text{Bi}$ . A similar method has been described by Perisko and Wicke (1988).

The natural gamma-ray activity measured can be related to the emanation of radon and this in turn is related to the emanation coefficient, defined as the ratio of the radon released to the total radon formed within the sample. This coefficient depends on a number of factors including the porosity, mineral species, radium mineralogy, particle size and interstitial or pore water content. It will be described and evaluated.

## References:

1. Perisko, J and Wicke, A. (1988) Measurement techniques for the estimation of Rn-222 concentration and the exhalation rate indoors and outdoors using an activated carbon bed. *Postzpy Fizyki Medycznej*, Vol 23, No. 4, pp 263-270.