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DESIGN OF A RADON MEASURING DEVICE BASED ON THE DIFFUSION PRINCIPLE USING LR 115 DETECTOR

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ABSTRACT

This paper reports the theoretical studies undertaken to determine the optimum dimensions of the diffusion chamber and the membrane thickness which is sufficient to prevent the thoron gas diffusion and permit the rapid establishment of equilibrium between radon concentration outside and inside the chamber volume.

KEYWORDS

Radon measurement; LR 115 II; diffusion chamber; filter membrane.

INTRODUCTION

A passive integrating radon measuring device based on the diffusion principle and using a nuclear track detector for the registration of alpha particles from radon and its short-lived daughters, has been developed for use in mines. The device consists of an enclosed small sized chamber with LR 115 nuclear track detector at one end and a gas-permeable non-porous polymeric membrane made of polyethylene at the other. The cylindrical chamber of diameter a = 3 cm is mounted on Plexiglas stand (8 cm x 4.6 cm x 1 cm) containing lateral perforation allowing the free access of radon-containing air. The radon diffuses through the filter membrane which allows discrimination between radon and thoron signals and excludes ambient daughter nuclei. It also stops all dust particles and moisture (Alter and Fleisher, 1981). It has been found that the sensitivity of this passive dosemeter depends on different parameters such as the diffusion chamber dimensions, the characteristics of the filter membrane and the energy response of the track detector, etc. (Djeffal and Allab, 1993; Djeffal, 1995). The detector used is the LR 115 type II, which detects only those alpha particles with energies lying within the range 1.7 - 4.2 MeV, under our (Djeffal, 1995) etching conditions (NaOH 2.5 M at 60°C for 110 min). These energy limits are used to define the sensitive volume and sensitive area of the diffusion chamber.

CALCULATION PROCEDURE

For the determination of optimum dimensions of this diffusion chamber, the theoretical model for calculation of radon concentration developed by Fleisher has been used (Fleisher, 1984). Assuming that the contributions of alpha particles come only from ^{222}Rn, ^{218}Po and ^{214}Po, the present calculations were performed taking into account the energy limits and the minimum incidence angle for alpha tracks production in the LR 115 detector and the contribution of radon and its daughters present both within the chamber volume (sensitive volume) as well as those plated-out on the interior walls of the chamber (sensitive area). Under our geometry configuration, it is a reasonable approximation to assume that the radon gas is uniformly distributed in the enclosed air volume, whereas the short lived radon daughters are uniformly plated-out on the interior-walls of the chamber.