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DOSEmanPRO – Active electronic online personal air sampler for detection of radon progeny long lived alpha nuclides

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ABSTRACT

Using the micro system- technology we developed a online personal air sampler not bigger than a mobile phone, to open a new dimension in personal dosimetry of inhaled radioactive aerosols. The DOSEman PRO containing an internal pump with a continuous air flow of 0.15 l/min sample the radon progeny or other nuclides on a Millipore filter with excellent spectroscopic resolution. A 1.5 cm² light protected ion-implanted silicon detector analyses the alpha radiation at the filter. This small detector head contains also the pre amplification and pulse processing. The alpha radiation of the radon progeny and the long lived alpha nuclides is analysed by a 60 channel spectrometer. The energy resolution of the online analysed filter spectra is in the order of 150 keV. Mechanical and electronic design enables one to distinguish the long lived alpha nuclides from the radon and thoron progeny very easily. Using a special algorithm we correct the influence of the tailing of the radon progeny to the long lived alpha nuclides and take into consideration possible interference in determining the long lived alpha nuclides. Because of the air sampling volume of nearly 10 l/h, the system has a high efficiency. The detection limit by 2 hours sampling time is 0.05 Bq/m³ alpha nuclide concentration. In a modified device for air sampling especially of long-lived alpha nuclides like Uranium, Radium or Plutonium, the flow rate is increased to 0,3 l/min e.g. during a 10 h sampling period we can detect 0.005 Bq/m³ in a low Radon atmosphere. Assuming increased radon progeny concentration, the statistical error for the long lived alpha nuclides will be higher, but in most of the cases for use in nuclear facilities low radon concentrations are ambient conditions.

This concept of an electronic personal air sampler with an alpha spectroscopy offers some outstanding advantages compared to passive dosimeters or off-line alpha air filters: The dose value and the nuclide concentration is calculated and displayed online during the exposure time, given dose limits can be watched by an alert function. Rapid changes of the concentration can be detected and the dose gets available in its time distribution as well. The PC-based dose management provides an administrator desk for stuff planning and enables the change of measurement pre-set. The standard infrared interface handles the data communication with a PC. As required, the electronic dosimeter is easy to handle and rugged enough to withstand the rough working conditions. The device is water protected and can work up to 98% relative humidity. The smallest adjustable integration time is 1 min (correspond to a Radon progeny detection limit of nearly 6 Bq/m³). The following acquired measurement data will be stored to the internal memory (capacity 300 cycles): 60 channel sum spectra, time distribution of 5 region of interest (ROI), PAEC, PAEE, ERC and dose, average values. Free ROI set up enables for instance to focus on Po218, adjust the next ROI

on Po214, one on Po212, the next on U 238/Ra 226 3,5 ...4.9 MeV and the last on Pu 239/ Po210 / Am 241 4.9 ...5.6 MeV. DOSEman Pro is a unique continuous WL monitor with a efficiency in the order of the state-of-the-art devices but cost-effective with a price that is a tenth of a progeny monitor. DOSEman Pro will fit the requirements for personal dosimetry as well as local dosimetry or long term monitoring. The system can be used for the online detection with alert function of "dirty Bombs". First results from Plutonium, Polonium and Radium in air will be presented.