ETERE: A PORTABLE RADIOACTIVE AEROSOL MONITOR CAPABLE OF FAST ALARM RESPONSE AND QUANTITATIVE SPECTROMETRIC ANALYSIS OF ARTIFICIAL ALPHA EMITTERS

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Artificial alpha-particle emitters are commonly found at radiochemistry laboratories and nuclear power plants, during either normal operation or decommissioning; thus, in the case of accident, the release of such isotopes poses a serious health risk to operators and to the general public. Several aerosol monitors are available on the market, generally designed as fixed stations devoted to routine monitoring. Even though largely appropriate during normal operation, their usability during an accident is limited. First, they are usually mains powered, and show low IP grade; thus, in the case of emergency, they are neither easily portable nor deployable. Second, their poor energy resolution and poor peak deconvolution algorithms generally limit proper isotopic recognition, making it difficult to correctly assess the alpha emitter concentration in air; thus, proper isotope-specific emergency responses and mitigation actions are unavoidably delayed.

A new aerosol monitor is under development, designed to be both a routine monitoring system as well as a readily usable emergency device. It is characterised by a rugged and compact design, battery powered, and it is easily deployable in-field. The core of the detection system consists of a silicon detector facing an air filter on which ambient air is forced by a pump. The energy released by alpha and beta particles collected on the filter is sampled by the detector and analysed by a dedicated multichannel analyser. The software devoted to the analysis is based on two innovative detection algorithms. The first algorithm, which is based on a Regions Of Interest (ROIs) counting logic, is optimised to get high-counting statistics, and it is capable to identify the presence of small concentrations of artificial alpha and beta emitters in air, even in the case of high natural RnTh concentrations. Thus, an alarm signal is promptly triggered even when small amounts of artificial radionuclides are sampled.

In the case of alarm, a second algorithm devoted to alpha particle spectrometry is promptly enabled. It is based on a patented linear deconvolution algorithm, initially developed by ENEA for alpha spectrometry in-vacuum, and then specifically adapted for the present application. The optimised algorithm is capable of (1) identifying the presence of different alpha emitters in air (good spectrometric performances), and (2) quantitatively calculate their activity concentration. The algorithm proved to be extremely robust, reliable and flexible, even in conditions of extremely poor detector resolution and in the case of multi-peak sources' deconvolution.

In this work, the results obtained with the first prototype of the device measuring both natural and artificial radioactive sources are presented.

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