NUCLEAR INSTRUMENTS AND METHODS 68 (1969) 159; © NORTH-HOLLAND PUBLISHING CO.

A TRITIUM MONITOR BASED ON SCINTILLATION

A. A. MOGHISSI, H L. KELLEY, C. R. PHILLIPS and J. E. REGNIER

Southeastern Radiological Health Laboratory, Montgomery, Alabama 36101, *U.S A.*

Received 21 October 1968

The monitoring of tritium in the air, water, and urine in working areas is essential for proper evaluation of the safety of these areas. Most tritium air monitors currently in use are ionization chambers having no energy discrimination capability. Their accuracy and limit of detection are thus influenced by changes in the concentration of radioactive gases such as radon in the air and by background gamma radiation variations. Tritium monitors for air[1]) and for water[2]) using plastic phosphors have been reported. This paper describes a monitor based on scintillation with increased sensitivity for detecting tritium in air, water, and urine

The electronic system primarily consists of commercially available components. Two photomultipliers with bialkali photocathodes featuring high quantum efficiency and low dark current are arranged in coincidence. Their outputs are also fed to a summing amplifier, linear amplifier, and single channel analyzer. The output of the single channel analyzer is gated by the coincidence analyzer such that only those events which are in coincidence within 30–50 nsec and in the energy "window" of interest are recorded in a linear ratemeter. The ratemeter contains an audible and visible alarm which may be set at a predetermined level.

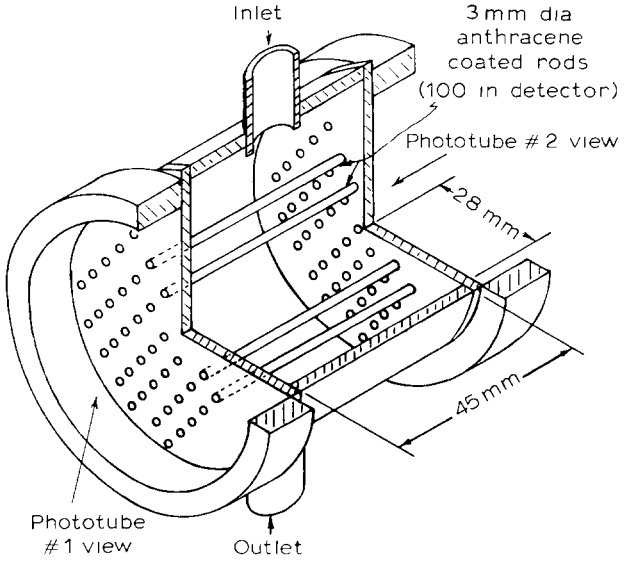

Fig. 1. Schematic diagram of the detector.

The present detector consists of parallel 3 mm diameter plexiglas rods coated with anthracene which are contained within a cylindrical chamber. These rods are viewed by opposing photomultiplier tubes. The outer is 56 mm i.d. plexiglas pipe 45 mm long with a useful volume of approximately 80 cm^3. A schematic diagram of the detector is shown in fig. 1.

The rods are coated with anthracene by filling the assembled detector with acetone and allowing it to remain for approximately ten minutes. This partially dissolves the surface of the rods and forms an adhesive layer upon which the anthracene is deposited. Immediately upon removing the acetone the detector is filled with crystalline anthracene which has been ground into a fine powder. The detector is then shaken until all surfaces of the rods are coated and the excess anthracene removed by shaking.

This detector has been operated without shielding in our laboratory which has normal external gamma radiation levels with a resulting background count rate of approximately 30 counts/min.

The detector was calibrated for tritiated water vapor in air by passing dried air through tritiated water contained in a bubbler immersed in a constant temperature bath. The response was found to be linear with an efficiency of approximately 20 counts/min for each nanocurie per liter.

The efficiency for tritiated water is approximately 10 counts/min for each μCi/liter. Urine may be counted in the detector by passage over a charcoal column to decolor it prior to passage into the detector. In this manner urine is counted with the same sensitivity as tritiated water.

The memory effect often observed with plastic phosphors is minimized in this detector for air as well as for water. It is estimated that the monitor can be commercially produced for a price of $ 2000 or less.

Work is presently in progress to optimize the present system and to adapt it to the monitoring of other radionuclides.

References

1) F Sannes and B Bannville, A portable tritium-in-air monitor, Chalk River, Ontario AECL-2283 (1965).

2) M Muramatsu, A. Koyano and N. Tokynaga, Nucl. Instr. and Meth. **54** (1967) 325.