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A portable and high detection efficiency measure instrument to monitor tritium surface contamination

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Tritium, a radioactive form of hydrogen, has been widely used in research as fusion reactors and neutron generators. It has a half-life of 12.32 years and it decays into helium giving off a weak beta particle (Energy Max.18.6KeV, Energy Average 5.7KeV), but it can damage human cells if it occurs within us. So the use of a portable and high detection efficiency Instrument to measure Tritium is necessary for monitoring surface contamination in existing tritium location. This paper introduces a portable tritium measurement instrument, which is designed with column proportional counter (flow-through ion chamber, which has a surface area of 1.25cm^{2}and uses firedamp of 99.99% concentration) and adopted advanced microprocessor, and other data and information processing techniques. We have built and tested over 30 portable instruments which have been used to measure tritium surface contamination in China. The paper describes the design of these instruments and reports results from tests and calibrations.

The following are results derived from experimental tests:

1.The length of level ground is 300V,and the gradient of level ground is 0.608%/100V.(measurement condition: check-up source:Tc-99(0.6μCi),gas flux:120ml/min:environment temperature:18˚C;relative humidity:81%;no shield;time:10$\times$10s).

2.The lower limit of detection is 0.221Bq/cm^2 (measure condition: high voltage: 3950V; gas flux: 125ml/min; environment temperature:18˚C;relative humidity:81%;no shield;time;600s).

3.The stability of the instrument was 0.56%/h and had a variant coefficient of 2.88%measure condition: using a standard source of H-3 and its surface emissivity is 1307 /(2π min);environment temperature:22˚C;relative humidity:69%;high voltage:3950V;total time:8h(every time 60s,interval 60s).

4.Detection efficiency was 84% (using a standard source of H-3 with surface emissivity of 1307 /(2π min)).

Key Words: Tritium Measure Instrument, Tritium Surface Contamination, High Detection Efficiency, Capability