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**Horia Hulubei National Institute for
R&D in Physics and Nuclear
Engineering**

**Method for determining of the tritiated
water radioactive concentration by
Electron Spin Resonance spectrometry
(ESR)**

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Abstract

Usually, the activity of tritiated water is determined using Liquid Scintillation Counter (LSC). But LSC method is limited, counting rate cannot exceed the value of 10^6 dpm (Disintegrations Per Minute), recommended less than 200 000 dpm without consideration of the dead time.

In specific case of samples with high tritium content, this limitation implies multiple isotopic dilutions which lead to:

- Generation of liquid radioactive wastes with medium activities.
- Increasing of measurement uncertainty by introducing of dilution steps (minimum 3 samplings/ determination at LSC)

In this patent an alternative method to LSC was proposed. The method relies on the accumulation and detection of free radicals radio-induced by self-radiolysis in frozen tritiated water samples.

The ESR analysis of the tritiated water samples stored in liquid nitrogen confirmed the accumulation of the hydroxyl radical.

The ratio between the ESR signal (signal intensity or amplitude for central line with g 2.026) and the radioactive concentration is linear on the 0.1 ... 46 GBq/ml range of the radioactive concentrations.

The relative deviation for HTO with 45.9 GBq/ml radioactive concentration is $\pm 2.6\%$ in case of determination of the signal intensity and $\pm 3.6\%$ for determination of the amplitude of central line.

Advantages

- The proposed ESR method does not generate radioactive wastes
- The samples are fully recovered because are not altered physically or chemically in the analytical step.

Technology stage

The method was validated for tritiated water by inter-comparison with Liquid Scintillation technique. The patent is ready for licensing.

Applications

Determination of radioactive concentration of tritiated light water and/or tritiated heavy water with high tritium contents.

Target groups

- Tritiated heavy water from NPP Cernavoda Calandria
- Cernavoda Tritium Removal Facility;
- Water Detritiation Systems for ITER (International Thermonuclear Experimental Reactor) and JET (Joint European Torus)

Contact

Dan D. Enache
Tel: 0040214042303
Fax: 0040214574210
Email: dan.enache@nipne.ro