Application of a sensitive LSC measurement procedure to the determination of ^{3}H in drinking water and rainwater in the city of Seville

J. L. García-León[1,*], M. García-León[2], G. Manjón[1]

[1]Universidad de Sevilla, Spain. Departamento de Física Aplicada 2. ETS Arquitectura. Av. Reina Mercedes 2. 41012 Seville, Spain.

[2]Universidad de Sevilla, Spain. Departamento de Física Atómica, Molecular y Nuclear. Facultad de Física. Av. Reina Mercedes, sn. 41012 Seville, Spain.

** e-mail: jgarcia34@us.es*

The determination of tritium in environmental matrices is an important tool for carrying out environmental research such as hydrological studies when water samples are analysed and biological studies in the case of organically bound tritium. In both situations, as tritium produced during nuclear weapon tests has mostly decayed nowadays, more sensitive methods for the determination of this radionuclide are needed. Simultaneously, this reduction of the total tritium activity in the environment allows to perform a wider variety of environmental studies using this radionuclide as a tracer.

In this work, we present recent applications of an experimental procedure published recently (García-León et al., 2024), where the Liquid Scintillation Counting (LSC) equipment available at the University of Seville was optimized to obtain a Minimum Detectable Activity (MDA) as low as 74mBq/L, or 0.627 Tritium Units (TU) per litre of sample starting from 250ml of a water sample that was subject to electrolytic enrichment and counted by LSC for 10h.

This optimization was achieved by performing a careful selection of an NPE-free scintillation cocktail and counting conditions of the newer Quantulus GCT 6220, which provided a low background due to the use of Guard Compensation Technology (GCT). In the present contribution, the results of participation in Spanish and international proficiency tests are shown, allowing to conclude that the newer procedure is accurate in addition to being precise and more sensitive. Additionally, some insight into the medium-term performance of the system is given, as stability concerns regarding newer, more software-reliant spectrometers such as the Quantulus GCT 6220 have been raised by other authors.

Once the validation of the method had been performed, its application to two sets of rainwater and tap water samples, collected in Seville, (N37.359196 W5.98679), has allowed to obtain two respective time series of tritium activity concentration. Consequently, a decreasing trend in the activity concentration of ^{3}H in drinking water has been observed, with a minimum of $(130 \pm 40)\mathrm{mBq/L}$. Additionally, the results in rainwater show interesting variations, being the minimum value obtained $(180 \pm 50)\mathrm{mBq/L}$. As expected, this improved procedure allowed us to obtain values above the MDA in almost all cases, allowing to continue with environmental monitoring even though the levels of tritium are the lowest observed in the time series in our monitoring station.

References

García-León, J. L., García-León, M., Manjón, G., & Rivera-Silva, J. (2024). Optimization of a new liquid scintillation spectrometer for the measurement of environmental levels of 3H in water samples. *Journal of Environmental Radioactivity*, *277*. https://doi.org/10.1016/j.jenvrad.2024.107465

Acknowledgements

This work has been funded partially by the government of Spain through PID2022-140680NB-I00 of MCIN/AEI/10.13039/501100011033 and the Consejo de Seguridad Nuclear (CSN).