**Optimization of a liquid scintillation counting methodology for the determination of tritium in water using the Hidex 300 SL spectrometer**

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Tritium (3H) is a cosmogenic radionuclide produced naturally in the Earth's upper atmosphere. Additionally, significant amounts of anthropogenic tritium have been introduced into the environment as a result of nuclear weapons testing and operations of nuclear facilities, including nuclear power plants. Monitoring tritium levels in the environment is crucial for assessing the impact of nuclear energy production, ensuring environmental safety, and managing radioactive waste.

This study presents the development and optimization of an analytical method for the low-level determination of tritium in aqueous samples, using a Hidex 300 SL liquid scintillation counter equipped with an Active Guard system. Specific calibration and optimization steps were performed to achieve the lowest possible detection limits. Deep glacial groundwater from Krakow was employed as dead water for background evaluation. The analytical procedure included an initial distillation step to remove potential contaminants affecting measurement accuracy. Optimization focused on selecting suitable parameters such as the type of vials (PTFE, polyethylene or glass vials), the sample volume, the scintillation cocktail (e.g., Hidex AquaLight+ ULL for ultra-low level tritium counting or AquaLight Beta), and the counting time. Data acquisition and analysis were performed using MicroWin software. The resulting protocol achieved a minimum detectable activity (MDA) of 2.9 Bq/kg, enabling high-sensitivity tritium determinations and contributing to improved environmental monitoring in the context of nuclear energy activities.

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