Development of a radiochemical method for determination of strontium-90 in soil/sediment samples using solvent extraction and cherenkov radiation detection

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Strontium-90 (Sr-90) is a long-lived fission product that decays by beta emission to yttrium-90 (Y-90) and subsequently to stable zirconium-90 (Zr-90). Its presence in the environment, particularly in soil and sediment, is of significant concern due to its radiotoxicity. In addition, its chemical similarity to calcium complicates the processes of separation and quantification. This study developed a radiochemical method for determining Sr-90 in environmental samples based on the extraction of Y-90, its daughter nuclide, via solvent extraction, followed by Cherenkov radiation detection using a liquid scintillation counter (LSC) without the use of a scintillation cocktail. The method provides high sensitivity, selectivity, and cost-effectiveness. To enhance the efficiency of Y-90 separation, a chemical precipitation step was incorporated during sample preparation. The optimized method achieved an average recovery of 107.7% for Sr-90–spiked sediment samples, demonstrating a significant improvement compared with the 50% recovery obtained without chemical precipitation. The developed method enables precise detection of Sr-90 even in matrices containing high calcium concentrations, making it highly suitable for environmental radioactivity assessment. In conclusion, this developed method provides a robust, selective, and environmentally friendly analytical method for Sr-90 determination, contributing to reliable environmental monitoring and radiochemical research applications.

Keywords: Cherenkov radiation; Liquid scintillation counter; Solvent extraction; Strontium-90; Yttrium-90