

Selective Separation and Ultra-trace Analysis of ^{99}Tc

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ABSTRACT

The fate and transport of ^{99}Tc in the environment is coming under increased scrutiny as part of the U.S. effort to close the nuclear fuel cycle. The radioisotope has a long half-life ($2.13 \cdot 10^5$ y), a high fission yield ($\sim 6\%$) and exists predominately as the pertechnetate anion $^{99}\text{TcO}_4^-$ in the environment. The anionic nature of ^{99}Tc makes it more mobile in environmental waters than many other fission products because $^{99}\text{TcO}_4^-$ is not easily exchanged onto sediment or geological surfaces. It has been reported that the majority of the ^{99}Tc introduced into the environment remains mobile in the water column. Thus, a more thorough knowledge of ^{99}Tc transport at significant distances from a source is needed to select the optimum waste form and disposition technologies for nuclear fuel reprocessing waste streams. A key part of this effort is the ability to measure this isotope at much lower concentrations than previously necessary for dose estimates and to establish drinking water standards. A trace-level analysis technique is therefore being developed to quantify ^{99}Tc . This approach involves a selective separation method that will concentrate the ^{99}Tc from environmental ground and surface waters. The isotope is then electroplated onto a filament and quantified using a triple sector thermal ionization mass spectrometer. This technique will allow measurements to be made at sub-picogram levels. Results of the study will be presented and discussed.