

Rapid Radiochemical Method Californium-252 (²⁵²Cf) in Water Samples



EPA's rapid radiochemical methods expedite analytical turnaround time for selected radionuclides while providing quantitative results that meet measurement quality objectives. Methods are applicable to samples where contamination is from either known or unknown origins. This fact sheet is intended for radioanalytical laboratory personnel, decision makers within the incident command structure, additional reoccupancy decision makers (e.g., state and local public health), and other field environmental response personnel.

Method Summary: This method uses extraction chromatography resin cartridges to isolate and purify californium (Cf) by removing interfering radionuclides as well as other matrix components. The method uses vacuum-assisted flow to improve the speed of the separations. Americium-243 (²⁴³Am) tracer equilibrated with the sample is used as a yield monitor. Water samples are concentrated using a calcium phosphate [Ca₃(PO₄)₂] coprecipitation. The Ca₃(PO₄)₂ precipitate is dissolved in a load solution containing nitric acid and aluminum nitrate before continuing with chemical separations. Extraction chromatography resin cartridges are then used to isolate and purify ²⁵²Cf and ²⁴³Am by removing interfering radionuclides and other matrix components. Following chemical separation of curium and americium, the sample test source is prepared by microprecipitation with cerium fluoride. The alpha emissions from the source are measured using an alpha spectrometer and used to calculate the activity of ²⁵²Cf in the sample.

<p>Time to Process: 8 hr</p> <p>Includes radiochemical processing and counting</p> <p><u>Compare to traditional method:</u> N/A; no validated methods available</p>	<p>Method Application</p> <p>The method is specific for the determination of soluble ²⁵²Cf in drinking water and aqueous samples. Application of this method should be validated by the laboratory using the protocols provided in Method Validation Guide for Qualifying Methods Used by Radiological Laboratories Participating in Incident Response Activities, or the protocols published by a recognized standards organization for method validation.</p>
<p>Measurement Quality Objectives</p> <p>Required method uncertainty: 2.0 pCi/L Analytical action level (AAL): 15.3 pCi/L Required relative uncertainty: 13% above AAL Minimum detectable concentration: 1.5 pCi/L Sample quantity: 0.2 L Count time: At least 4 hr</p>	<p>Equipment and Supplies</p> <p>Alpha spectrometer: range includes 4.5 and 7 MeV Analytical balance: 10⁻² g readability or better Cartridge reservoirs: 10 or 20 mL syringe style with locking device, or columns plus 12 mL reservoirs Centrifuge and tubes: 225 mL, 50 mL, or equivalent Crucibles: 250 mL, zirconium, with lids Heat lamp Hot plate Laboratory supplies: 150, 250, 500, and 1,000 mL plastic/glass/Teflon ware; electronic pipettor and 1–10 mL plastic tips; manual pipettor and 100 µL, 200 µL, 500 µL, and 1 mL plastic tips or equivalent; stainless steel planchets or other sample mounts able to hold 25 mm filter; tweezers Oven capable of 100–600° C Polypropylene filter: 0.1 µm pore size, 25 mm diameter, or equivalent Vacuum system: box/rack; pump or laboratory system; white inner tips; yellow outer tips Vortex mixer</p>
<p>Sample Preservation</p> <p>Analysis within 3 days of sampling: No preservation required Holding time >3 days: Adjust pH to <2 with concentrated nitric acid then store for at least 16 hours prior to analysis</p>	<p>Contacts</p> <p><u>Program:</u> Kathy Hall 513-379-5260 hall.kathy@epa.gov</p> <p><u>Technical:</u> John Griggs 334-270-3450 griggs.john@epa.gov</p>
<p>Waste Generated per Sample</p> <p>~ 210 mL basic waste ~ 80–105 mL acidic waste 1 mL hydrofluoric acid, ~ 5 mL ethanol Resin cartridges Polypropylene filter disk with ~ 100 µg cerium fluoride Low levels ²⁴³Am, ^{252/250}Cf, other radionuclides as present in samples</p>	