AN-1410-10

Rapid Determination of Sr in Emergency Urine Samples

Summary of Method Strontium is separated and concentrated from 100mL urine samples using calcium phosphate precipitation. An optional wet-ashing step with HNO_3-H_2O_2 destroys residual organic material. The precipitate or wet-ashed residue is dissolved in nitric acid and aluminum nitrate. Strontium is then separated from matrix impurities and potentially interfering radionuclides in the sample using a 2mL cartridge of Eichrom Sr Resin. Radiostrontium is measured on a low background gas flow proportional counter or liquid scintillation counter. Chemical yield of strontium is determined by gravimetric recovery of stable strontium or ICP-AES measurement. Typical chemical recovery of strontium is >80%. Measured values of ^{90}Sr agreed to within 1.7% of reference values for 10 minute count times, although longer count times can be used to improve detection limits and uncertainty. A single operator can complete the separation method for batches of 12-24 samples in as little as 3-4 hours.

Reagents

Sr Resin, 2mL Cartridges (Eichrom SR-R50-S)
Nitric Acid (70%)
Ammonium Hydroxide (listed as 28% NH_3 or 56% NH_4OH)
Hydrogen Peroxide (30%)
Deionized Water
1.25M $Ca(NO_3)_2$
3.2M $(NH_4)_2HPO_4$
Sr Carrier (10mg/mL)
2M $Al(NO_3)_3$
^{90}Sr standard
Oxalic acid

Equipment

Vacuum Box (Eichrom AR-24-BOX or AR-12-BOX)
Cartridge Reservoir, 20mL (Eichrom AR-200-RV20)
Inner Support Tubes-PE (Eichrom AR-1000-TUBE-PE)
Yellow Outer Tips (Eichrom AR-1000-OT)
50mL and 250mL Centrifuge Tubes
Centrifuge
Cupped Stainless Steel Planchets (~5mL volume)
Gas Flow Proportional Counter
Hot Plate
Analytical Balance
250mL Glass Beakers
Vacuum Pump

Figure 1. Sample Preparation

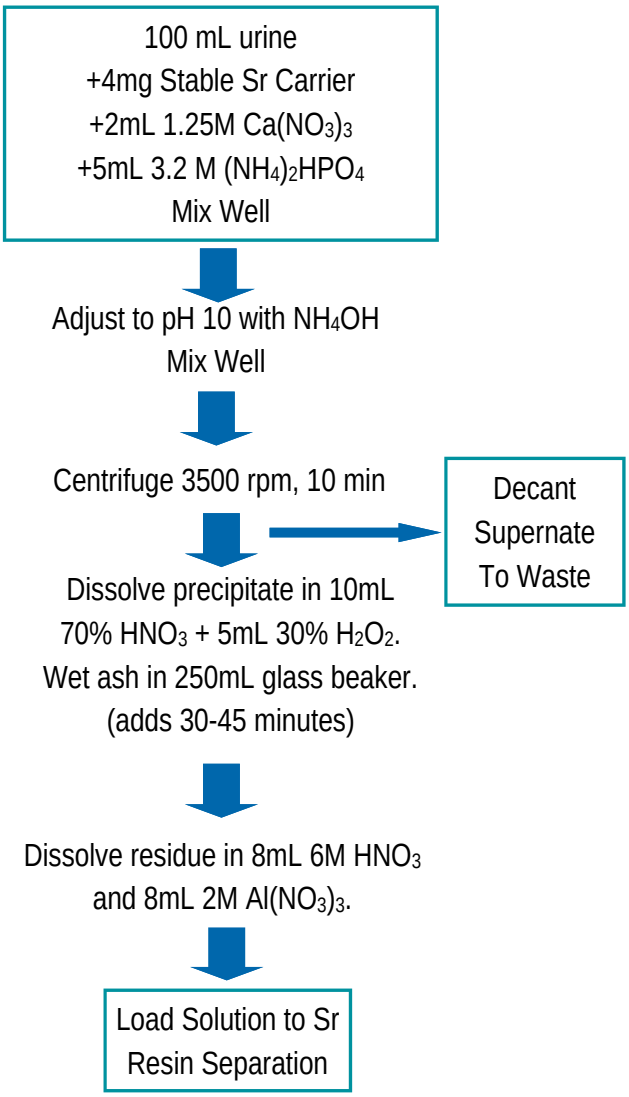


Figure 2. Load Solution Preparation and Strontium Separation

(1) Precondition Sr Resin with 10mL 8M HNO_3.

(2) Load sample at 1-2mL/min.

(3) Rinse sample tube with 3mL 3M HNO_3.

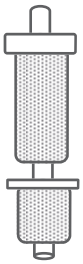
(4) Add tube rinse to Sr Resin. Elute at 1-2mL/min.

(5) Rinse Sr Resin sequentially with:
- 10 mL 8M HNO_3
- 5mL 3M HNO_3 - 0.05 oxalic acid
- 5mL 8M HNO_3

(6) Dispose of (1) to (5) as waste.

(7) Strip Sr with 15mL 0.05M HNO_3 at 1mL/min.

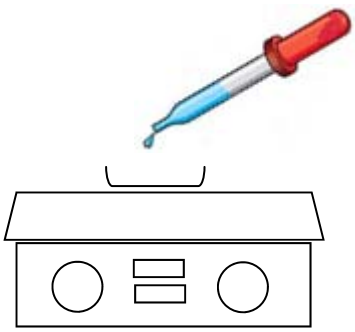
2mL + 1mL Sr Resin Cartridges



Gas Flow Proportional Counting:*

(8) Evaporate samples to dryness on tared cupped stainless steel planchets.

(9) Rinse Sr sample vials with 2mL 0.05M HNO_3. Transfer vial rinse to planchets. Evaporate to dryness.



(10) Weigh planchets on an analytical balance to determine gravimetric yield of stable $Sr(NO_3)_2$.

(11) Measure radiostrontium in samples on low background gas flow proportional counter.

*(Options for $^{89/90}Sr$ Descrimination)

(a) Sr fraction from step (7) can be transferred to a liquid scintillation vial. ^{89}Sr can be measured by Cerenkov counting (no LSC cocktail). $^{89/90}Sr$ may then be measured after adding liquid scintillation cocktail.

(b) Sr fraction from step (10) can be dissolved in 10mL 8M HNO_3 after >7 days of ^{90}Y ingrowth. $^{89/90}Sr$ can be removed on Sr Resin. ^{90}Y will elute in Sr Resin load and can be counted by liquid scintillation or gas flow proportional counting.

Actinides may also be measured by adding a 2mL TEVA, TRU and DGA cartridges above Sr Resin and following the separation scheme in Eichrom application note AN-1412, “Rapid Determination of Actinides in Emergency Urine Samples.”

References

1) Sherrod L. Maxwell, Brian K. Culligan, “Rapid separation method for emergency water and urine samples,” *J. Radioanal. Nucl. Chem., 279(3), 901-907* (2009).