

Rapid Determination of Sr in Emergency Air Filter Samples

Summary of Method Strontium is separated and concentrated from air filters. Samples are digested in Teflon beakers once with $\text{HNO}_3\text{-H}_2\text{O}_2\text{-HF}$ and then several times with $\text{HNO}_3\text{-H}_2\text{O}_2$. After evaporating to dryness from $\text{HNO}_3\text{-H}_3\text{BO}_3$ to complex any residual fluoride, strontium is separated on a 2mL cartridges of Eichrom Sr resin. Radiostrontium is measured by low background gas flow proportional counting or liquid scintillation counting. Chemical yield of strontium, which averaged $86\pm 5\%$, is determined by gravimetric recovery of stable strontium carrier or ICP-AES measurement. ^{90}Sr measurements agreed to within 10% of reference values. ^{89}Sr and ^{90}Sr activities can be determined by Cerenkov counting or by subsequent ^{90}Y ingrowth, separation and measurement. Sample preparation for batches of 12 samples can be completed by a single operator in <8 hours.

Reagents

Sr Resin, 2mL Cartridges (Eichrom SR-R50-S)

Oxalic acid/Ammonium oxalate

Sr carrier (10mg/mL)

Deionized Water

2M $\text{Al}(\text{NO}_3)_3$

HNO_3 (70%)

HF (49%) or NaF

Boric acid

H_2O_2 (30%)

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)

Hot Plate

Analytical Balance

250mL Teflon beakers

Cupped Stainless Steel Planchets (~5mL volume)

Low background gas flow proportional counter

Vacuum Pump

Figure 1. Sample Preparation

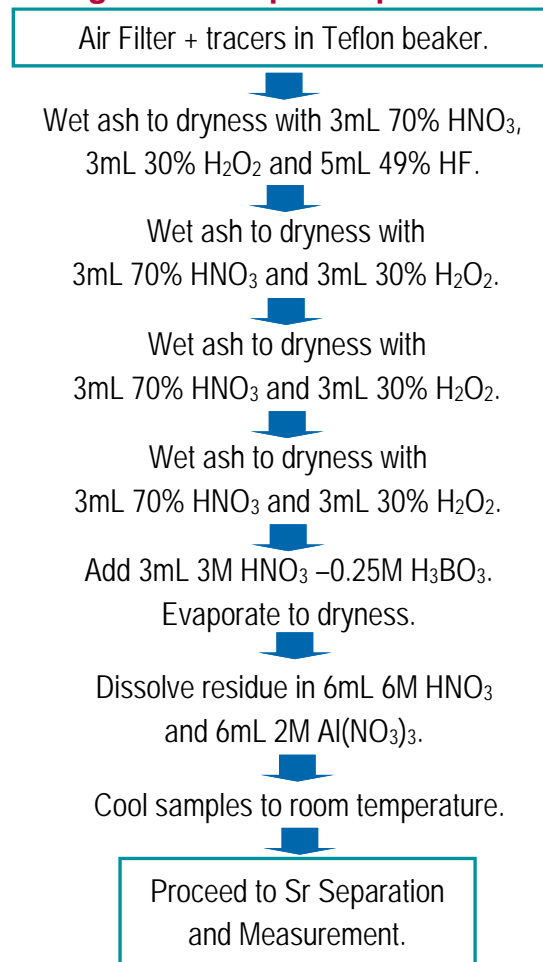
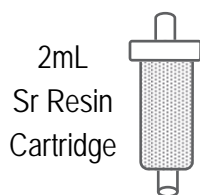


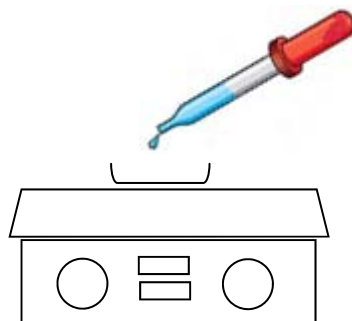
Figure 2. Load Solution Preparation and Strontium Separation

- (1) Precondition Sr Resin with 5mL 8M HNO₃.
- (2) Load sample at 1-2mL/min.
- (3) Rinse sample tube with 3mL 3M HNO₃.
- (4) Add tube rinse to Sr Resin. Elute at 1-2mL/min.
- (5) Rinse Sr Resin sequentially with:
 - 10 mL 8M HNO₃
 - 5mL 3M HNO₃ - 0.05 oxalic acid
 - 5mL 8M HNO₃
- (6) Dispose of (1) to (5) as waste.
- (7) Strip Sr with 15mL 0.05M HNO₃ at 1mL/min.



Gas Flow Proportional Counting.*

- (8) Evaporate samples to dryness on tared cupped stainless steel planchets.
- (9) Rinse Sr sample vials with 2mL 0.05M HNO₃. Transfer vial rinse to planchets. Evaporate to dryness.



- (10) Weigh planchets on an analytical balance to determine gravimetric yield of stable Sr(NO₃)₂.

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

*Options for ^{89/90}Sr Discrimination

(a) Sr fraction from step (7) can be transferred to a liquid scintillation vial. ⁸⁹Sr 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 HNO₃ after >7 days of ⁹⁰Y ingrowth. ^{89/90}Sr can be removed on Sr Resin. ⁹⁰Y will elute in Sr Resin load and can be counted by liquid scintillation or gas flow proportional counting.

*Actinides also be measured by placing 2mL cartridges of TEVA, TRU and DGA resin above Sr Resin and following the separation scheme in application note AN-1433.

References

- 1) Sherrod L. Maxwell, Brian K. Culligan, Gary W. Noyes, "Rapid separation method for actinides in emergency air filter samples," *Applied Radiation and Isotopes*, 68(12), 2125-2131 (2010).