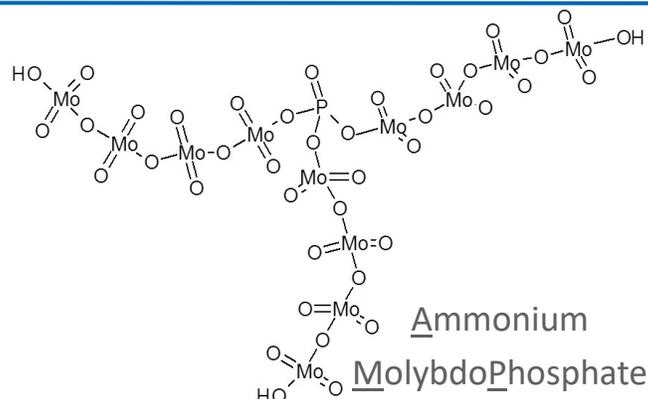


Cs Separation on AMP-PAN and KNiFC-PAN Resins

AMP-PAN contains an inorganic ion exchange material (ammonium molybdophosphate, AMP) dispersed in an inert polymeric support (polyacrylonitrile, PAN). The AMP has been shown to exhibit high selectivity for Cs from a wide range of solutions, including high acid concentrations and high salt concentrations (sea water). The AMP is imbedded into the PAN to improve the flow characteristics of packed columns. The material exhibits fast kinetics and high radiation stability, with no change in uptake observed for radiation doses of up to 1000 kGy [1]. Recovery of Cs from the AMP-PAN resin requires elution with 10 bed volumes of 5M NH₄Cl or NH₄NO₃.



AMP-PAN has been used to remove Cs-137 from radioactive acidic waste streams containing high levels of sodium and potassium [2]. Actual waste and waste simulants were loaded onto 1.5 mL columns at 0.7 mL/min. In the first cycle, 0.15% breakthrough of Cs-137 was measured after 1500 mL of feed (99.85% Cs-137 removal). After regenerating the column by eluting Cs-137 with 50 mL of 5M NH₄NO₃, 0.53% breakthrough of Cs-137 was measured after 1250 mL of feed (99.47% removal of Cs-137). Average recovery of Cs-137 in the 5M NH₄NO₃ regeneration cycles was 87%.

AMP-PAN has also been used to recover Cs-137 from sea water samples [3]. 5 mL columns of AMP-PAN were used to process 20 L samples of sea water which had been acidified to pH 1-2. Stable Cs, measured by ICP-MS, was used to trace the chemical recovery during the column separation. Flow rates of 35 mL/min were used. Recovery of Cs was 93.5 ± 5.0%.

Reagents

AMP-PAN Resin

5 mL Cartridges (HC5-R10-M)

2 mL Columns (HC-C50-M)

5 mL Columns (HC5-C20-M)

8 mL Columns (HC8-C20-M)

10 mL Columns (HC10-C20-M)

Nitric Acid (70%) Deionized Water

Ammonium chloride or Ammonium Nitrate

Equipment

Vacuum Box (AR-24-BOX or AR-12-BOX)*

Cartridge Reservoir, 20mL (AR-200-RV20)*

Inner Support Tubes-PE (AR-1000-TUBE-PE)*

Yellow Outer Tips (AR-1000-OT)*

50 mL Centrifuge Tubes

Vacuum Pump*

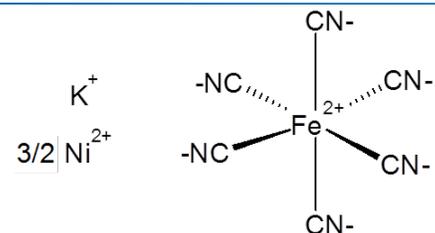
*Or appropriately sized gravity flow column and accessories (see reverse).

References

- 1) F. Sebesta, V. Stefula, "Composite ion exchanger with ammonium molybdophosphate and its properties" *J. Radioanal, Nucl. Chem.*, 140(1), 15-21 (1990).
- 2) Brewer, et al. "AMP-PAN column tests for the removal of Cs-137 from actual and simulated INEEL high-activity wastes," *Czechoslov J Phys*, 49(S1), 959-964 (1999).
- 3) Pike, et al. "Extraction of cesium in seawater off Japan using AMP-PAN resin and quantification via gamma spectroscopy and inductively coupled plasma mass spectrometry," *J Radioanal Nucl Chem*, 296(1), 369-374 (2012).
- 4) Triskem INFOS, No 10, July 2013. http://www.triskem-international.com/scripts/files/59d1f4fc2ec7b3.42683976/tki10_binder_en_web.pdf

KNiFC-PAN contains an inorganic ion exchange material (potassium nickel ferrocyanate, KNiFC) dispersed in an inert polymeric support (polyacrylonitrile, PAN). The KNiFC has been shown to exhibit high selectivity for Cs from a wide range of solutions, including sea water and other environmental waters. The KNiFC is imbedded into the PAN to improve the flow characteristics of packed columns.

KNiFC-PAN has been used to remove cesium from sea water samples [5]. 100 L samples of sea water were processed through 25 mL columns of KNiFC-PAN at flow rates of up to 300 mL/min. Stable Cs was added as a yield tracer (measured by ICP-MS). Yields for cesium were $92.9 \pm 1.1\%$ for 100 L samples of sea water acidified to pH 1. For 100 L samples of sea water (unacidified), cesium yields were $90.2 \pm 2.7\%$.



Potassium Nickel
FerroCyanate (KNiFC)

Reagents

KNiFC-PAN Bulk Resin (NC-B50-M)
Nitric Acid (70%)
Hydrochloric Acid (37%)
Deionized Water

Equipment

Empty Columns
2 mL snap tip (AC-141-AL)
2 mL cap tip (AC-100-MT-PP)
5 mL (AC-50E-5M)
20 mL (AC-20E-20M)
Column Reservoir
For 2 mL columns (AC-120-TK)
250 mL For 5 and 20 mL columns (AC-20X-20M)
Column Rack
15 hole for 2 mL columns (AC-103)
12 hole for 5 and 20 mL columns (AC-20M-RACK)
50 mL Centrifuge Tubes

Comparison of AMP-PAN and KNiFC-PAN Resins

Parameter	AMP-PAN	KNiFC-PAN
Cs Capacity	64 mg / g dry resin	256 mg / g dry resin
Density	0.27 g/mL	0.20 g/mL
Recommended sample pH	1 - 2	1 - 7
Sample Types	Waste, Environmental	Environmental
Regeneration	5M NH ₄ Cl or NH ₄ NO ₃	None

References

5) Kamenik, et al. "Fast concentration of dissolved forms of cesium radioisotopes from large sea water samples," *J. Radioanal. Nucl. Chem.*, 292(2), 841-846 (2012)