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2 Case Studies Using Eichrom's Nickel Resin: A Nuclear Power Plant and a Commercial Laboratory

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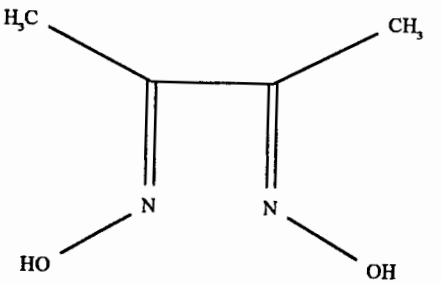
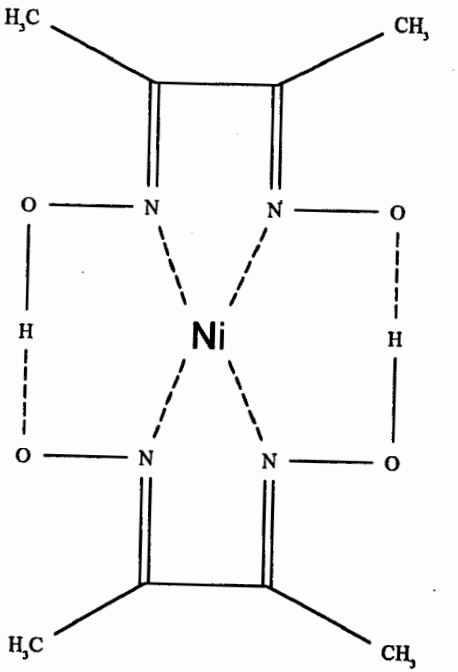


DMG



Ni-DMG Complex

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Physical Characteristics of Eichrom's Nickel Resin

- 11% (w/w) DMG loading
- Resin Density ~ 0.25 g/mL
- Working Capacity ~ 3 mg Ni

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Nuclear Power Plant
Nickel Procedure

- 50 mL Sample + 2 mg Ni Carrier
- Evaporate
- Convert to Chloride
- Dissolve Residue with 1 M HCl
- Add 1 M ammonium citrate
- Adjust pH = 8 - 9 with conc. NH_4OH

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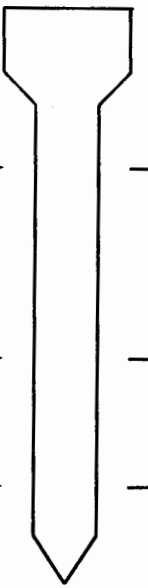
Nuclear Power Plant
Nickel Procedure (cont.)

- Load: Sample + 2 mg Ni carrier → Discard
- Rinse: 20 ml 0.2 M ammonium citrate at pH = 8 - 9 → Discard
- Strip: 3 mL 3 M HNO_3 → Measure Ni-63 by LSC and Ni-59 by X-Ray



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COMPARATIVE Ni-63 ACTIVITY (µCi/unit) DETERMINATIONS

SAMPLE TYPE	STANDARD METHOD	NICKEL COLUMN	RATIO
TL/HS Tank	2.30 E-6	2.38 E-6	0.97
Lab Waste Tank	2.66 E-6	2.49 E-6	1.08
WECT Tank	4.31 E-6	4.17 E-6	1.03
NI-63 Spike	5.07 E-4	5.35 E-4	0.95
NI-59 Spike	1.00 E-2	1.07 E-2	0.93
DAW Smears	4.18 E-2	4.63 E-2	0.90
Radwaste Filter	7.40 E-1	7.79 E-1	0.95
RWCU Resin	1.83 E+0	2.05 E+0	0.89

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COMPARATIVE Ni-63 ACTIVITY (µCi/unit) DETERMINATIONS (cont.)

SAMPLE TYPE	STANDARD METHOD	NICKEL COLUMN	RATIO
PWR Reactor Coolant	1.98 E-6	3.35 E-6	0.59
		4.53 E-6	0.44
PWR Reactor Coolant	1.93 E-6	1.60 E-6	1.21
DUPLICATE	1.84 E-6	1.71 E-6	1.08
PWR Reactor Coolant	6.89 E-6	5.86 E-6	1.18

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Decontamination Factors
RWCU Resin Sample

Cr-51	>37,000
Mn-54	270,000
Co-58	110,000
Co-60	113,000
Nb-95	13,700
Cs-134	>9,000
Cs-137	58,000

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MISCELLANEOUS OBSERVATIONS
ON EICHROM NICKEL COLUMN PERFORMANCE

PARAMETER	STANDARD METHOD	COLUMN METHOD
Chemical Yield	63 ± 9%	90 ± 14
LLD (50 ml/30 min)	1.2 E-7	6.5 E-8
Analysis Time:		
Overall	12 Hours	4 Hours
Hands On	8 Hours	2 Hours
LSC Cocktail	Mixed Waste	____

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Commercial Laboratory Nickel Procedure

- Sample + 2 mg Ni Carrier
- Evaporate

Little or No Residue

TRU Resin Fe Separation

Large Residue

Anion Exchange 1 x 8 column

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Commercial Laboratory Nickel Procedure (cont.)

TRU Resin Fe Separation

- Dissolve residue in 15 mL 8 M HNO_3
- Add Fe carrier (~ 1 mg)
- Load sample onto TRU column
- Rinse TRU column with 15 mL 8 M HNO_3
- Evaporate eluate almost to dryness

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Commercial Laboratory Nickel Procedure (cont.)

Anion Exchange 1 x 8 column

- Dissolve residue in 12 M HCl
- Add Fe carrier (~ 1 mg)
- Load sample onto anion column
- Rinse anion column with 10 - 12 mL 12 M HCl
- Evaporate eluate almost to dryness

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Commercial Laboratory Nickel Procedure (cont.)

- Convert to Chloride
- Dissolve Residue with 1 M HCl
- Add 1 M ammonium citrate
- Adjust pH = 8 - 9 with conc. NH_4OH

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Commercial Laboratory Nickel Procedure (cont.)

- Load: Sample + 2 mg Ni carrier → → Discard
- Rinse: 20 ml 0.2 M ammonium citrate at pH = 8 - 9 → → Discard
- Strip: 10 mL 3 M HNO_3 → → Measure Ni-63 by LSC

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Summary of Ni-63 Results Using EIChroM's Ni Column at Commercial Lab

ID	Chem. Yield	Results	Error	Rad. Chem. Yield	Comments
	%	dpm/sample	dpm/sample	%	
Blank 1	91.60	0.114	1.309		No Fe Cleanup
Spike 1	91.70	45.000	3.830	89.95%	No Fe Cleanup
Spike 2	92.70	9.910	1.827	97.60%	No Fe Cleanup
Blank 3	95.60	0.044	1.255		Ion Exchange Fe Cleanup
Spike 5	86.70	46.590	3.990	92.64%	Ion Exchange Fe Cleanup
Spike 6	83.80	8.772	1.899	86.48%	Ion Exchange Fe Cleanup
Blank 4	89.70	-1.428	1.256		TRU Fe Cleanup
Spike 7	88.20	46.800	3.981	93.31%	TRU Fe Cleanup
Spike 8	96.10	9.781	1.775	96.35%	TRU Fe Cleanup
Blank 5	86.30	-0.704	1.598		TRU Fe Cleanup
Blank 6	83.90	-0.210	1.664		TRU Fe Cleanup
Spike 9	84.80	46.180	3.947	92.10%	TRU Fe Cleanup
Spike 10	77.90	7.612	2.121	75.00%	TRU Fe Cleanup
Sample 1	78.60	-1.621	1.724		TRU Fe Cleanup
Sample 2	85.10	-1.221	1.603		TRU Fe Cleanup
Dup. 1	85.60	-1.695	1.574		TRU Fe Cleanup
Dup. 2	88.00	-0.702	1.566		TRU Fe Cleanup

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Miscellaneous Observations on Eichrom Nickel Column Performance

Parameter	Std. Method	Column Method
Chemical Yield	57 %	87%
LLD (200 mL/200 min)	7 pCi/L	5 pCi/L
Analysis:		
Elapsed	2 - 2 1/2 days	2 days