Applications of TK400 Resin for the Separation of ^{55}Fe

Hibaaq Mohamud[1], Ben Russell[1], P. Ivanov[1], Andy Pearce[1] and Dilek Demir[2]

[1]Nuclear Metrology Group, National Physical Laboratory, Hampton Road, Teddington, UK

[2]University of Surrey, Guildford, UK

Overview

Separation of ^{55}Fe

- Analysis Requirements
- Current Methods
- Developments

Initial Results

- K_d plots
- LSC Measurement

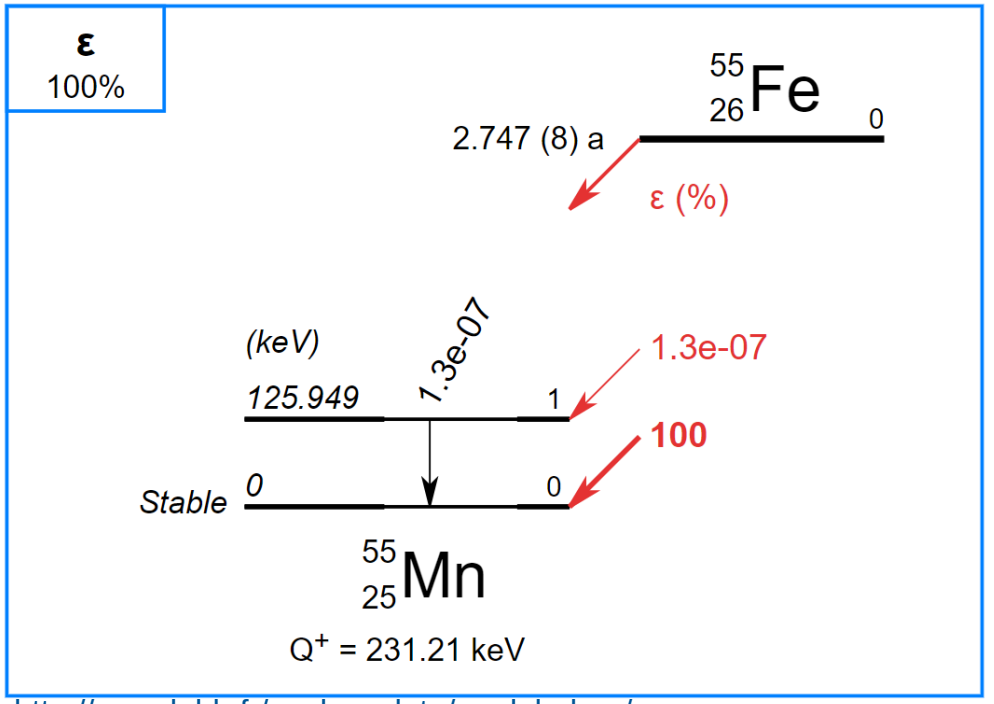
Next Steps

^{55}Fe: Analysis Requirements

- Produced by irradiation of stable iron with neutrons
- Major contributor to residual activity present in steel
- Routine environmental monitoring
- Nuclear decommissioning

Current Methods for Iron-55 Measurement

Matrix	Separation	Measurement	LOD	Reference
Concrete	TRU resin	LSC	0.004 Bq/g	Gautier *et al.* 2020
Graphite	AG resin	LSC	0.091 Bq/g	Hou, Østergaard and Nielsen, 2005)
Leach Solution	AG resin	LSC	0.82 Bq/g	Song et al., 2019)

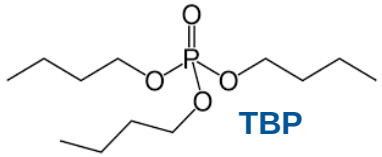


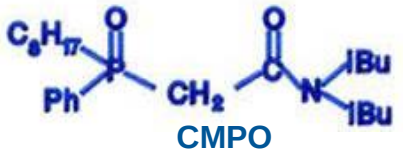
http://www.lnhb.fr/nuclear-data/module-lara/

Previous Triskem UGM showed that TK400 resin was an option for Fe separation

Iron-55 Separation with TRU Resin

Extractant system: CMPO mixed in tri-n-butyl phosphate (TBP)





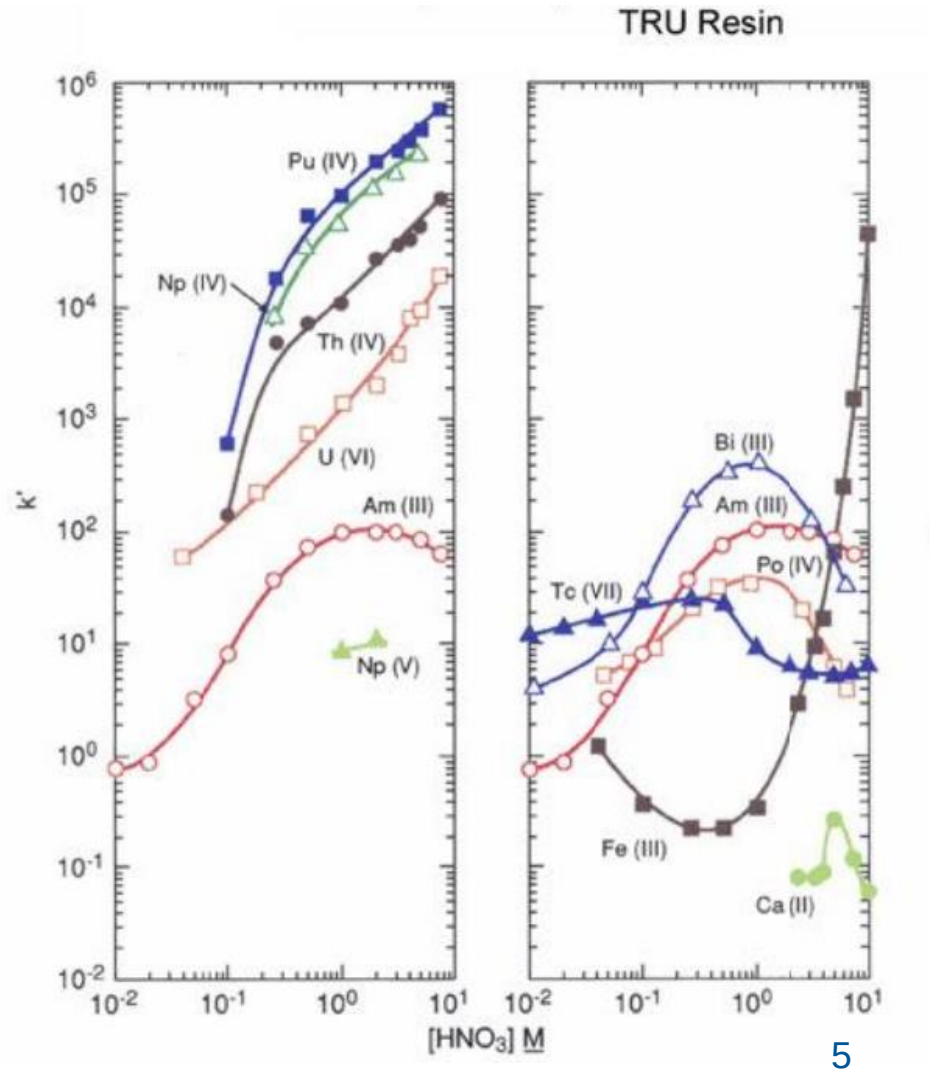
Separation of **TransUranium elements**

e.g. Th(IV) and Pu (IV).
Load sample in 5-8 M HNO_3

Fe can be eluted using dilute HNO_3 (2 M)

Well established method for LSC measurement

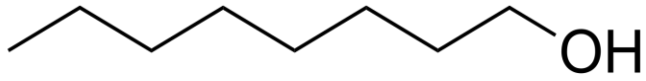
TRU Resin Product Sheet



Developments - TK400 Resin

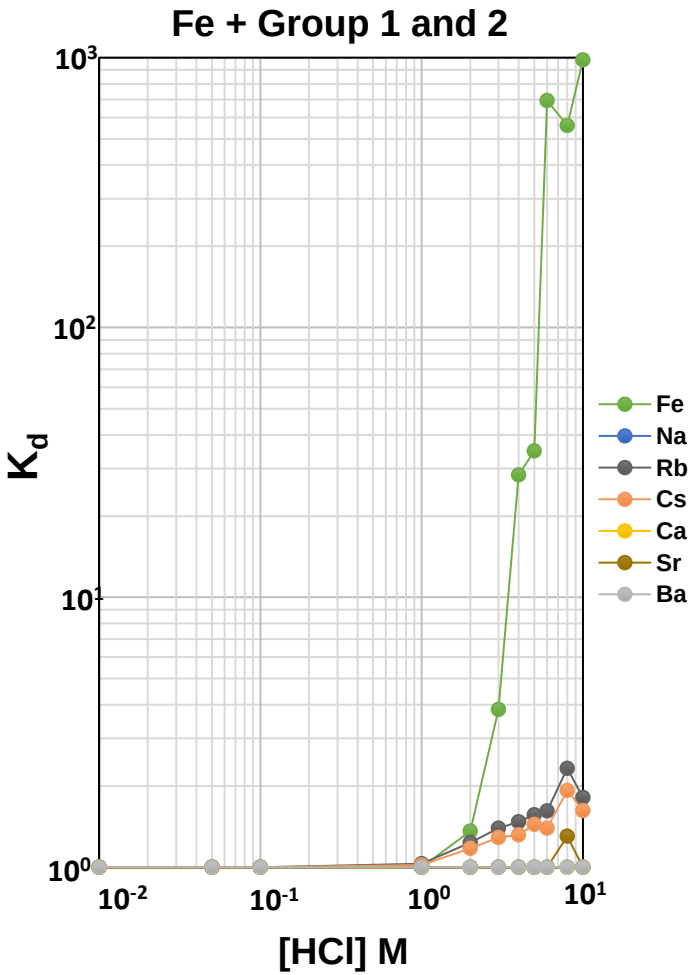
TK400 Resin

- Based on a long-chain alcohol i.e., octanol impregnated onto an inert support.
- Suitable for the separation of protactinium, iron, gallium and niobium.
- Minimum capacity of ~ 10 mg Fe/mL compared to 2.5 mg Fe/mL for TRU resin

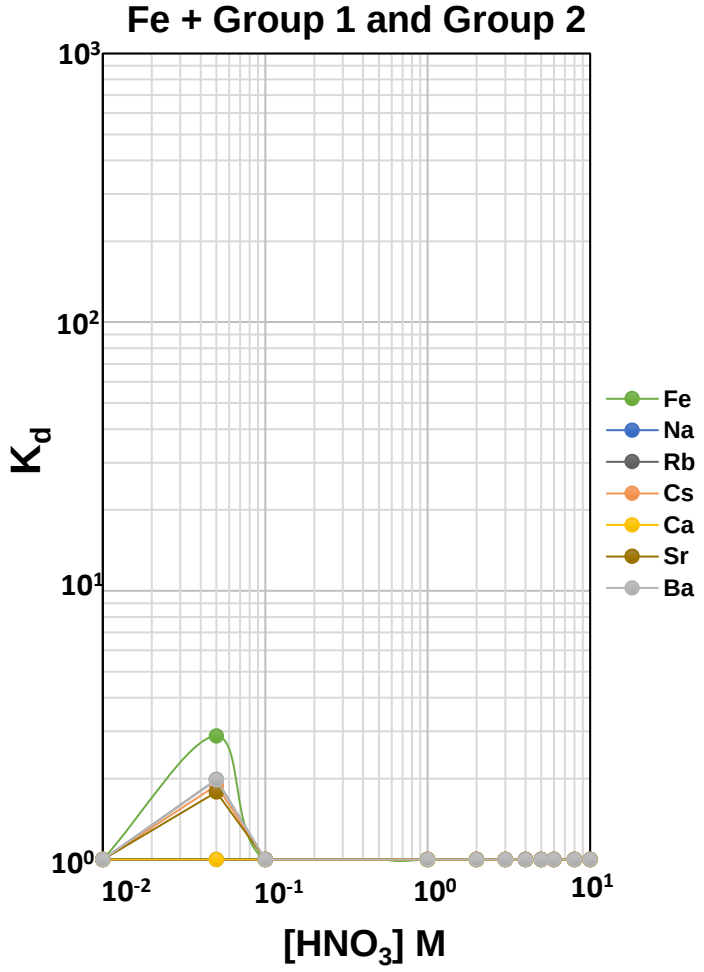


Initial Results - K_d plots: TK400 Resin

Varying HCl conditions (0.01 to 10 M)



Varying HNO_3 conditions (0.01 to 10 M)



High Fe retention under HCl conditions

Low retention of Sr

Can elute Fe using dilute HCl or HNO_3 (0.01 M)

Initial Results - K_d plots: TK400 Resin

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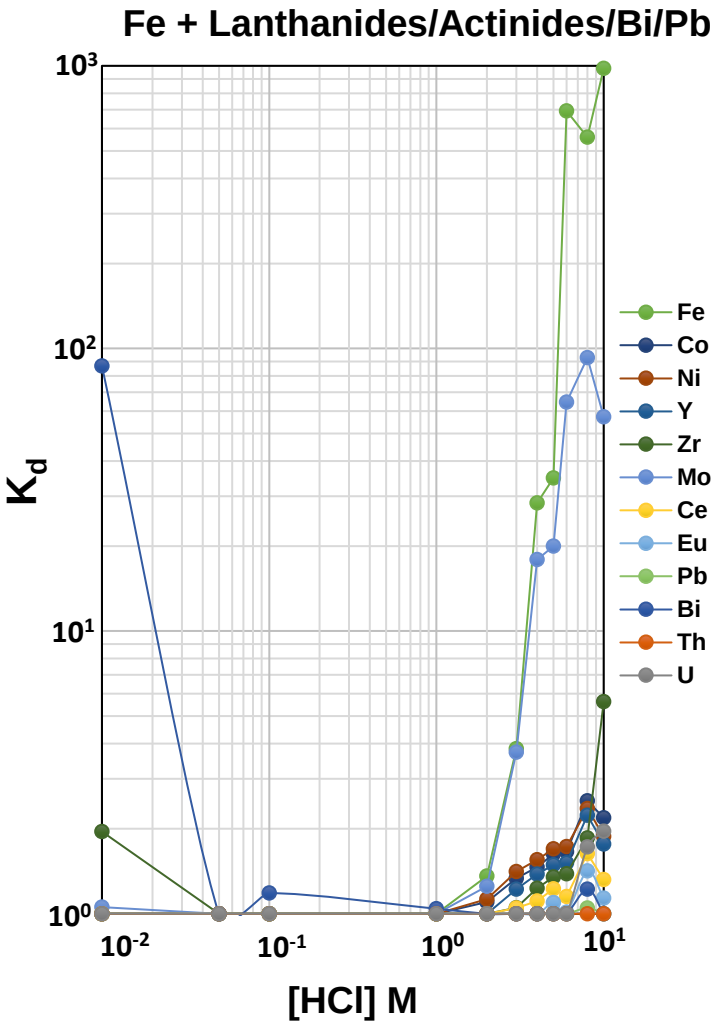
Varying HCl conditions (0.01 to 10 M)



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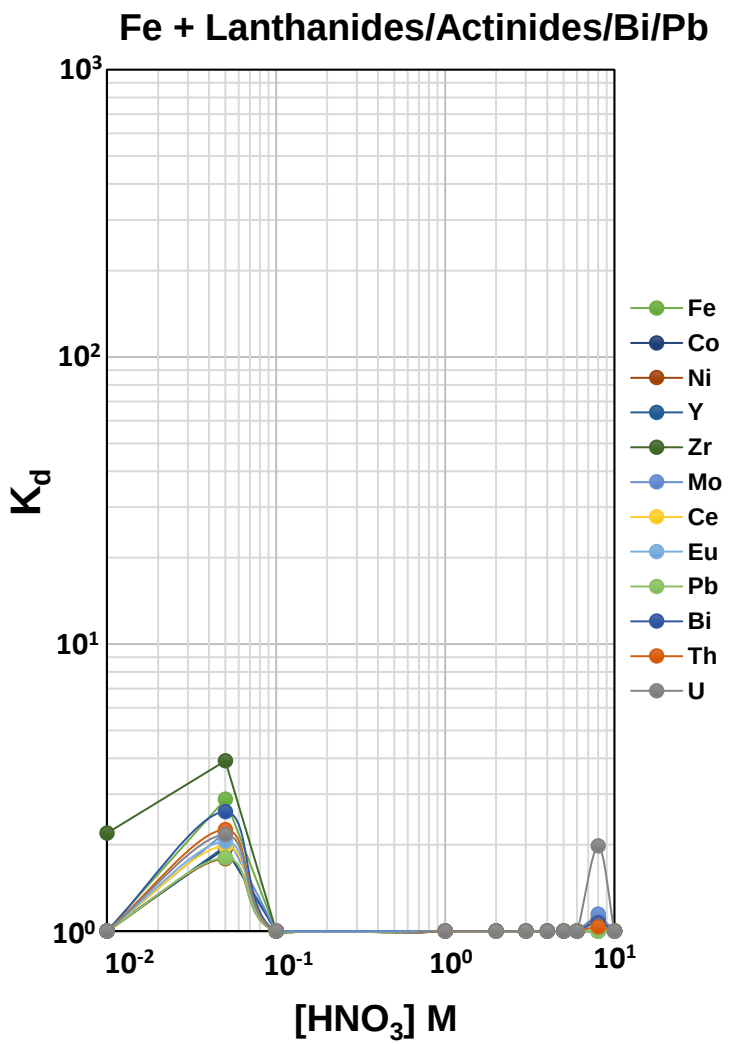


Retention of Mo and Bi observed under HCl conditions

Low retention of Ni, Th and U

Proposed Method - TK400 Resin

Separation Scheme

1) Load: 10 mL 9 M HCl

^{55}Fe

- 9 M HCl solution spiked with 100 Bq ^{55}Fe source

2) Wash: 30 mL 9 M HCl

Eluent B: 5 mL 0.01 M HNO_3

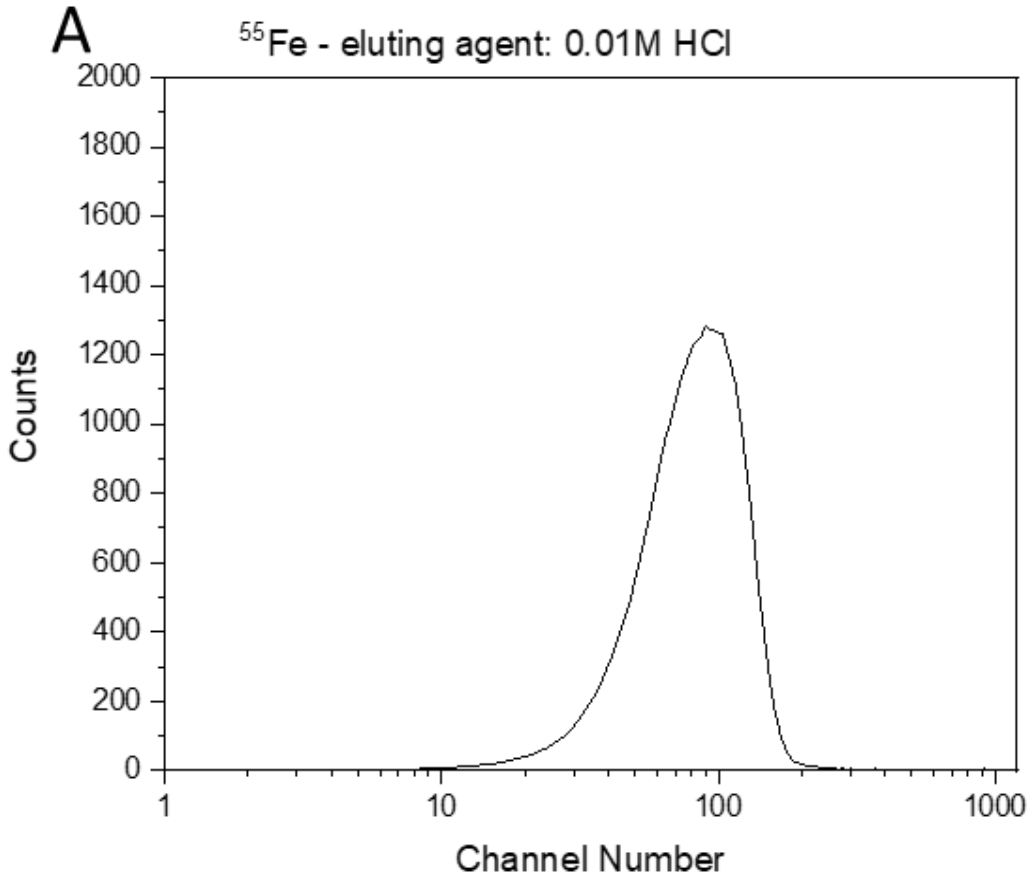
Eluent A) 5 mL 0.01 M HCl

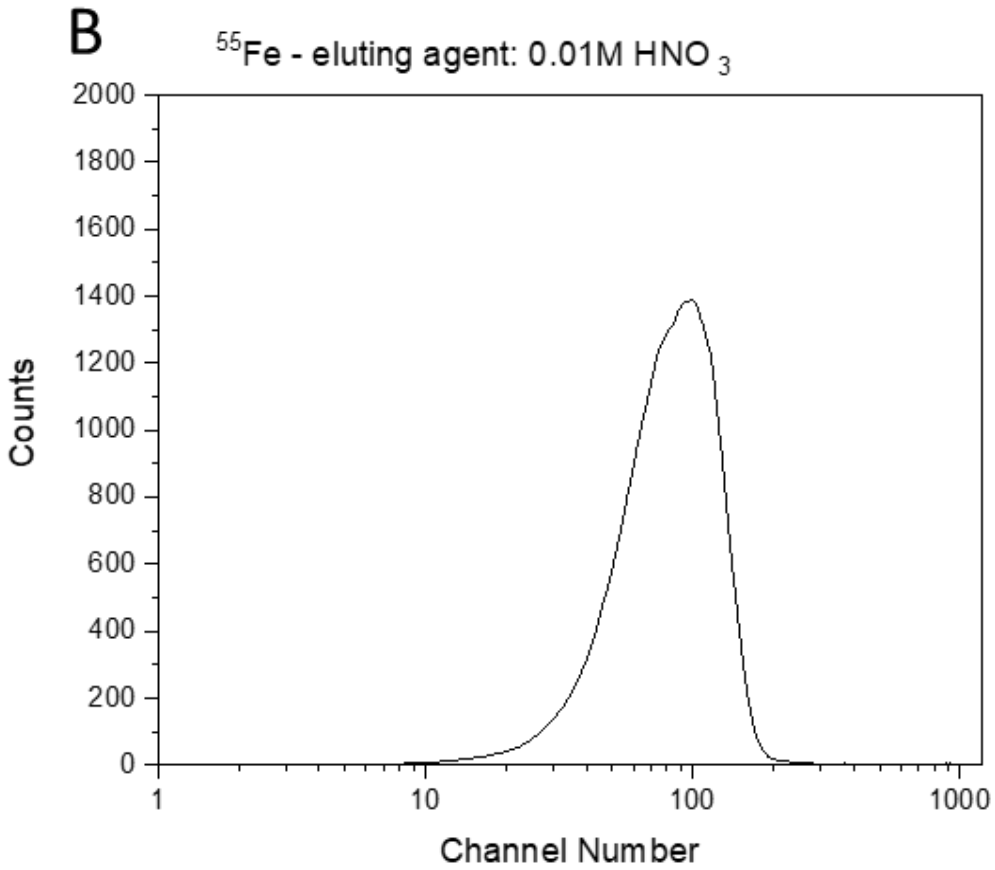
LSC Measurement

^{55}Fe

- Transfer eluted ^{55}Fe samples to a LSC vial containing 12 mL of Ultima Gold AB + 0.5 mL of H_3PO_4

Initial Results - TK400 Resin



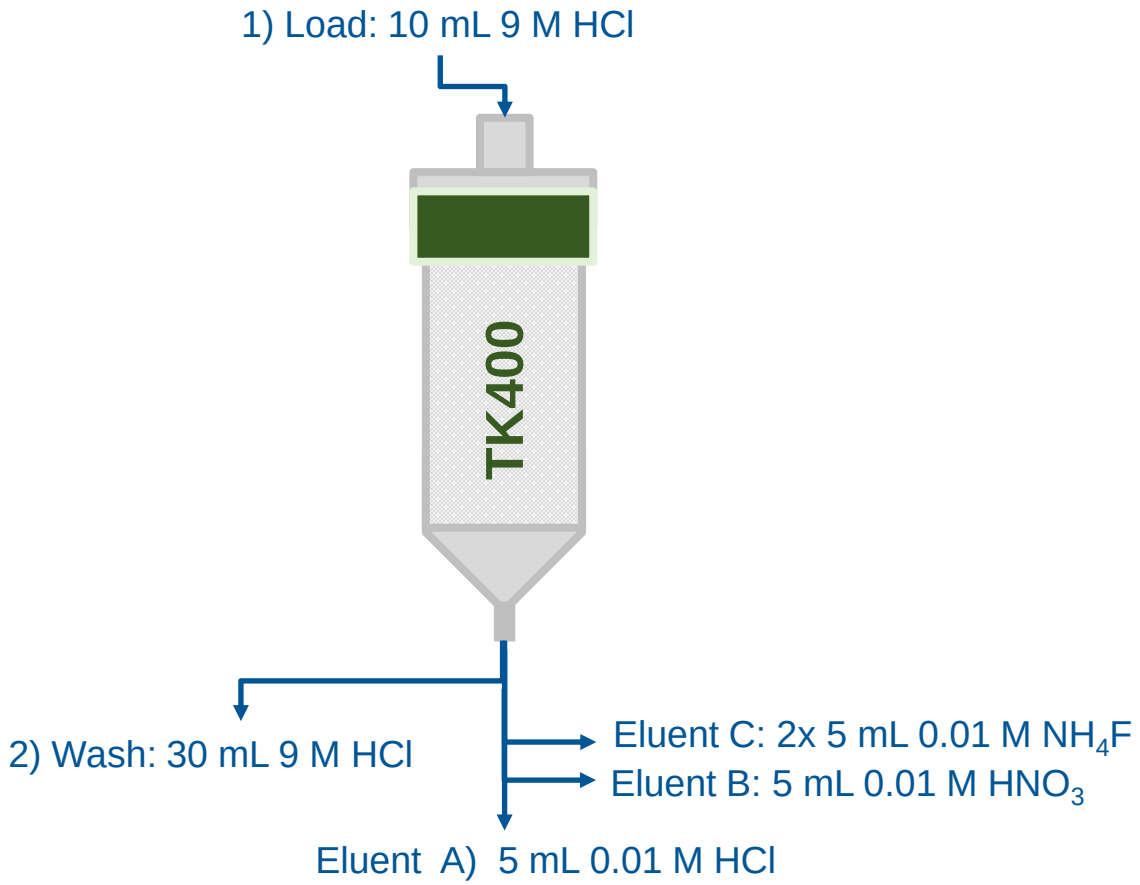


Typical ^{55}Fe recovery achieved with TK400 resin: > 80 %

On-going Work: LSC measurement of blank sample spiked with Fe-55, Ni-63 and Sr-90 separated on TK400 resin

Next Steps

- Investigate alternative eluting agents e.g., ammonium fluoride, which can lead to improved Fe-55 chemical recoveries and avoid co-elution issues.
- Investigate the effectiveness of TK400 resin in the presence of high matrix samples.



Acknowledgments

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Many Thanks for Listening!
Any Questions?

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Expertise in Separation Chemistry