

## Abstract

The TK227 Resin, composed of TO-DGA, ionic liquid, and long-chain alcohol, has been developed to facilitate the determination of Sr-90 levels via Y-90 in seawater samples ranging from 1 to 50 liters. It further may be used in the rapid determination of Sr-90 in surface waters. Compared to existing methods, the goal is to concentrate and purify Y-90 in equilibrium with Sr-90 from seawater samples acidified with HNO<sub>3</sub>, and then collect Y-90 for measurement in less than 4 hours. The presence of the ionic liquid enhances the retention of yttrium even at low HNO<sub>3</sub> concentrations (particularly at 0.01–0.1 M HNO<sub>3</sub>) compared to the standard DGA,N Resin previously used for Y-90 retention in this type of matrices. Accordingly, the TK227 Resin also allows for Y-90 concentration, and purification, from surface waters acidified to 0.1M HNO<sub>3</sub>, allowing rapid and easy to automate Sr-90 determination in such samples.

The characterization results as well as application data and alternative geometry of the TK227 Resin are presented here.

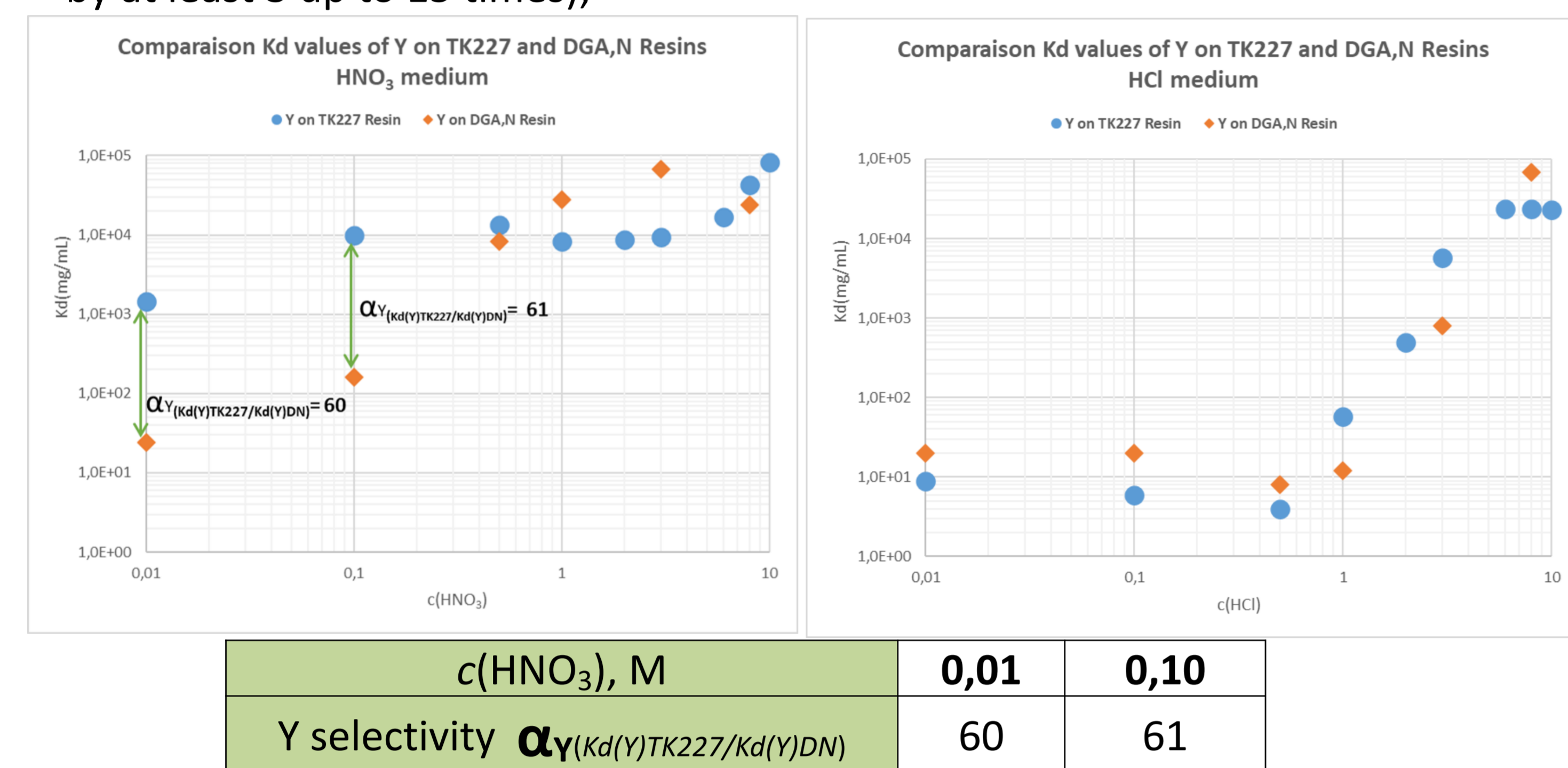
Key words: TK227 Resin, Sr-90, Sr-90 separation, seawater sample

## TK227 Characterization for Yttrium

TK227 Resin was developed to increase Yttrium retention at low HNO<sub>3</sub> concentrations compared to DN Resin.

⇒ Yttrium carrier needed to improve the uptake: minimum of 1mg Y-carrier;

⇒ Allow reduced use of concentrated HNO<sub>3</sub> for sample acidification (volume reduced by at least 3 up to 15 times);



- Higher Y retention on TK227 Resin @ 0,01M and 0,1M HNO<sub>3</sub> compared to DGA,N Resin.
- Y retention are similar for HNO<sub>3</sub> concentrations above 0,5M HNO<sub>3</sub>.
- Y behaviour is similar on both TK227 and DGA,N resins in HCl medium.

## Applications

Automated system to concentrate and measure Sr-90 via Y-90 in 1-50L seawater

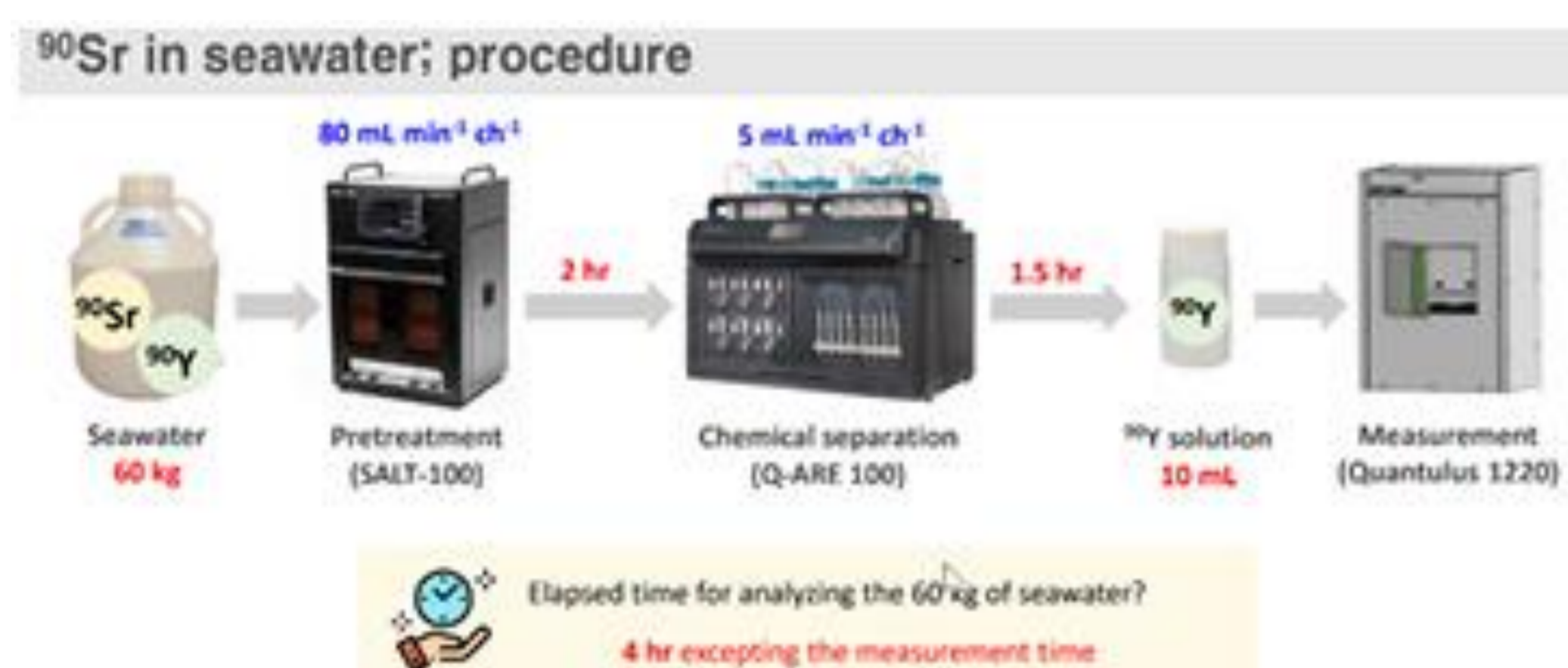


Figure 1: Workflow Sr-90 determination in seawater according to Kim et al. [1 – 4]

- Analysis of Sr-90 via Y-90 in in 1-50L seawater samples in < 4h
- Decrease of HNO<sub>3</sub> cc to be tested

## On-going work on TK227 Resin

- Data obtained for Yttrium to be tested on other trivalent elements such as Am with possibility to preconcentrate it @ pH1
- Alternative geometry: Transposition of the TK227 Resin to impregnated membrane discs
  - preconcentration of trivalent elements on membrane during filtration (Y-90, Am)
  - measurement by LSC and GPC of the membrane for Y-90 or measurement by alpha-spectrometry of Am directly of the membrane

## Conclusions

TK227 Resin is better suited for Y separation than DGA,N Resin and allows for

- Preconcentration of Y-90 from 1-50L seawater @0,2M up to 2M HNO<sub>3</sub> depending on the sample volume (the higher the volume, the higher the initial HNO<sub>3</sub> cc); additional work to improve Y retention for seawater samples @ 0,3-0,5M HNO<sub>3</sub>;
  - Preconcentration of Y-90 from surface waters @pH 1;
- Y-90 needs to be carried by stable Y.

On-going studies:

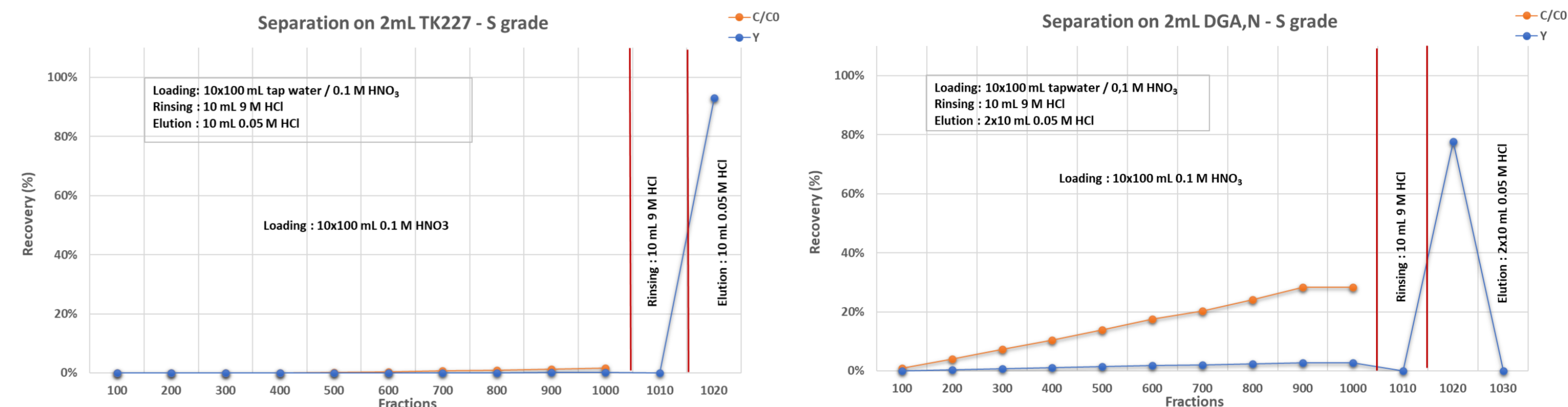
- Use of TK227 Resin for Am determination in environmental samples acidified @ pH1;
- Transposition of TK227 Resin on TK227 filtering membranes for easy and fast measurement of Y-90 and other trivalent such as Am for alpha spec measurement.

## Bibliography

- [1] Hyuncheol Kim and Gahyun Kim: "A simple and straightforward technique for analyzing radionuclides in sea water" presented at the Raddec/Triskem Workshop (as part of the 2024 LSC conference) on April 18 in Portsmouth (UK). Available online: [https://www.triskem-international.com/scripts/files/662fa5023ef284.68970177/raddec\\_tki-ws-2024\\_6\\_kim.pdf](https://www.triskem-international.com/scripts/files/662fa5023ef284.68970177/raddec_tki-ws-2024_6_kim.pdf)
- [2] Video KAERI Method: "Simple and Straightforward technique for Sr-90 analysis in seawater". Available online: <https://www.youtube.com/watch?v=i2R2b98oTCU>
- [3] Hyuncheol Kim, Yoo Gyum Kang, Yong-Jin Lee et al.: "Automated extraction chromatographic radionuclide separation system for analysis of 90Sr in sea water", Talanta 217 (2020) 121055. <https://doi.org/10.1016/j.talanta.2020.121055>
- [4] Gahyun Kim, Sang-Do Choi, Jong-Myoung Lim, Hyuncheol Kim, Strontium-90 levels in seawater southeast of Jeju Island during 2021–2023, Marine Pollution Bulletin, Volume 193, 2023, 115258. <https://doi.org/10.1016/j.marpolbul.2023.115258>

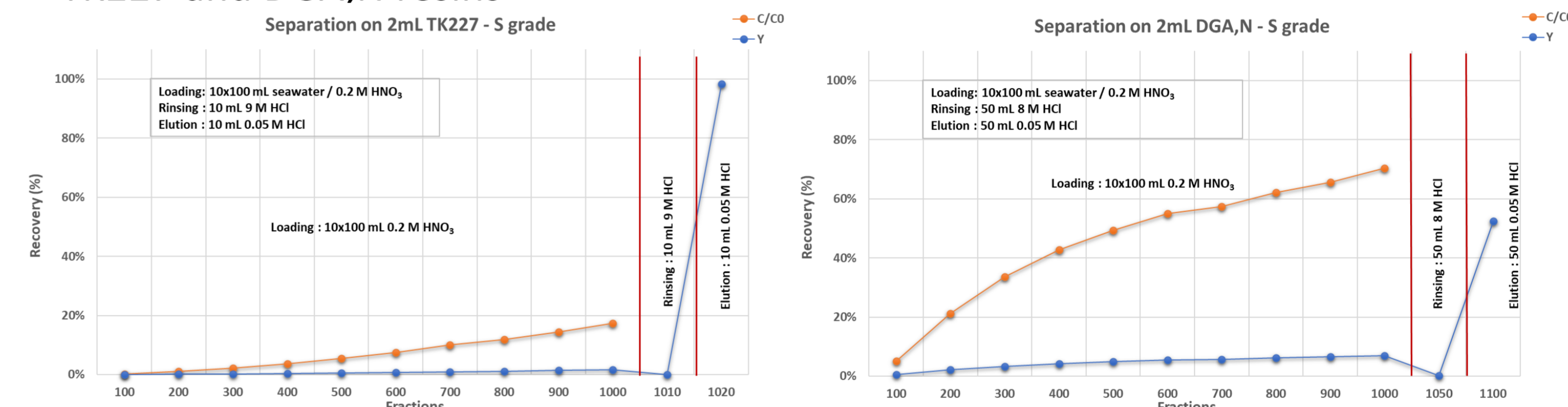
## Elution studies

Tap water samples: acidified @ pH1: yttrium breakthrough testing on TK227 and DGA,N resins



Results: Small Y breakthrough starting at 900mL on TK227 Resin compared to Y breakthrough starting after 100mL on DGA,N Resin

Seawater samples: acidified @ 0,2M HNO<sub>3</sub>: yttrium breakthrough testing on TK227 and DGA,N resins



Results: @ 0,2M HNO<sub>3</sub>, Y breakthrough starting at 300mL on TK227 Resin compared to Y breakthrough starting after 100mL on DGA,N Resin

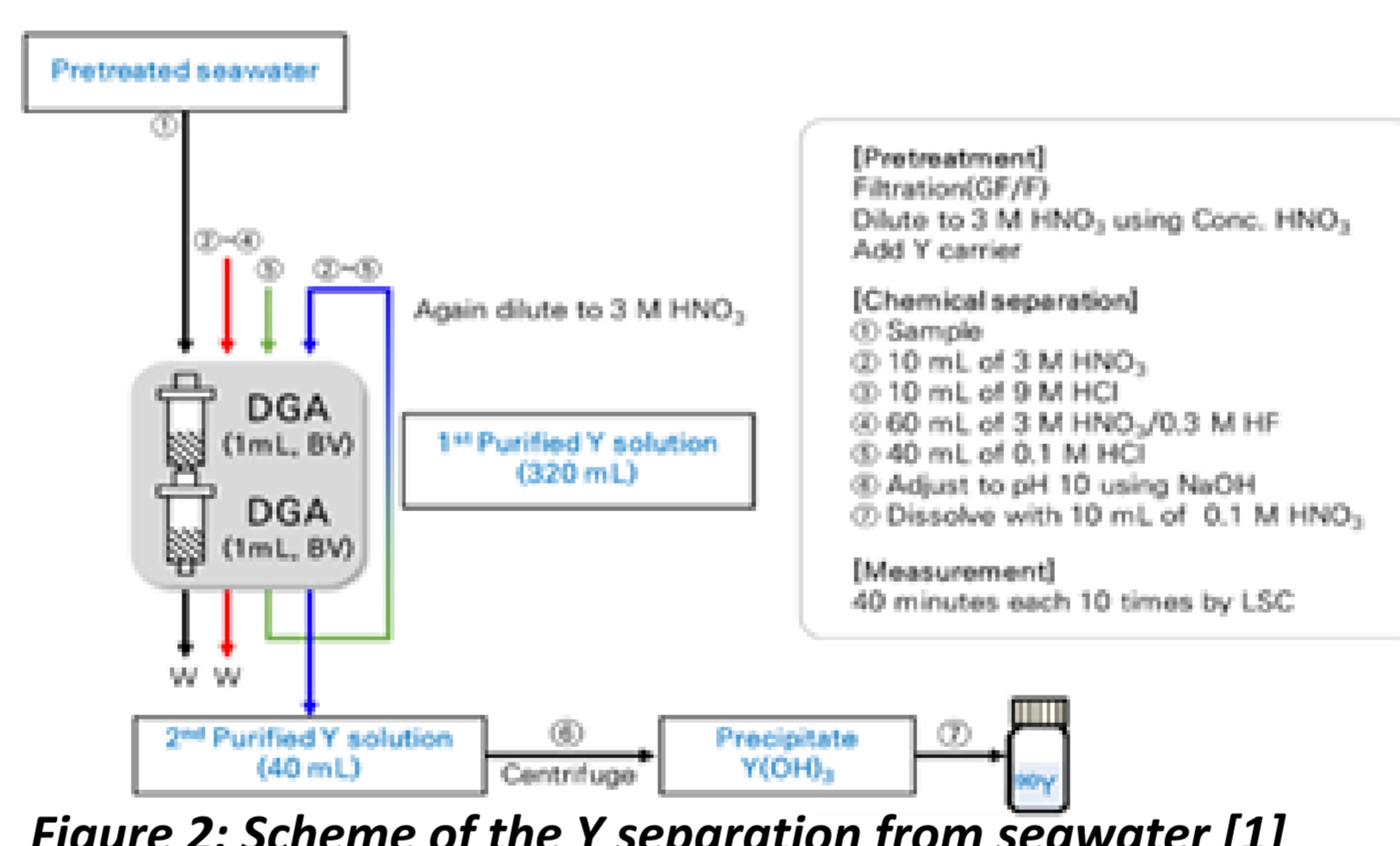


Figure 2: Scheme of the Y separation from seawater [1]

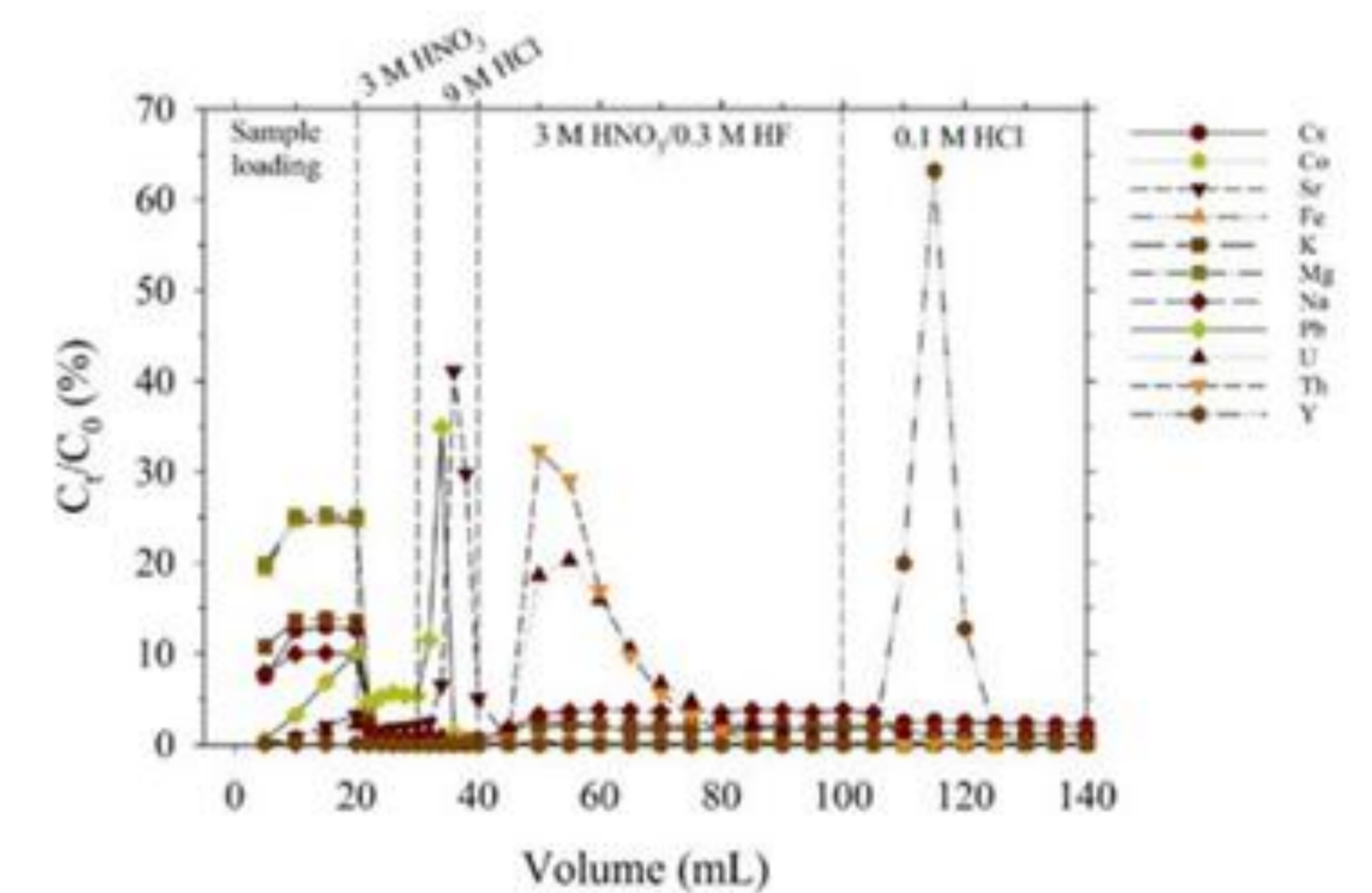


Figure 3: Separation of Y from interferences on DGA [1]

