



Rapid analysis of ^{90}Sr and ^{99}Tc in low active effluent using extraction disks: the advantages of liquid scintillation counting

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Table of content

- Introduction of the Business Unit Services and the radioactivity measurement laboratory of IRE ELiT
- Rapid extraction disks for the ^{90}Sr and ^{99}Tc analysis of low radioactive effluents
 1. Identification of potential interfering isotopes by LSC
 2. Determination of the chemical yield by using an internal tracer
- Conclusions

Business Unit Services



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We contribute to protecting the environment

- Radioactivity analysis and development of radiological monitoring systems
- Radiological characterization of waste and facilities
- Consulting and technical services in the radiation and nuclear sectors
- Dismantling of radioactive sealed sources



ISO 17025

Accredited laboratory



OUR ASSETS FOR YOUR SUCCESS

1

Reliability of the results provided



2

Flexibility with regard
to your requirements








3

Responsibility of our staff



Summary

- Resource: 7 employees
- Number of samples collected: ~ 2500 per year
- Number of analysis: ~ 7000 per year
- 20 analysis procedures under ISO 17025 accreditation
- Activity fields:
 -  Radiological monitoring survey
 -  **Analysis of water samples**
 -  Monitoring of workers
 -  Food chain survey
 -  Support to the industries



ISO 17025
Accredited laboratory
444-TEST



•A•F•S•C•A•
Agence
Fédérale pour la
Sécurité de la
Chaîne
Alimentaire



IAEA
International Atomic Energy Agency

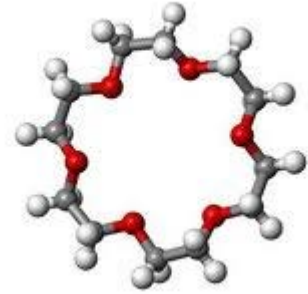
Rapid extraction disks for the ^{90}Sr and ^{99}Tc analysis



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Extraction disks

- ✓ PTFE membrane coated by a chelating agent
- ✓ Selective for strontium, radium or technetium element
- ✓ For waters or effluents sample
- ✓ Measurement by Liquid scintillation counting or proportional counting



■ References:

^{99}Tc : ASTM D7168-16 Standard Test Method for ^{99}Tc in Water by Solid Phase Extraction Disk

^{90}Sr : 3M Empore Test method SR-95

Analysis methodologies in routine

^{90}Sr	^{99}Tc
V = 500 ml	V = 250 ml
HNO_3 (2N)	HCl (1N)
Filtration using 0.45 μm membrane	
Internal ^{85}Sr tracer	Standard addition method
Up to 6 samples in parallel	Up to 5 samples in parallel
Sample extraction following by water	
Elution with EDTA solution	Dried on a metallic planchet
Liquid scintillation counting after ingrowth	Direct proportional gas counting



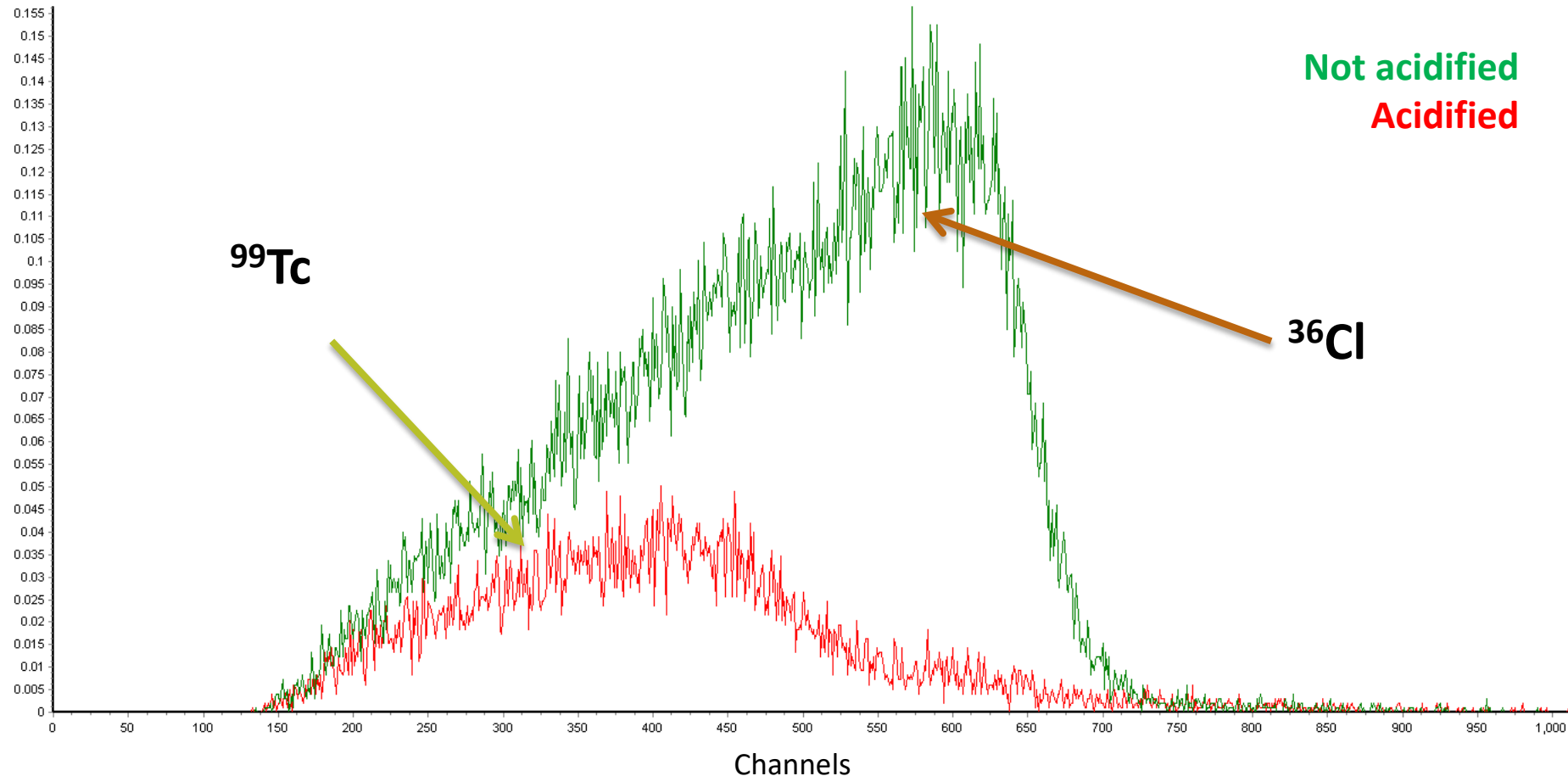
⁹⁹Tc: Potential interfering isotopes by LSC

- Known radioactive interferences
 - ¹⁰³Rh and ¹⁰⁶Rh → gamma measurement
 - ²⁴¹Pu-241 → low beta energy no impact with proportional counting
- NPL 2012 PT exercise (⁹⁹Tc, ³H and ³⁶Cl in NaOH)
 - Reference value for ⁹⁹Tc : 0.143 Bq/g
 - Reported activity : 0.79 Bq/g → ζ score = **7.58!**
 - Sample not acidified before analysis

	Without HCl	With HCl
Background (cpm)	0.7	0.6
Sample Count rate (CPM)	12.91	2.92
Global efficiency (%)	22.6	22.8
⁹⁹ Tc activity (Bq/g)	0.793 ± 0.056	0.150 ± 0.016
ζ score	7.58	0.83

^{36}Cl interference detected by LSC

LSC spectrum of the NPL 2012 Tc rad disk with 20 ml optiphase Hisafe III

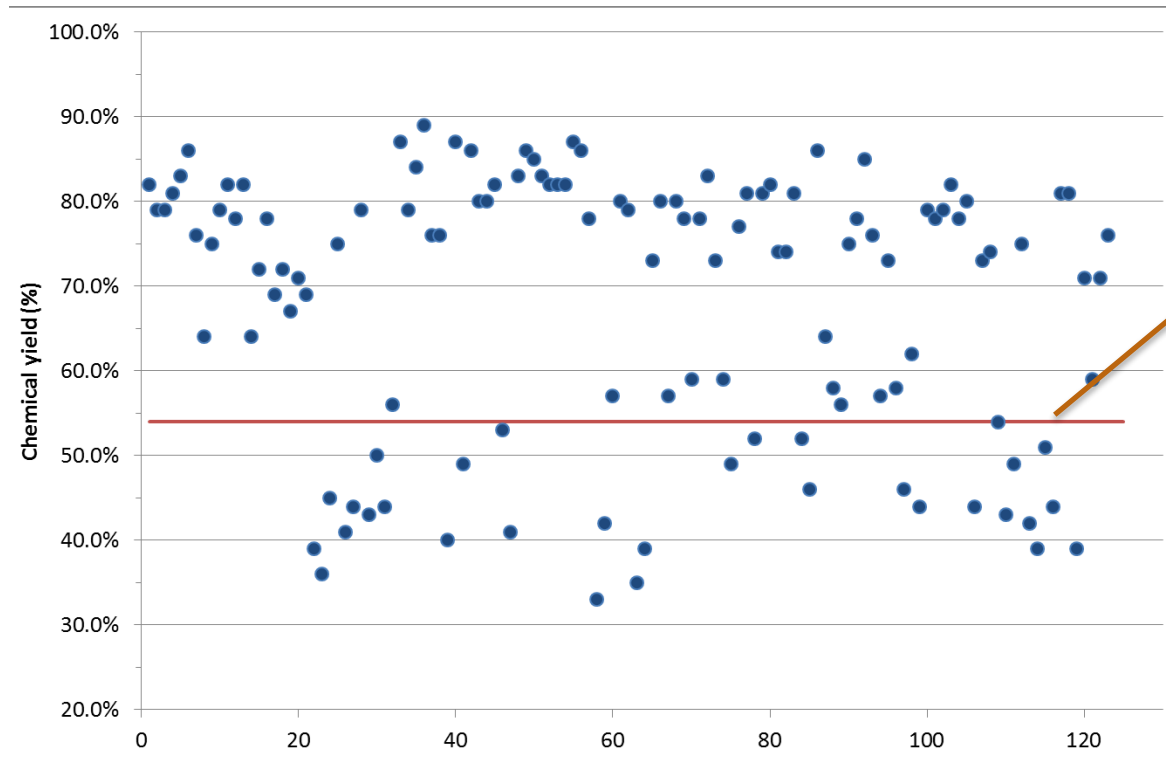


→ Co-extraction of the two isotopes

→ Impact of ^{36}Cl reduced by the addition of hydrochloric acid (cold chloride)

Chemical yield issue for complex matrix

- Sr-90 analysis on routine effluent samples
- By counting the Sr-90 and Y-90 at equilibrium with a proportional counter

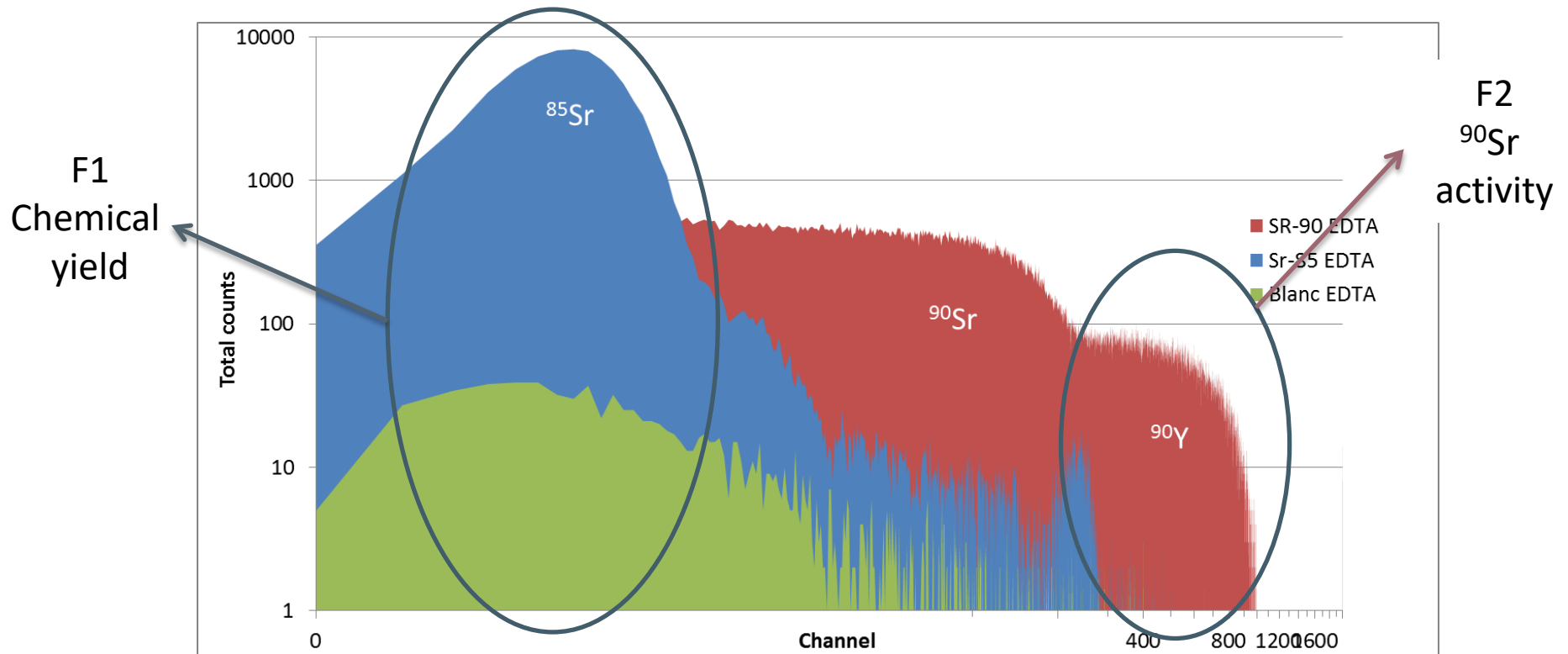


**54% = minimum
validated yield**
(By standard
addition method)

→ Strong influence of K, Na, Ca, NH₄ cations

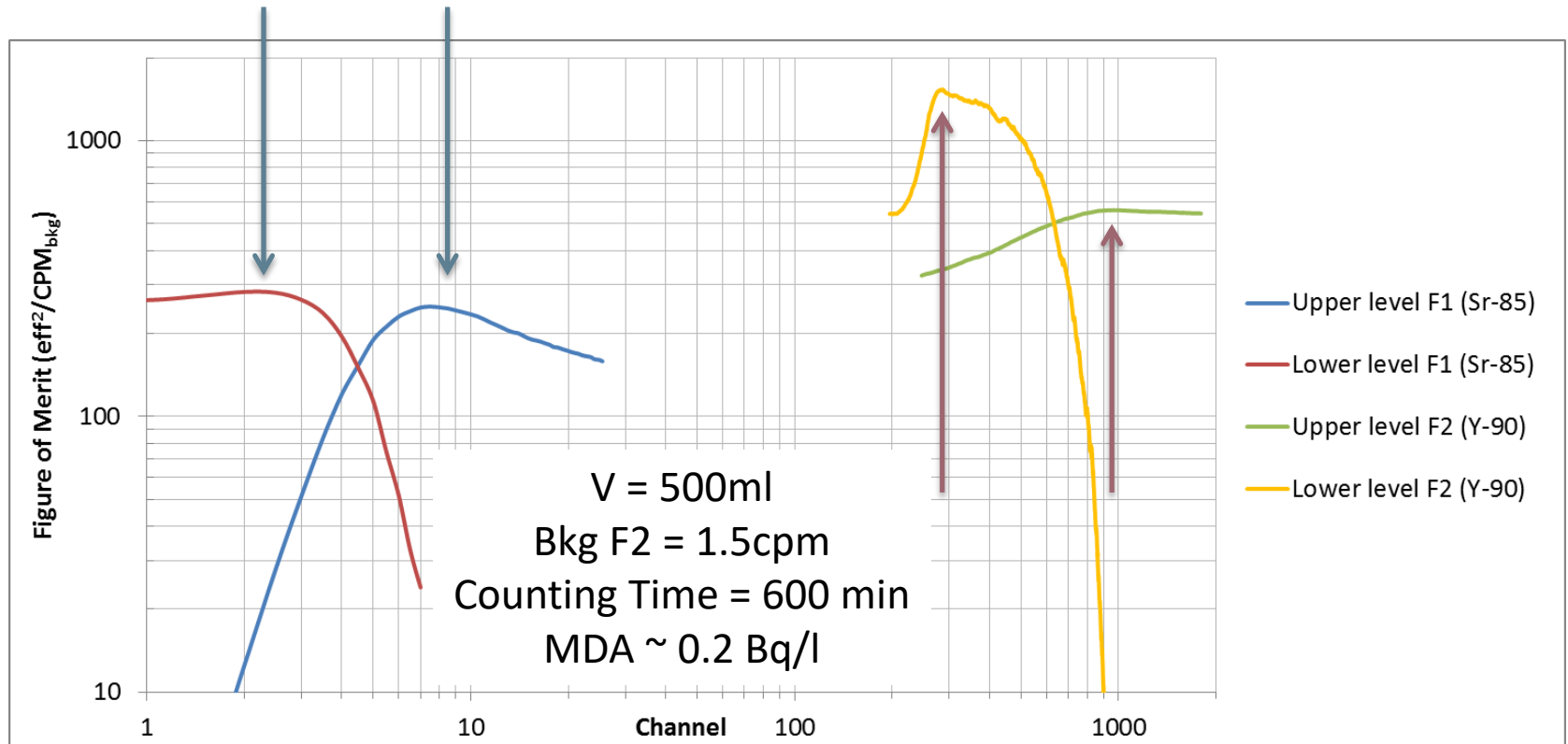
^{85}Sr tracer for chemical yield determination

- LSC spectra on TriCarb 3180 BGO system of ^{85}Sr and $^{90}\text{Sr}/^{90}\text{Y}$ EDTA solution



But optimization of the counting windows needed!

Optimization of counting windows



- F1 : From channel 2 to 8 $\rightarrow \text{Eff}_{\text{F1}} = 28\% \rightarrow \text{FoM} \sim 285$
- F2 : From channel 290 to 960 $\rightarrow \text{Eff}_{\text{F2}} = 57\% \rightarrow \text{FoM} \sim 1530$

Conclusions

Solid phase extraction Disks from Empore™ are an efficient alternative to conventional radiochemical sample preparation methods.

However it requires to be used with caution regarding the potential interferences that can impact the recovery factor or directly the truthiness of the measurement.

Thanks to the liquid scintillation, the unexpected interference of ^{36}Cl in the ^{99}Tc analysis has been discovered.

In addition, the liquid scintillation allow the use of the ^{85}Sr as an internal tracer to monitor the chemical yield in the routine analysis of effluent samples.



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Thank you for your attention

Please visit our poster (session 2, n°222)