



HAL
open science

Is it easy to improve radiochemical methods in respect of REACH regulation?

C. Gautier, C. Colin, J.-P. Degros, P. Perret, C. Cruchet, M. Giuliani, E. Laporte, C. Mougél

► **To cite this version:**

C. Gautier, C. Colin, J.-P. Degros, P. Perret, C. Cruchet, et al.. Is it easy to improve radiochemical methods in respect of REACH regulation?. International Conference on Advances in Liquid Scintillation Spectrometry (LSC - 2017), May 2017, Copenhagen, Denmark. cea-02437083

HAL Id: cea-02437083

<https://cea.hal.science/cea-02437083>

Submitted on 13 Jan 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Is it easy to improve radiochemical methods in respect of REACH regulation?

C. Gautier, C. Colin, J.P. Degros, P. Perret, C. Cruchet, M. Giuliani, E. Laporte and C. Mougel

Den - Service d'Etudes Analytiques et de Réactivité des Surfaces (SEARS), CEA, Université Paris-Saclay, F-91191, Gif-sur-Yvette, France

Corresponding author's e-mail: christele.colin@cea.fr

For more than twenty years, the LASE (Operator Support Analysis Laboratory) has been developing and implementing radiochemical methods devoted to the determination of Difficult To Measure radionuclides in radwaste. In particular, its expertise concerns the characterization of long-lived beta emitters such as ^{55}Fe , ^{63}Ni and ^{99}Tc in various matrices. The purification procedures applied for a long time are highly selective towards those radionuclides but mainly based on liquid-liquid extraction steps including the use of chloroform which is restricted through REACH regulation [1,2]. The elimination of this solvent is a real challenge for radioanalytical laboratories. Furthermore, the management of short-lived radioactive tracers such as $^{99\text{m}}\text{Tc}$ is becoming difficult. Consequently, alternative radiochemical methods have to be investigated.

The presentation will first focus on the results of speciation calculations (performed with Chess[®] software) which are of prime interest to better understand the involved chemical processes and to optimize the alternative separation methods before LSC measurements [2]. The second part of the work will deal with the improvements made for the analysis of ^{55}Fe , ^{63}Ni and ^{99}Tc . Extraction chromatography was introduced to maintain high decontamination factors towards the interfering elements [3,4]. TRU[®], Ni[®] and TEVA[®] resins were respectively tested in the purification procedures dedicated to ^{55}Fe , ^{63}Ni and ^{99}Tc measurements by LSC. In order to increase the responsiveness of the laboratory, the implementation of rhenium instead of $^{99\text{m}}\text{Tc}$ as tracer was also investigated [5]. The results will be compared in terms of separation yield, selectivity and accuracy for real radioactive waste and effluent samples. In particular, the influence of the medium obtained after radiochemistry was investigated towards the quenching effect and the counting efficiency for LSC measurements. In the future, this approach can be extended to other radionuclides such as ^{93}Zr .

Table 1 Comparison of two radiochemical procedures applied to measure ^{55}Fe by LSC in various radioactive waste samples

Sample	Recovery yield (%) based on liquid-liquid extraction with cupferron	Recovery yield (%) based on TRU [®] resin	^{55}Fe (Bq/g) based on liquid-liquid extraction with cupferron	^{55}Fe (Bq/g) based on TRU [®] resin
Aluminum	72	82	$3.70 \times 10^5 \pm 8 \%$	$3.62 \times 10^5 \pm 8 \%$
Steel	23	80	$3.80 \times 10^3 \pm 7 \%$	$3.73 \times 10^3 \pm 7 \%$
Ion-exchange resin	74	86	$2.62 \times 10^3 \pm 5 \%$	$2.50 \times 10^3 \pm 5 \%$

References:

1. Hepiegne P. et al., The separation of ^{99}Tc from low and medium-level radioactive wastes and its determination by inductively coupled plasma mass spectrometry, *Talanta* 41 (1995) 803-809.
2. Gautier C. et al., A comparative study using liquid scintillation counting to determine ^{63}Ni in low and intermediate level radioactive waste, *J. Radioanal. Nucl. Chem.* 308 (2016) 261-270.
3. Horwitz E.P. et al., Separation and preconcentration of actinides by extraction chromatography using a supported liquid anion exchanger: application to the characterization of high-level nuclear waste solutions *Anal. Chim. Acta* 310 (1995) 63-78.
4. Hou X. et al., Critical comparison of radiometric and mass spectrometric methods for the determination of radionuclides in environmental, biological and nuclear waste samples, *Anal. Chim. Acta* 608 (2008) 105-139.
5. Shi K. et al., Determination of technetium-99 in environmental samples: A review, *Anal. Chim. Acta* 709 (2012) 1-20.