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

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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 ^{99m}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 ^{99m}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	3.70×10^5 ± 8 %	3.62×10^5 ± 8 %
Steel	23	80	3.80×10^3 ± 7 %	3.73×10^3 ± 7 %
Ion-exchange resin	74	86	2.62×10^3 ± 5 %	2.50×10^3 ± 5 %

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