Current and future needs of radioanalytical laboratories

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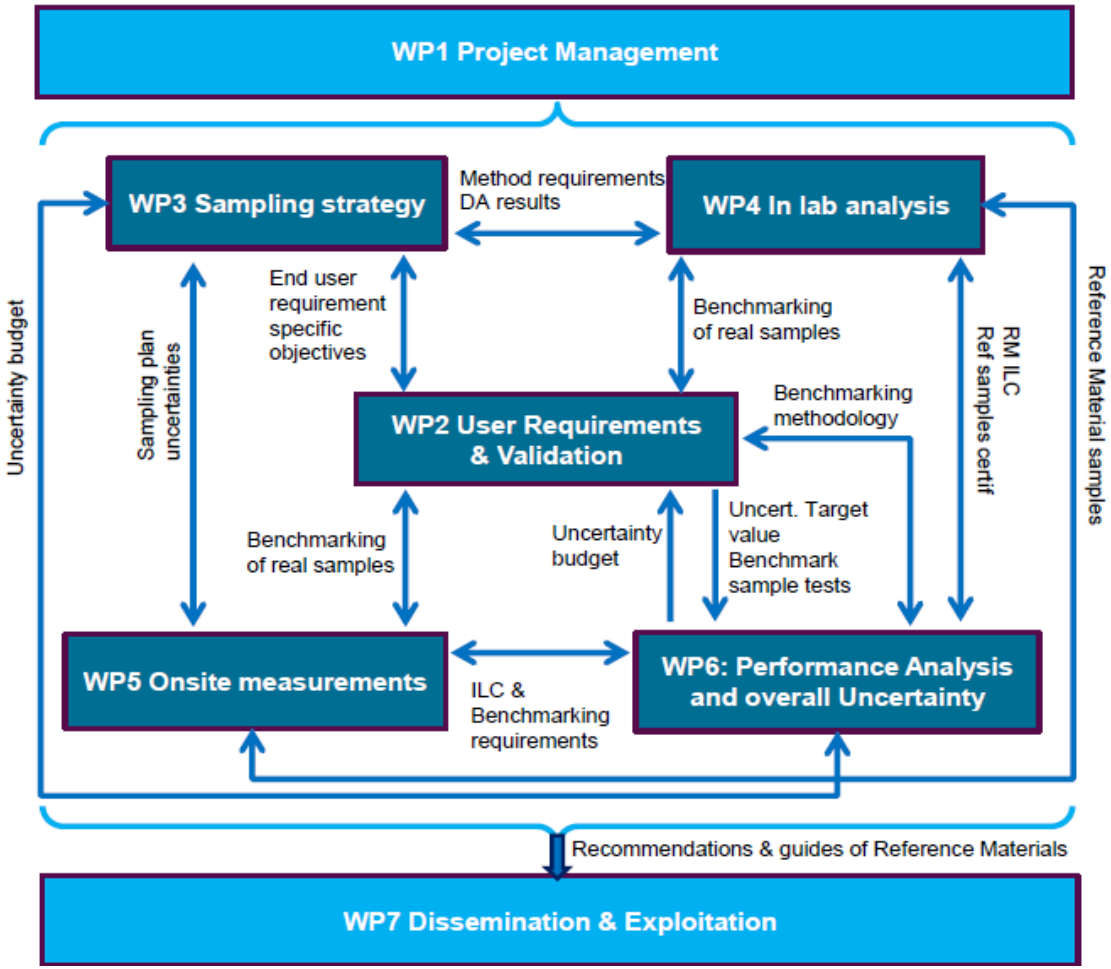
WP4 Description

- **Links with the other WP**
- **WP2** (requirement and validation)
- **WP3** (sampling strategy)
- **WP6** (inter-laboratory comparison)



Objective in Work Package 4

- Comprehensive review of radiochemical measurement techniques, including validation of microsystem as part of WP4

Task in Work Package 4

- **Task n.1: Evaluation of radiochemistry measurement techniques**
  - KIT, JRC

Task 4.1 - Evaluation of radiochemistry measurement techniques

- **Description**

  - KIT/ JRC
  - Distribute questionnaire to determine parameters in evaluating radiochemistry measurement techniques
  - Questionnaire to be collated and evaluated, and scoring criteria devised
  - Literature review of radiochemistry techniques, which will be scored against criteria
  - Recommendations also used in WP6 to assess performance of techniques in inter-laboratory comparison

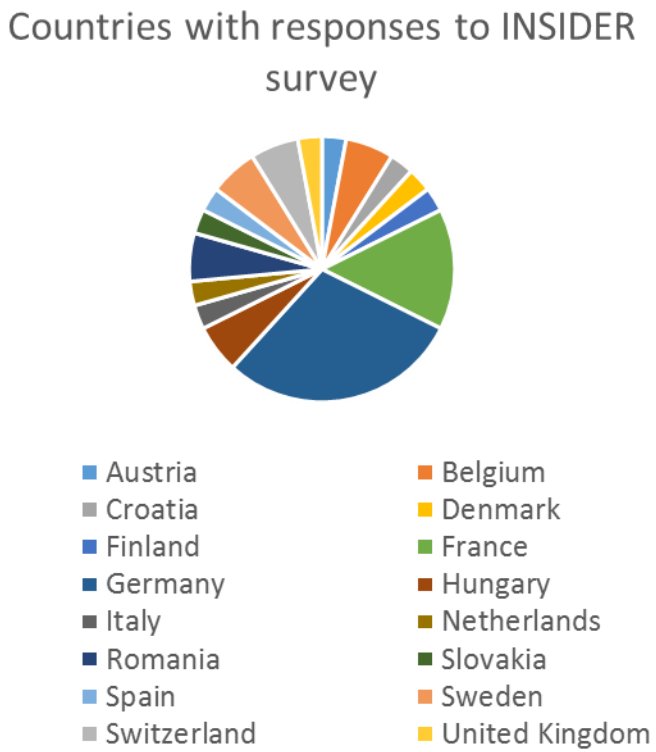
Survey Distribution

- INSIDER WP 4.1: survey conducted on the current state of radiochemical methods throughout Europe to assess challenges for the future of decommissioning

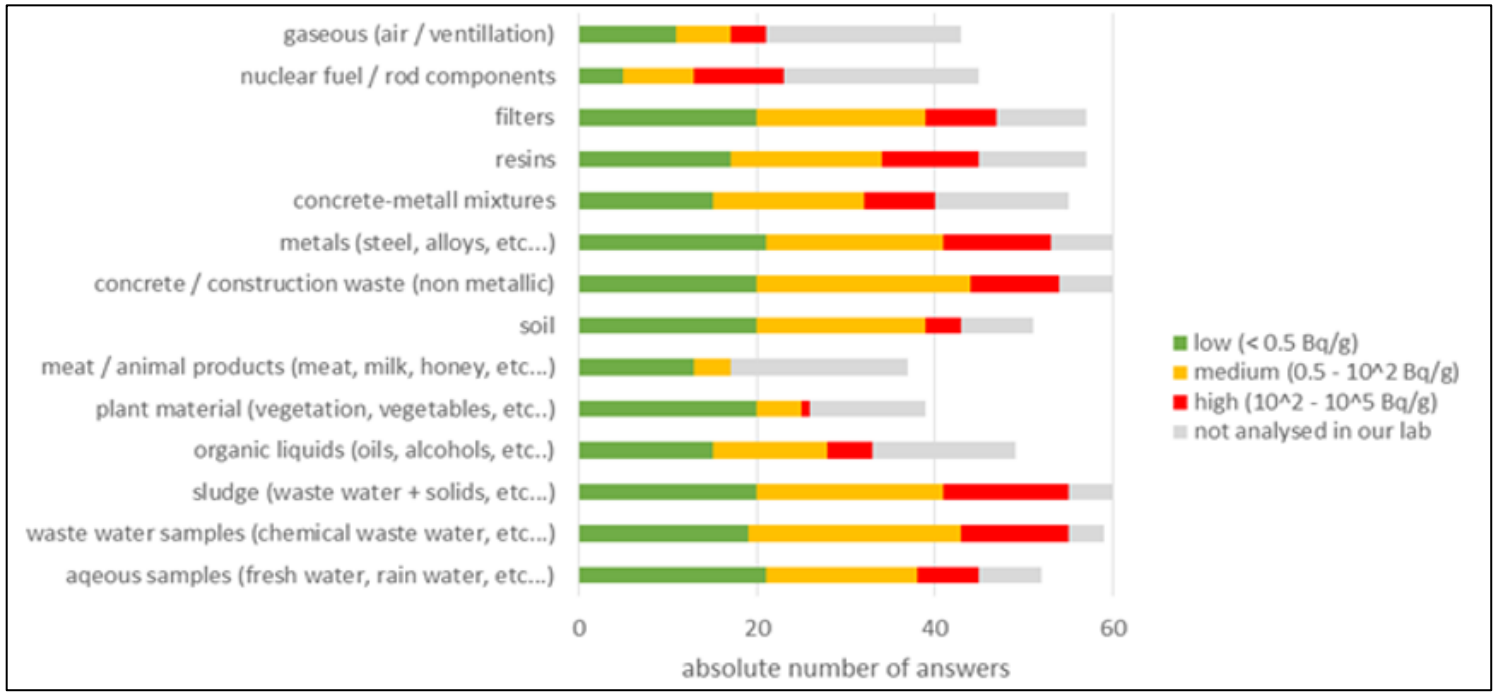
- 18 questions
  - Sample materials
  - Activity levels
  - Sample preparation
  - Nuclides analysed
  - Analytical methods
  - Future challenges

Survey participants

- Ca. 140 persons contacted
  - INSIDER: 35 (technical members)
- Ca. 80 answers
  - INSIDER: 15
- 75 survey links sent
  - INSIDER: 22
- 34 surveys completed
  - INSIDER: 11

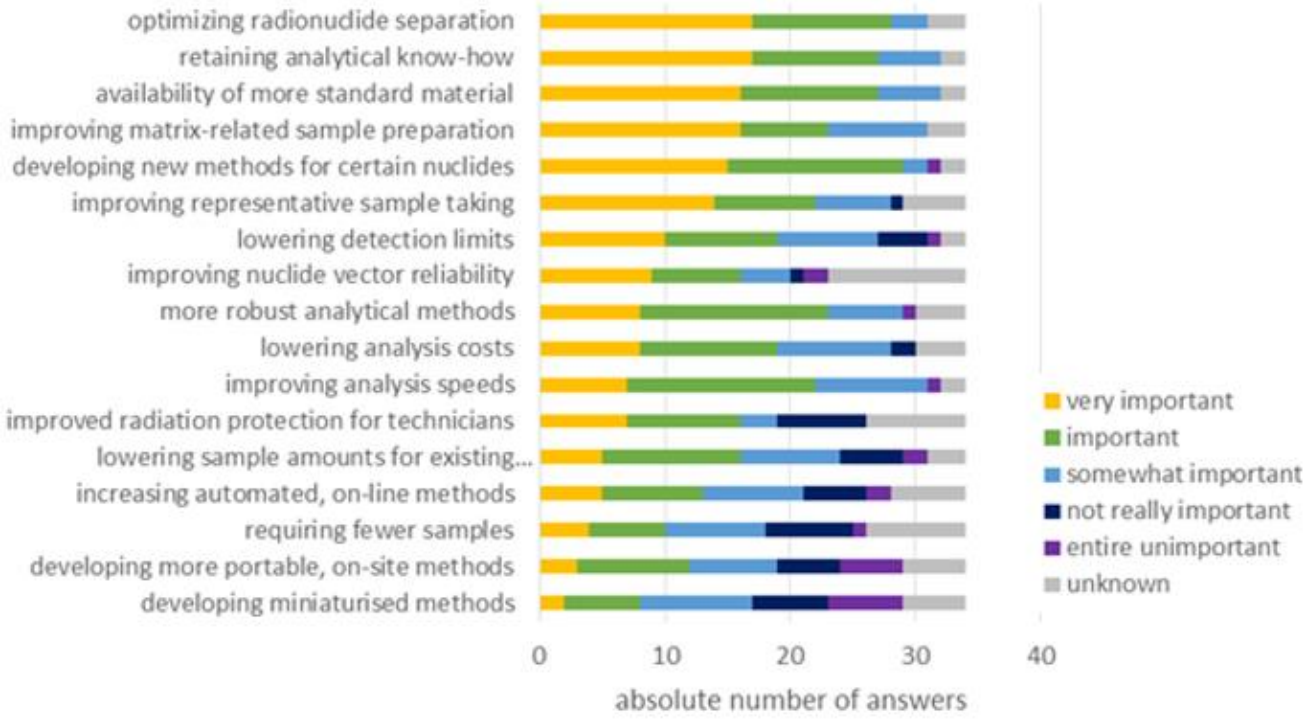


Example of results: Activity levels in sample materials



- Sample materials analysed in most labs: waste water, sludge, construction waste and metal
- 75 – 85 % of analyses with samples < 10^2 Bq/g

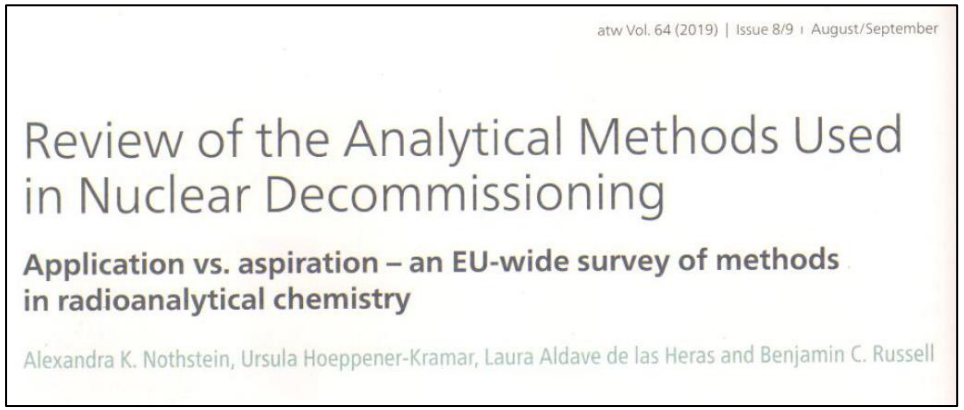
Example of results: Analytical challenges in the future



- Optimisation of radionuclide separation, retaining know-how and reference material availability were amongst the most important

Communications

- Report published and available on INSIDER consortium website
- Publication in International Journal of Nuclear Power (Nothstein et al., vol. 64, 2019, Issue 8/9)



Task in Work Package 4

- **Task n.2: Development of a novel radiochemical measurement technique for use in a restricted facility**
  - CEA

Task 4.2 - Development of a novel radiochemical measurement technique for use in a restricted facility

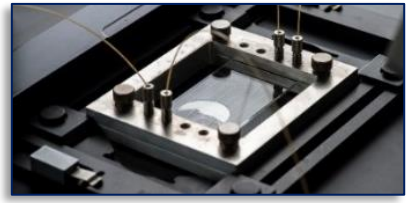
- **Description**
- Method developed for ^{55}Fe based on liquid-liquid microsystem
- Technique and measurement uncertainties validated
- Technique also potentially applied to inter-laboratory comparison in WP6 for spiked aqueous material
- Testing of samples from CEA stock materials, measured for ^{55}Fe using the micro-system and existing CEA protocol, and the results compared

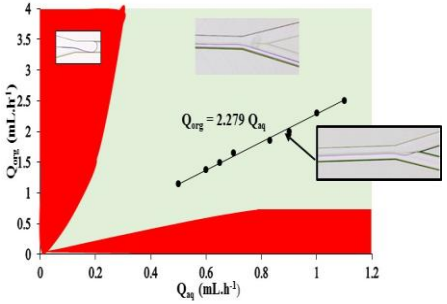
Task 4.2

- **Objective :** develop a microsystem-based analytical protocol for the extraction and purification of a radionuclide (^{55}Fe) prior to its analysis
- **Main advantages of analytical microsystems :**
  - Minimise the quantity of sample required for the analysis
  - Reduce the risks related to radioactive sample manipulation in the laboratory
  - Reduce the chemicals and wastes from the analytical activities
  - Reduce the constraints related to the shipment of the radioactive samples from the facility to the laboratory
  - Reduce the time of analysis and/or run the analyses in parallel

Task 4.2 : Main results

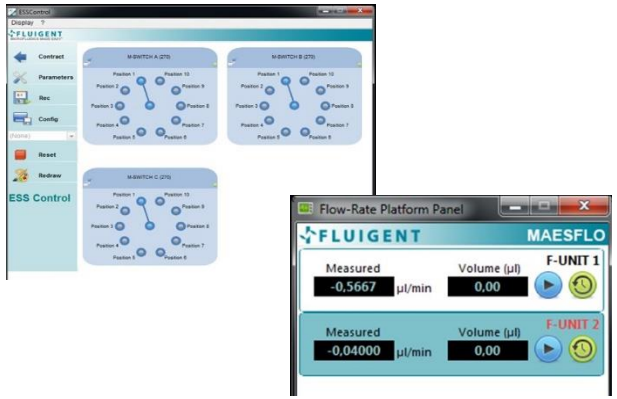
- Development of a **microsystem-based set-up for the selective recovery of iron**, to improve a current analytical protocol for the measurement of ^{55}Fe in samples
- A protocol based on **solvent extraction** was developed and tested regarding the control of hydrodynamics in the micro-channel, quantitative extraction of Fe, and selectivity versus Co and Cs that may interfere in the measurement
- **Time saving thanks to microfluidic** : Preparation and equilibration of flow rate take about 5-10 minutes, the extraction and phase separation last less than 2 seconds, whilst achieving a yield of >80 %





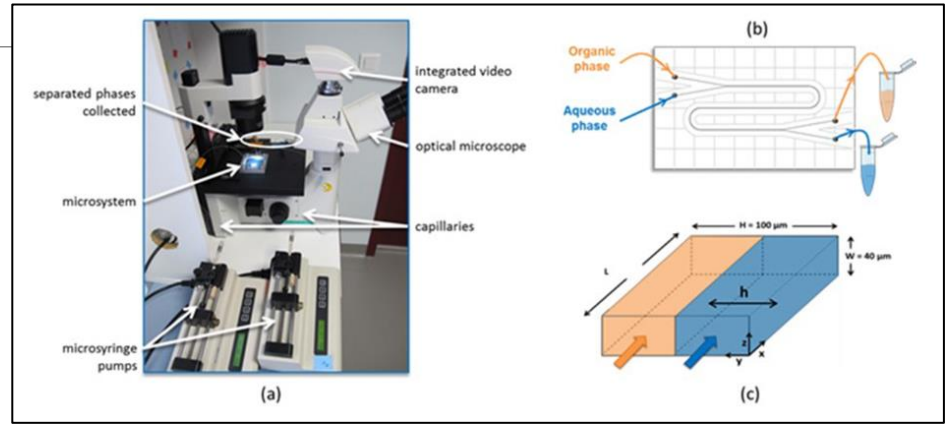
Further advances:

- Adaptation of the device and analytical tests with ^{55}Fe-containing samples
- Automation of the method (software control)
- Evaluation of the effective gain (efficiency, radioprotection, reduction of chemicals and wastes, increase of analysis statistics / uncertainties) for real samples

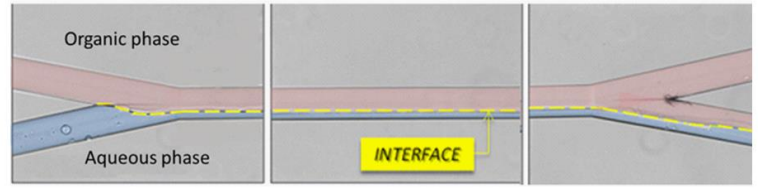


Task 4.2 Communications

- Deliverable 4.2 : **Analysis of radionuclides in microsystem: application to the selective extraction of ^{55}Fe by solvent extraction**, report, Sept. 2018
- Oral presentation at DEM 2018, 22-24 Oct. 2018, Avignon, France.
  Microfluidics tools for radionuclides analysis in acidic samples, S. Rassou, C. Mariet, A. Vansteene, J.–P. Jasmin, M. Losno, T. Vercouter
- **Sustainable Solvent Extraction Process for Fe Analysis in Radioactive Samples Based on Microfluidic Tools,** S. Rassou, T. Vercouter, C. Mariet, *Solvent Extraction and Ion Exchange* (2020), 38(2), 236-249. https://doi.org/10.1080/07366299.2020.1712096
- **Analysis of radionuclides in microsystem: Application to the selective recovery of ^{55}Fe by solvent extraction,** S. Rassou, C. Mariet, T. Vercouter, EPJ-N Nuclear Sci. Technol. 6, 10 (2020) https://doi.org/10.1051/epjn/2020002



(a) Experimental setup for extraction studies in a glass microsystem; (b) scheme of the single-stage microsystem; (c) focus on a part of the microchannel: extraction length L = 12 or 20 cm, width H = 100 µm, h the position of the interface and depth W = 40 µm)



Example of the position of the interface in the ICC-DY10 microsystem (based on microscope photographs)

THANK YOU