How Digital Autoradiography technique can be useful for D & D projects?

Pascal Fichet, Raphaël Haudebourg, CEA Saclay, DPC/SEARS/LASE, France
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Outline

• LASE laboratory: Analytical Support to Facilities Laboratory

• Digital Autoradiography Technique

• Digital Autoradiography for Radionuclides Mapping

• Digital Autoradiography in support of sampling processes

• Conclusions
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Different characterization techniques for low and intermediate level wastes.
Destructive analysis (sample = 1 g)
Radiochemistry
Alpha, Gamma, LSC
Elemental analysis

In situ technique: Autoradiography
Lots of Radwastes must be characterized

Innovations are required for in situ techniques, for techniques allowing a better sampling process

Destructive techniques need less than 1 g of sample for digestion process
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DA Technique

Radiography

Source → Detector

Autoradiography

Source → Detector

Interests: H, C, S, ... radionuclides difficult to measure
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DA Technique

Sensitive side  Plastic side

« Image » of radioactivity
Screens can be reused hundreds of time

(1) Screen initialization
(2) Screen Deposit
(3) Exposure Time
(4) Screen withdrawn
(5) Screen scan
(6) Calculations
DA Technique

- Semi quantitative values are achievable.
- Repeatability corresponds only to few percents
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Radionuclides mapping

High radioactivity Laboratories in Facility 459 CEA, Saclay

3 laboratories (250 m² each) must be destroyed. After historical study characterization is required.
Radionuclides mapping

1) Shutdown after the period of research
2) Cleanup
3) Researches on the history of the facility
4) R&D required for initial state characterizations.
5) Dismantling
Radionuclides mapping

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Radionuclides mapping

A grid corresponding to 70 screens

Radioactivity image, here C-14
Radionuclides mapping

100 % measurements is very difficult and not efficient when considering geostatistical approach

35 zones were drawn on concrete surface

1000 screens were deposited on the floor and located precisely by using a telemeter.
Radionuclides mapping

All Autoradiography images are processed by a homemade software.

Here image resolution corresponds to small square of 5 mm * 5 mm.

X1, Y1, DLU1
X2, Y2, DLU2
X3, Y3, DLU3

......
Radionuclides mapping

For the characterization: approximately 20,000 values processed

Variogram calculated
Radionuclides mapping

Kriging calculation

Uncertainties

Tritium traces

Only 20% investigated by autoradiography

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Classical sampling process by *wipe tests* = problems for non labile radioactivity

**Sampling process**

**Classical sampling process**

- Alpha spectrometers
  - Liquid Scintillation Counting

**In Situ Samplings**

**Laboratory measurements**

In situ measurements by **Autoradiography**
Sampling process for tritiated wastes

Destructive measurement of H-3 is done by pyrolysis followed by Liquid Scintillation Counting (LSC)

Sample = 1 g
Rapid investigation of wipes containing Uranium traces

Only 3 wipes among 7 contained Uranium.

After studies with a destructive method: wipe digestion followed by alpha spectrometry and/or ICP-MS, detection limit was determined at **0.2 Bq/wipe** for Uranium.
Core made of concrete containing C-14

Activity on surface

Interesting sampling

Activity in depth
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Sampling process

Graphite cores containing C-14

4 small cores on the same screen

Calculations

Homogeneity of the contamination at a very low scale
Sampling process

Study of a resin located inside a plastic tube containing I-129

Plastic deposited on a film for 15 minutes

Efficient solution for sampling process
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• Autoradiography technique has been used for characterization of Radwastes.
• The technique is efficient for radionuclides difficult to measure: alpha and beta emitters
• Autoradiography is very sensitive to alpha > beta > gamma
• It allows characterizations to provide radionuclides mapping and better sampling process.
• Semi quantitative values can be obtained.

• Researches are going on to improve the Autoradiography technique:
  « Preliminary identification of α and β contaminations through Digital Autoradiography » R Haudebourg, P Fichet
Conclusions

THANK YOU for your ATTENTION!