Clearance at IRE : ^{90}Sr quantification in combustible waste

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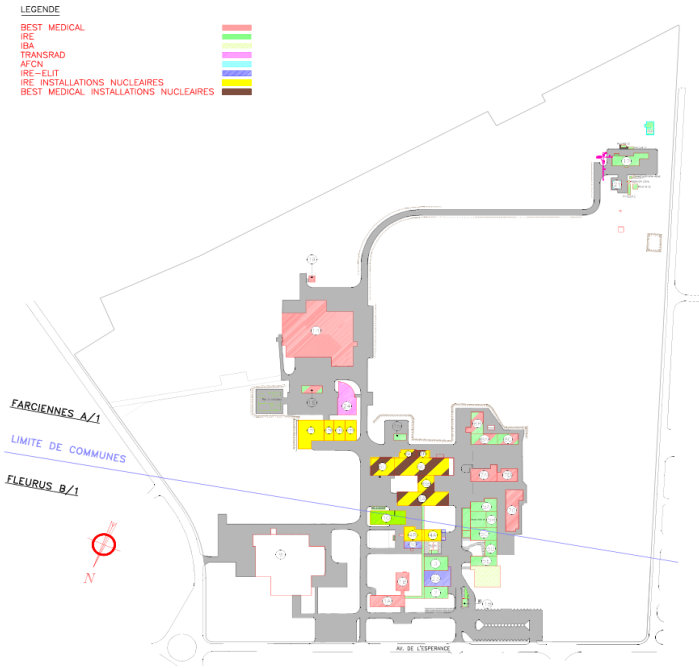
Our site

- IRE
  - Productions from irradiated U (-> fission products) : $^{99}Mo/^{99m}Tc$, $^{90}Sr/^{90}Y$, ^{131}I, ^{133}Xe, R&D
  - IRE ELIT : radiopharmaceutical productions ($^{68}Ge/^{68}Ga$, $^{188}W/^{188}Re$, ^{90}Y) & environmental control

- Other companies on site:
  - NTPE : productions: ^{192}Ir, ^{60}Co
  - ONSF (Ex Nordion) : ^{90}Sr, isotopes production by cyclotron
  - Transrad



Waste management

Sorting waste according to:

A) Producer	**B) Origin**	**C) ONDRAF**
IRE	$^{99}Mo/^{99m}Tc$	A11 (combustible)
IRE-ELIT	$^{90}Sr/^{90}Y$	A14 (non-compactable)
ONSF	^{131}I	A17 (compactable)
NTPE	R&D	…
	QC	
	Radiopharmaceutical	
	^{192}Ir	
	…	

in order to separate waste with different isotopic composition.

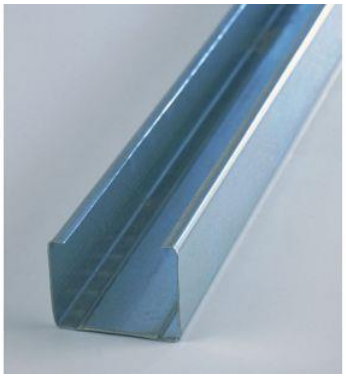
Conclusion : More than 70 waste flux

Clearance

- Surface Clearance
  - 2 independent measurements
  - Many conditions

YES:

NO:



- Mass Clearance

Waste characterization

- For measurable isotopes :
  - First gamma spectrometry (IQ3 : 3HP Ge detectors)
  - Crushing (homogenisation of the bulk + common waste + better sampling)
  - Second gamma spectrometry (IQ3)

- For non measurable isotopes :
  - Another method is needed

Waste characterization

First example : ^{90}Sr in the waste from ^{99}Mo/^{99m}Tc production

- Activities of non measurable isotopes are computed using a typical of a numerical calcul of the fission products produced by a neutron irradiation (numerical simulation)

- ^{90}Sr activity is computed with a representative isotope (^{144}Ce or ^{137}Cs)

$$A_{Sr\text{-}90} = 1/6 * A_{Ce\text{-}144} \qquad \text{if} < 2\text{ans}$$

or

$$A_{Sr\text{-}90} = 5{,}9/6 * A_{Cs\text{-}137} \qquad \text{if} > 2\text{ans}$$

Waste characterization

Second example : ^{90}Sr in the combustible waste from multi-isotopes area

- ^{90}Sr might not be proportional to ^{144}Ce/^{137}Cs due to ^{90}Sr/^{90}Y production
- Proportionality factor can't be used
- A specific process has been developed to quantify ^{90}Sr activity

Clearance method for waste with ^{90}Sr from $^{90}Sr/^{90}Y$ production

Mains constraints :

- ^{90}Sr is a β^- pur emitter :
  - $^{90}Sr \rightarrow {}^{90}Y\ (by\ \beta^-\ pure) \rightarrow {}^{90}Zr\ (by\ \beta^-\ pure)$

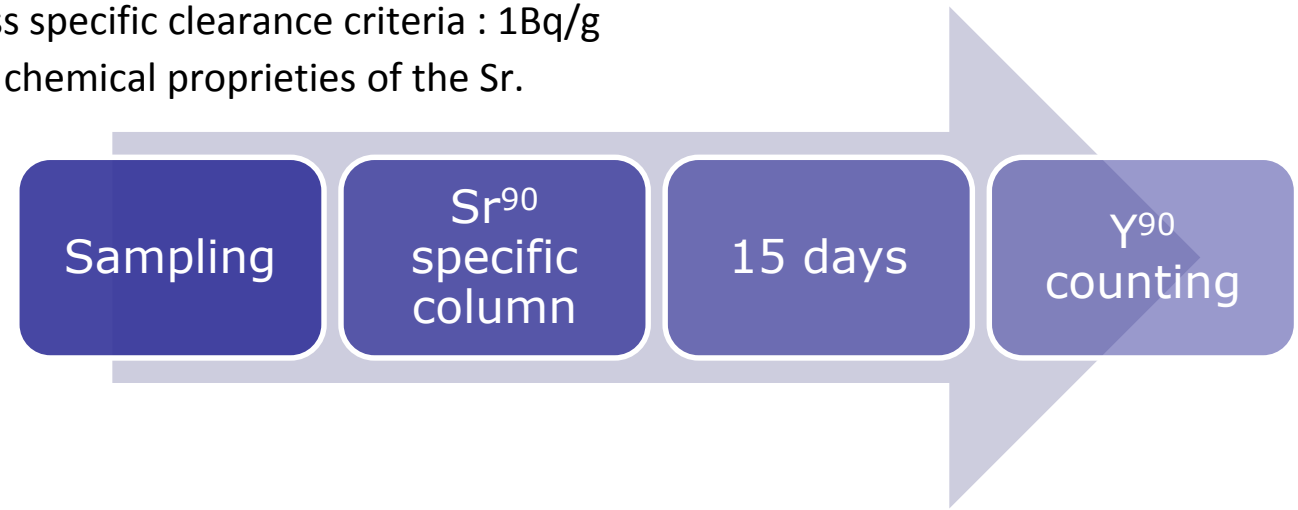
  -> Spectrometry γ is not possible
- Some waste flux might be contaminated with ^{90}Sr from $^{90}Sr/^{90}Y$ production area

  -> Cannot use a proportionality factor

⇒ **Another method is needed**

The method is based on :

- Mass specific clearance criteria : 1Bq/g
- The chemical proprieties of the Sr.

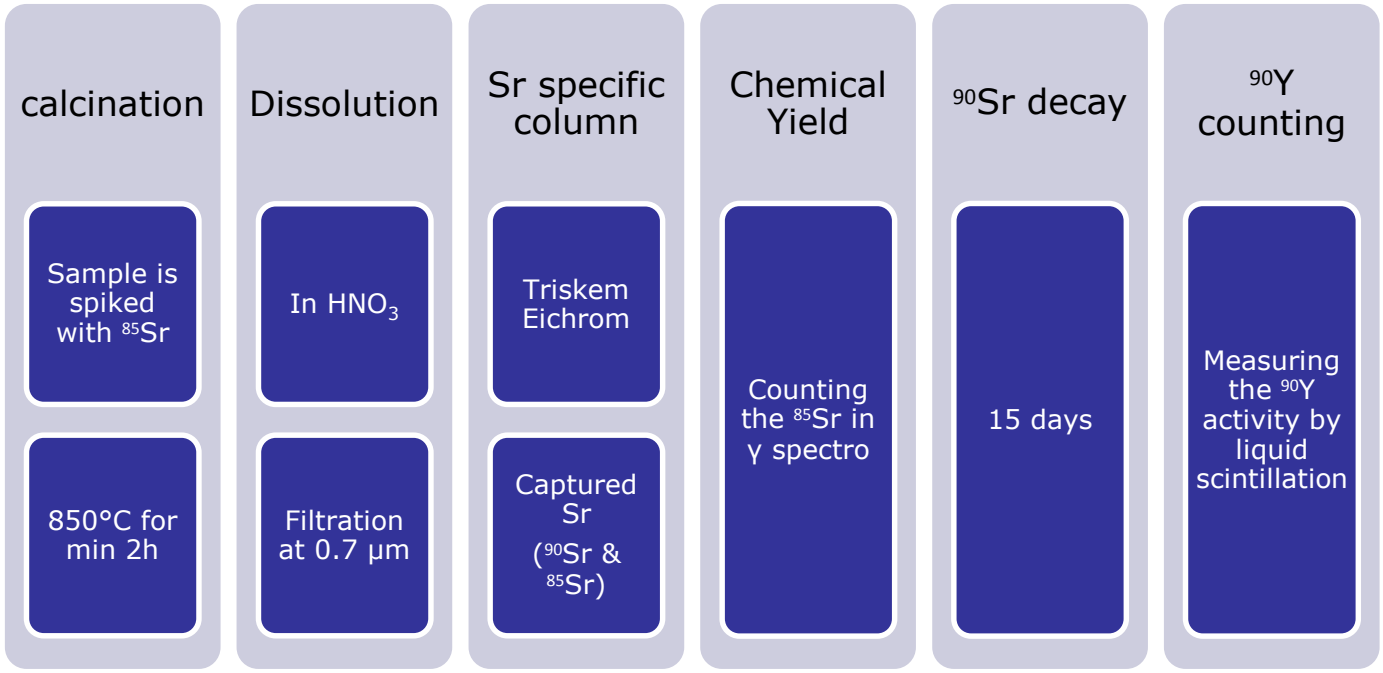


Clearance method for waste with ^{90}Sr from $^{90}Sr/^{90}Y$ production

1. **Sampling**

   A sample is taken at 3 different heights of the drum

2. **^{90}Sr measurement**



Clearance method for waste with ^{90}Sr from $^{90}Sr/^{90}Y$ production

1. **Sampling**
2. **^{90}Sr measurement**
3. **^{90}Sr specific Activity**

$$A_m = \frac{\overline{CPM_{samp}} - \overline{CPM_{Bl}} - \overline{CPM_{Sr85}}}{60 * \eta_{chem} * \eta_{Cer} * M_{tot}}$$

$\overline{CPM_{samp}}$ = Mean of liquid scintillation measures of the sample

$\overline{CPM_{bl}}$ = Mean of liquid scintillation measures of the blank

$\overline{CPM_{Sr85}}$ = Mean of liquid scintillation measures of the blank with ^{85}Sr

η_{Chem} = Chemical Yield of the Sr calculated with ^{85}Sr activity

η_{Cer} = Cerenkov Yield

M_{tot} = Mass of the sample

$$A_{90_{Sr}} = A_m + 2\sigma_{A_m}$$

$$\sigma_{AmSr90} = \sqrt{\sigma^2_{\eta chim} + \sigma^2_{\eta Cer} + \sigma^2_{CPMnets} + \sigma^2_{Mtot}}$$

Clearance method for waste with ^{90}Sr from $^{90}Sr/^{90}Y$ production

1. **Sampling**
2. **^{90}Sr measurement**
3. **^{90}Sr specific Activity**
4. **Limitations**

- Time consuming : 1 day/Analysis + 15 days for the ^{90}Sr decay

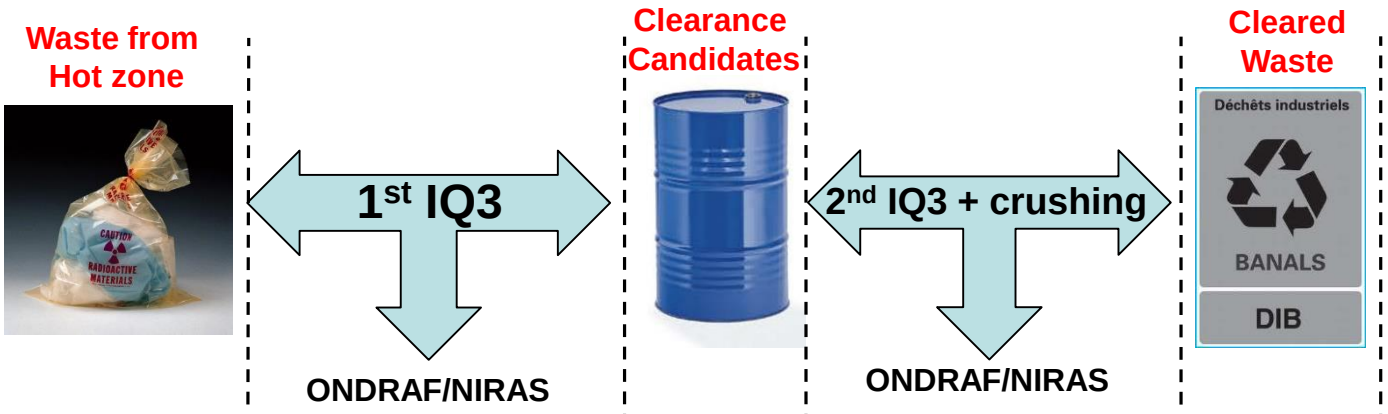
  ⟹ **Solution : sample pooling**

- Concern only combustible waste:
  - A11 (combustible solid waste)
  - Coal
  - Combustible liquid

- Competition between Sr and K in the column

Clearance at IRE

1. Mass Clearance : A11 example



^{99}Mo prod.	100		27		25
^{192}Ir prod.	100		17		12,5
Multi-isotopes area	100		51		47,5

Those 3 flux represent **88%** of the combustible waste produced on IRE site.

2. Surface Clearance for 2014 : 14 tons

Thank you for your attention !

Any Questions?

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