OPTIMIZATION

EFFICIENCY

ATRON METROLOGY

## LIQUID SCINTILLATION COUNTING : SMEARS AND AQUEOUS SAMPLES FROM INDUSTRIES

# LSC MEASUREMENTS

## OPTIMIZATION OF PARAMETERS

### CONSUMABLES, SAMPLING, METHODS

### CHOICE OF CONSUMABLES

**Liquid Scintillation Counting (LSC) is the detection of a radiation through the scintillation light produced in solutions. It has the advantage of mixing the sample within the sensitive medium, allowing the detection of low-energy radiations.**

The choice of consumables has a strong impact on the quality of countings made by liquid scintillation. However, optimization of measurement conditions consists in maximizing the Figure of Merit :

$$FoM = \varepsilon / b^2$$

Where ε is the detection efficiency and b the background noise level.

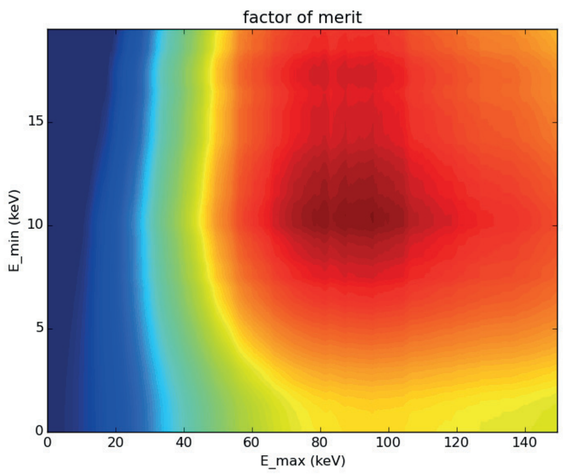
Based on this criteria, the most suitable consumables are 20 mL polyethylene vials, containing:

- 10 mL of UltimaGold scintillation liquid to measure radioactivity on smears with cellulose filter folded and rolled, placed at the bottom of the vial

- 10 mL of UltimaGold scintillation liquid to measure radioactivity in liquids with 2 mL of liquid sample mixed.

### MEASUREMENTS PARAMETERS

**Radionuclides that can be searched by LSC are for example $^{3}H$, $^{14}C$, $^{137}Cs$ or $^{40}K$. Their energy specta being different, definition of counting windows is also tuned on the basis of the FoM maximization.**




Under these requirements, best counting windows suited to the desire radionuclides are :

- [0:8] keV for $^{3}H$;

- [12:80] keV for $^{14}C$ (picture above);

- [25:400] keV for $^{137}Cs$;

- [100:750] keV for $^{30}K$.

### EFFICIENCY AND DETECTION LIMITS

**The detection limit is ~100 Bq/L for $^{3}H$ in a liquid sample and ~50 Bq/L for $^{14}C$, $^{137}Cs$ or $^{40}K$ considering ten minutes of counting time.**

This difference is mainly due to the detection efficiencies associated to these radionuclides which are ~40% for $^{3}H$ and ~75% for $^{14}C$, $^{137}Cs$ or $^{40}K$ and background which is prevalent at low energies.

Find more in "*Optimization of liquid scintillation measurements applied to smears and aqueous samples collected in industrial environments*", A. Chapon et al., Results in Physics 6 (2016) 50–58.

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