Nasal Swab Analysis by Liquid Scintillation Counting

Xiongxin Dai and Aaron Liblong
Chalk River Laboratories
Atomic Energy of Canada Limited

09 September 2010
LSC2010
Paris France
Nasal Swab Analysis for Radiation Emergency

• In radiological/nuclear emergency, a large number of victims or “worried well” need to be quickly measured for possible contamination, so that the physicians can make early decision on necessary medical intervention for lifesaving.

• The key to early medical management is not necessarily radiation dose calculation and assignment, but radiation dose magnitude estimation.

• For suspected inhalation intakes, nasal swab analysis is a quick and simple screening method, especially for the difficult-to-detect alpha and beta emitters.
Nasal Swab Screening Technique

• Uses cotton swab swiped inside a nostril followed with alpha/beta discrimination by LSC.

• Nasal swab analysis has been widely used as a screening tool for radiological protection and control.

• Use of nasal swab data for dose estimation is associated with significant uncertainty. ⇒ “False positive” and “False negative”

• Issue: signal attenuation by the swipe tip could cause low counting efficiency and induce dramatic distortion in alpha/beta PSD.
Pulse Shape Discrimination

Graph showing the light intensity over time for different types of particles: Alpha particles, beta particles, and Gamma rays. The y-axis represents light intensity on a logarithmic scale, and the x-axis represents time in ns.
Liquid Scintillation Counter
No Swab:
Am-241 and Sr-90/Y-90 liquid form

1.2Bq Am-241 and 5.2Bq Sr-90/Y-90, no swab

Counting efficiencies: 95% for Am-241; 97% for Sr-90/Y-90
Cotton Swab: Am-241 and Sr-90/Y-90, liquid form

1.5Bq Am-241 and 4.0Bq Sr-90/Y-90, Cotton Swab

Counting efficiencies: 2% for Am-241; 73% for Sr-90/Y-90
Cotton Swab:
Am-241 and Sr-90/Y-90, liquid form

1.2Bq Am-241, dripped on Cotton Swab

Counting efficiencies: 3% for Am-241

UNRESTRICTED / ILLIMITÉ
Cotton Swab: Am-241 and Sr-90/Y-90, liquid form

1.3Bq Am-241 and 3.3Bq Sr-90/Y-90, Cotton Swab

Swab was then taken out a few minutes after sitting in LS

Counting efficiencies:
7% for Am-241;
50% for Sr-90/Y-90

Counting efficiencies:
8% for Am-241;
51% for Sr-90/Y-90

UNRESTRICTED / ILLIMITÉ
Cotton Swab:
Am-241 and Sr-90/Y-90, liquid form

Add 1.4Bq Am-241 and 4.6Bq Sr-90/Y-90 in LS, then put Cotton Swab in vial

Counting efficiencies: 99% for Am-241; 85% for Sr-90/Y-90
Choices of Nasal swab

- Cotton
- Polyurethane
- Polyester
Choices of Nasal swab
Polyurethane Swab: Am-241 and Sr-90/Y-90, liquid form

0.5Bq Am-241 and 3.9Bq Sr-90/Y-90, Polyurethane Swab, counted immediately after sample preparation

Counting efficiencies: 100% for Am-241; 86% for Sr-90/Y-90
Polyurethane Swab: Am-241 and Sr-90/Y-90, liquid form

0.5Bq Am-241 and 3.9Bq Sr-90/Y-90, Polyurethane Swab, counted 2 hours after sample preparation

Counting efficiencies: 96% for Am-241; 92% for Sr-90/Y-90
Polyurethane Swab:
1.4Bq Am-241 on HTiO particulate

Counted immediately after sample preparation

56%

15min after preparation

75%

40min after preparation

90%

70min after preparation

98%

UNRESTRICTED / ILLIMITÉ
Conclusion

WINNER!
Next Step: Field Tests
Acknowledgement:
Funded by the CRTI 08-0241TD project: Field Techniques for Emergency Radiobioassay

Merci

AECL EACL