Air Sampling for Radioactive Materials

OSC Readiness Training
Phoenix, Arizona
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Radionuclide Air Sampling

Objectives

- Identify Radioactive Isotopes
- Assessment of Emergency Worker Exposure
- Assessment of General Public Exposure
- Assessment of Particulate Resuspension from Removal work
- Respiratory Protection
- Internal Dose Monitoring
- Determine Particle Size
Airborne Contaminants

- Gasses/Vapors
- Particulates
Gas Sampling Techniques

- Adsorption
- Absorption
- Grab Sample
Particle Sampling Techniques

- Sedimentation
- Electrostatic Precipitation
- Impaction

- Filtration
- Thermal Precipitation
Air Sampling System

- Vacuum pump
- Collecting device
- Metering Device

Figure A-1. Typical filter sampler arrangement diagram
Particle Size Distribution
Filter Media

- Glass Fiber
- Paper
- Membrane
Counting Filter Media

- Gamma spectroscopy
- Alpha spectroscopy
- Plastic scintillators
- Proportional counters
- Solid state detectors
Dual Alpha/Beta Counting System

Figure A-2 Alpha/Beta Counting System
Counting air samples

MODEL 3030 Alpha/Beta Scaler

- Dual Alpha/Beta Scaler
- Maximum Sample Size of 2" Diameter X 0.4" thick

PART NUMBER: 48-3204
Common Problems with Air Sampling

- Representativeness
- Sampling time
- Natural Airborne Radioactivity
Equation for Determining Sample Time

\[
LLD = \frac{2.71 + 3.29 \sqrt{R_B t_s \left[ 1 + \frac{t_s}{t_B} \right]}}{(t_s)(E_D)(E_F)(FF)(SAF)(Vol_{cc})(2.22E6)}
\]

**LLD** = lower limit of detection in \( \mu \text{Ci/ml} \)

- \( R_B \): background count rate in \( \text{cpm} \)
- \( t_s \): sample counting time in minutes
- \( t_B \): background counting time in minutes
- \( E_d \): detector efficiency in counts per disintegration
- \( E_F \): filter efficiency
- \( FF \): fraction of filter counted
- \( SAF \): self-absorption factor
- \( Vol_{cc} \): air sample volume in cc (or ml)
- \( 2.22E6 \): factor to convert dpm to \( \mu \text{Ci} \)
Uranium Series

NOTES:
The symbols α and β indicate alpha and beta decay, and the times shown are half-lives.
An asterisk indicates that the isotope is also a significant gamma emitter.
Thorium Series

NOTES:
The symbols \( \alpha \) and \( \beta \) indicate alpha and beta decay, and the times shown are half-lives.

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ALPHA-7 Alpha Air Monitor

The ALPHA-7A is a Continuous Air Monitor (CAM) designed to provide early warning to workers exposed to airborne releases of alpha-emitting radionuclides to reduce the internal inhaled dose. It is a modern, PC-based continuous air monitor providing faster and more powerful algorithms for the identification and quantification of airborne releases of alpha-emitting radionuclides, primarily transuranics such as Pu238 and Pu239.

Product Detail

Features:
- Fully Standalone
- Pentium class PC based, Windows 98 operating system
- Single configurations accommodates both ambient and stack monitoring applications
- Flexible detector configuration including positive and negative adjustable bias
- Removable filter holder cartridge
- High speed connections via 10 base T Ethernet connection
- RadNet Compliant
- Relay contacts provide for normal/fail, alert and alarm conditions
- 4-20 mA analog input and output capacity
- High visibility display for status and messages
- Calculates isotopic activity by mapping the peak(s) rather than using regions of interest (ROI)
- Spectrums updated once per second
- New isotopes easily added from the library
- New isotopes can be added to the library using any ODBC
Air Sampling - Emergency Response Phase

- Identify Radionuclide Source Term
- Estimate Emergency Worker Exposure
- Estimate Public Exposure
Air Sampling - Intermediate Phase through Long Term Phase

• Establish Worker Exposure Assessment Program
  • Evaluate the Need for Respiratory Protection
  • Evaluate the Need for Internal Dose Assessment Program

• Establish Public Exposure Assessment Program (NRC, DOE, EPA criteria)
Worker Exposure

- Identify ALI (annual limit on intake)
- Identify the DAC (derived air concentration) for the radionuclides of interest
- Develop Air Sampling Plan
Public Exposure

- Identify Public Exposure Limit
- Develop Air Sampling Plan
EPA Air Sampling Equipment
Assets Available to the OSC

- RADeCO Air Samplers
- F&J High Volume Air Sampler 4 inch head
- F & J 2 inch head
EPA Air Sampling Equipment
Assets Available to the OSC

- Deployable (40) 2 inch and 4 inch heads + Dose Monitors
- Genitron Remote Dose Monitors ORIA (20) ERT (40)
- Thermo Anderson High Volume (50) Regions and ERT
Questions?