Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology (S&T) Directorate of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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NUSTL

Portable Air Samplers for Measuring Radioactivity in Air

Local, state, and federal agencies with emergency response and recovery missions are often equipped with portable (i.e., transportable by a single person) air samplers to determine airborne concentrations of radioactivity after incidents involving releases of radioactivity into the atmosphere. These devices can be placed into two general categories: high volume samplers that are deployed at fixed locations, and personal samplers that are worn by individuals moving about a work site. Typical uses for high volume air samplers would be to measure concentrations of airborne radioactivity downwind of a source of radioactive emissions or at a site where radioactive remediation is underway, while personal air samplers might be used to measure airborne radioactivity levels in the breathing zone of individuals engaged in response and recovery duties in compliance with radiation safety regulations.

Technology Overview

Air samplers draw air through a sample collection medium, most commonly an air filter. Atmospheric radioactivity, in either particulate or gaseous form, is deposited on the collection medium, which is then removed from the sampler and analyzed at a laboratory or in the field using specialized radiation detection instrumentation.

Basic components of all air samplers are an air pump, the sample collection medium, and a flow controller to allow the user to set the sampler to draw air at an appropriate rate for the sample collection medium in use. Some air samplers have a flow compensator that automatically maintains a constant air sampling rate in response to changes in atmospheric temperature and pressure or increases in the flow resistance of the sample collection medium as it becomes loaded with particulate matter. Air samplers may have additional useful features such as programmable start and end times and data logging capabilities to automatically record the sampling start and end times, air flow rates, power failures, or other events.

Figure 1. A Portable Air Sampler

Air Sampler Types

High Volume Samplers

There is no precise definition of the air flow rate range that constitutes high volume air sampling. For the purposes of this TechNote, any air sampler that is capable of operating at a flow rate greater than about one liter per minute is a considered to be high volume air sampler.

High volume air samplers are most often used for bulk particulate sampling, in which the full range of particle sizes present in the atmosphere is collected for analysis. Bulk particulate sampling is accomplished using cellulose or glass fiber air filters as the sample collection medium.

More specialized sampling for particulates or radioactive gases can be carried out using various types of sampling devices and sampler collection media. For instance, air samplers can be equipped with a particle size selective air inlet so that only fine particulates capable of penetrating deeply into the respiratory tract will be collected on the air filter. Size selective particulate sampling can also be accomplished with sample collection devices called impactors, which allow users to separately collect particulates of different size ranges. Radioactive gases containing isotopes of iodine and noble gas elements can be collected using sampling media containing activated charcoal or silver zeolite.

Power for high volume samplers may come from standard wall outlets, batteries, or even solar panels for extended sampling at remote locations.

Personal Sampling Pumps

Personal air samplers use a battery powered pump to draw air through the sample collection medium at rates ranging from milliliters to liters per minute. They may be worn as a backpack, on a belt or in a shirt pocket. They are capable of operating continuously for many hours without changing batteries so that an individual can be monitored for an entire work shift. The air sampling inlet is positioned to draw in air from the worker's breathing zone, with the sample collection medium positioned at the inlet (figure 2).

Figure 2. A Personal Air Sampler

Available sample collection media for particulates are air filters and impactors, while gases are collected with sorbent tubes containing material that selectively retains the specific gaseous species that is to be sampled. Sorbent tubes are primarily used to collect non-radioactive gases; however, activated charcoal sorbent tubes, which can potentially be used to collect radioactive iodine and noble gas species are among the many types that may be purchased.

Air Flow Rate Calibrators

The flow rate during a sampling interval must be accurately known in order to accurately calculate the atmospheric concentration of radioactivity from the analysis of the sampling medium. Air flow rate calibrators are used to verify and correct any inaccuracies in the flow rate readings produced by the air flow meter in a sampling instrument. Standard methods often require air samplers to be calibrated at regular intervals, often at the start and end of each interval in which a sample is collected for analysis.

Calibrators for high volume air samplers often are of the venturi tube type, in which the pressure drop across a precisely manufactured constriction in a tube is measured to determine the flow rate. A common type of calibrator for personal air samplers are bubble meters, which measure the speed at which a soap bubble moves through a tube whose volume is well known. Basic calibration devices require the user to manually read and record calibration readings, while calibrators with electronic data storage capabilities are also available.

References and Resources

Additional information about technical and regulatory issues related to radioactive air sampling can be found in the following sources:

Air Sampling in the Workplace, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, NUREG-1400.
http://www.hss.energy.gov/healthsafety/wshp/radiation/NUREG-1400.PDF

OSHA Technical Manual, Section II, Part I: Personal Sampling for Air Contaminants.
http://www.osha.gov/dts/osta/otm/otm_ii/otm_ii_1.html#appendix_ii_1-1

Radioactive Air Sampling Methods, M.L. Maiello and M.D. Hoover, eds. CRC Press, 2010.