

Beyond Canisters (SUMMAs): Passive and Active Samplers and International Perspective

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December 1, 2010



Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 01 DEC 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE Beyond Canisters (SUMMAs): Passive and Active Samplers and International Perspective				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Tri-S Environmental, Newport Beach, CA, 92660				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 15th Annual Partners in Environmental Technology Technical Symposium & Workshop, 30 Nov ? 2 Dec 2010, Washington, DC. Sponsored by SERDP and ESTCP. U.S. Government or Federal Rights License					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 9	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

TO-17/PDS Tube

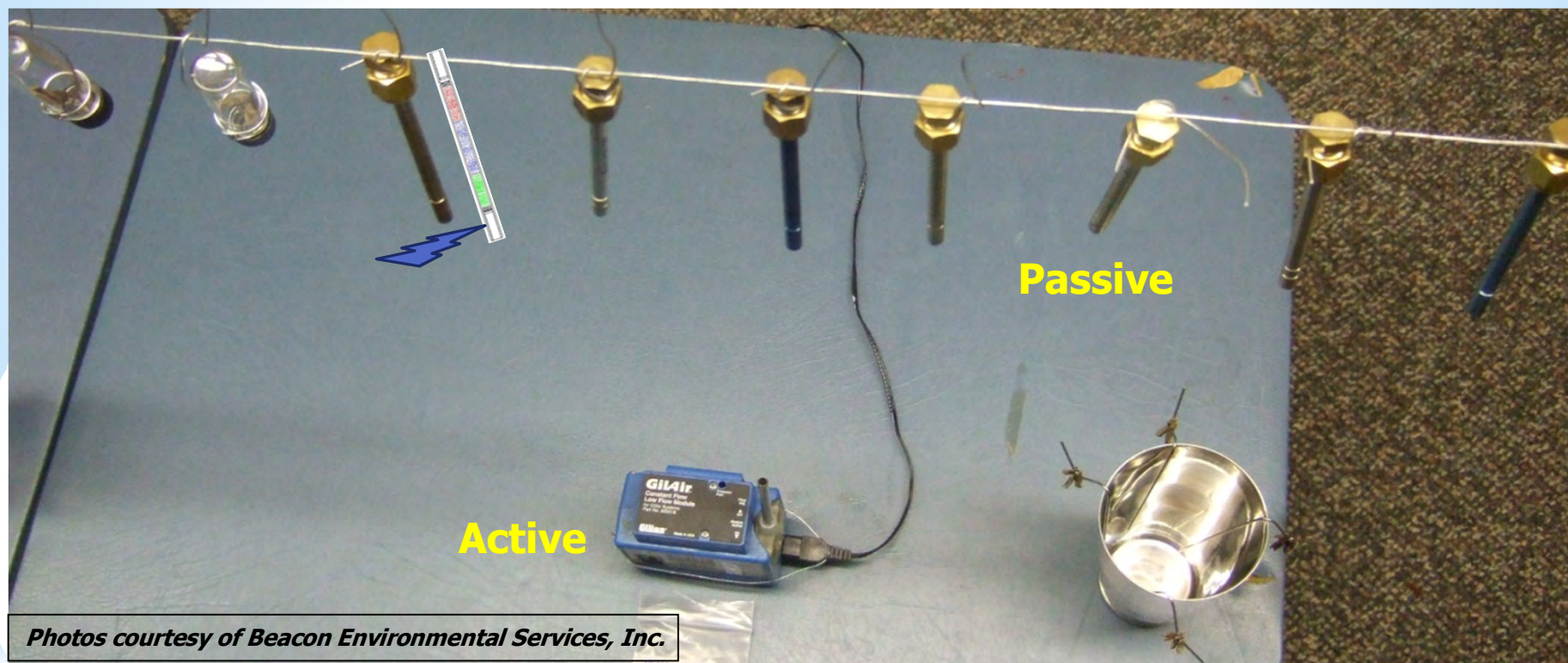
Length: Four inches (10. cm)

Diameter: ¼ Inch (6.3 mm)

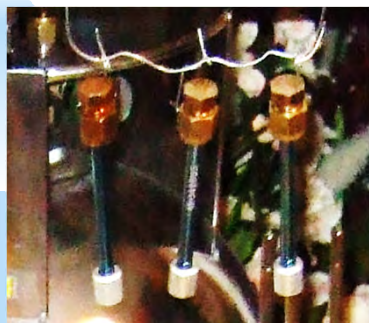
Weight: 1.8 ounces (45 g)

Passive and Active Applications

Passive Diffusion Devices and TO-17 Active Arrangement



Photos courtesy of Beacon Environmental Services, Inc.



Six-Liter Summa Canister

Height: One Foot plus (31 cm)

Diameter: ¾ Foot (22.9 cm)

Weight: Six Pounds (2.7 kg)

Advantages of Sorbent Tubes

- Convenient, small, portable and low cost
- Reusable at least 100 times
- Tubes are completely clean after thermal desorption and can immediately be reused for the collection of more samples.
- Suitable for a wide range of polar and nonpolar analytes
- Well validated with respect to storage stability – Up to 30 days for multi-sorbent tubes, 1-2 years for stable compounds on single sorbent tubes
- Suitable for a wide volatility range (C3 to C30 or C40 with quartz wool/beads)
- Well validated for occupational hygiene as well as ambient outdoor and indoor applications - low ppt to high ppm
- Large air volumes may be collected and analyzed facilitating better detection limits
- Suitable for both pumped and diffusive sampling (hours to weeks)



Limitations of Sorbent Tubes

- Not suitable for ultravolatile species such as acetylene
- Limited number of experienced laboratories in US, but growing
- Additional uptake rate studies needed for long-term exposure for diffusive samplers

Sources: Markes International Ltd. and Beacon Environmental Services, Inc.

Advantages of Canisters

- Quantitative retention of very volatile organics
- Well validated for volatile nonpolar analytes for example US EPA TO-14/TO-15 target analytes and C₂ to n-C₁₀ ozone precursors
- Easy collection of grab-samples into evacuated canisters

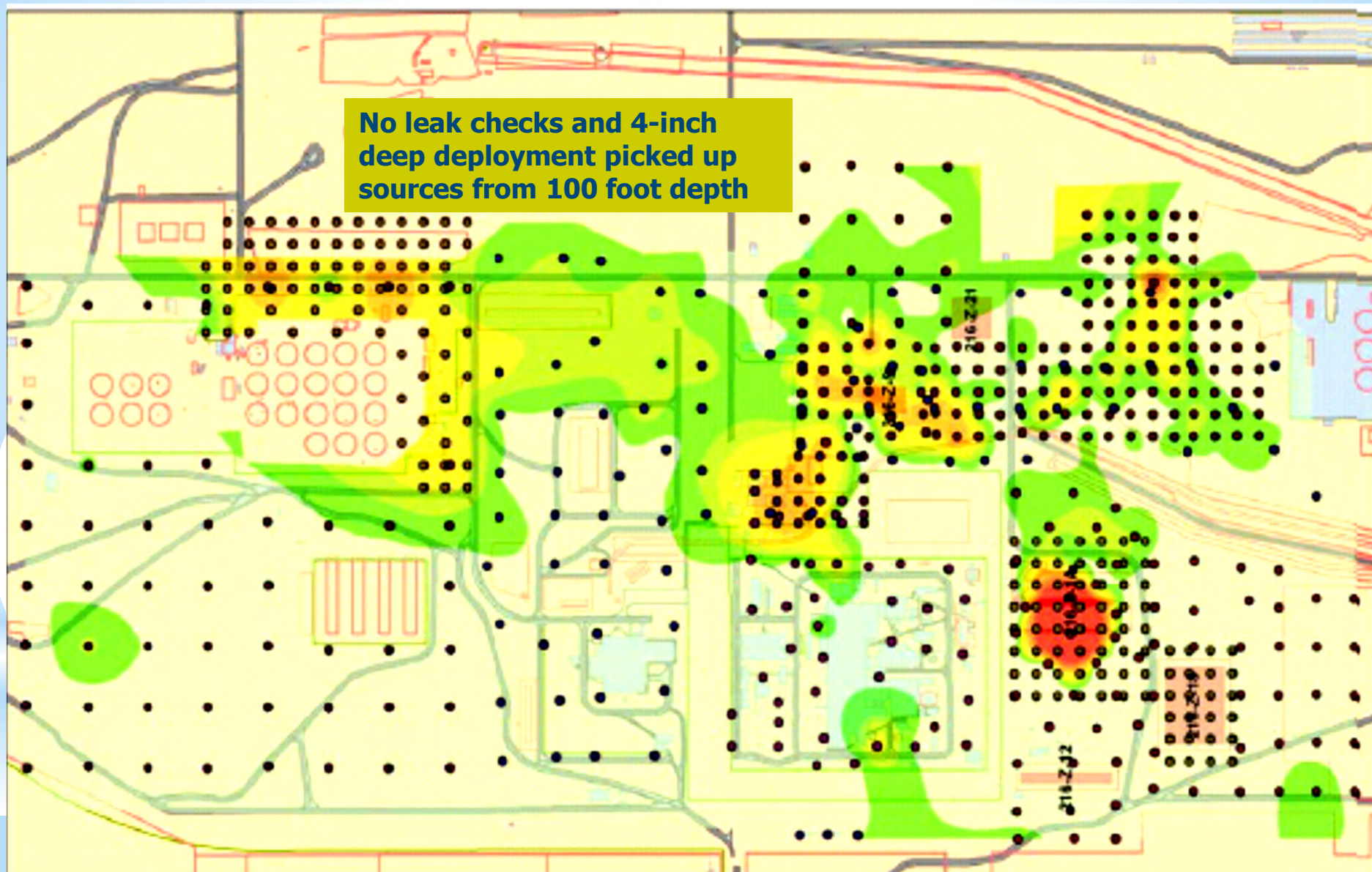


Limitations of Canisters

- Restricted analyte range - not suitable for polar compounds or VOCs with volatility >C₁₀.
- Difficult and expensive to clean-Up to 100 cleaning cycles may be necessary. An effective and more efficient approach, however, is to put the contaminated canisters through 3 cleaning cycles, allow the canisters to sit for a couple of days, then repeat cleaning through three cycles, and check for cleanliness. Repeat this clean, store, and clean sequence as many times as necessary.
- Bulky - require special storage facilities and transport
- Partitioning effects with liquid water (*i.e.*, condensation inside the canister) can cause quantitation difficulties
- Sensitivity limited by the volume of air that can be sampled in the canister and the sampling period
- Not well suited for Time-Weighted Average monitoring over 24-hour periods.

Sources: Markes International Ltd. and Beacon Environmental Services, Inc.

Rapid Spatial Variability Assessment Using Sorbents



Carbon Tetrachloride Soil Gas Plume at the Plutonium Finishing Plant at Hanford: Waste Management Con. March 2010

Sorbent Sampling Guidance

EPA TO-17

Determination of VOCs in Ambient Air Using Active Sampling Onto Sorbent Tubes

ASTM D6196-09

Standard Practice for Selection of Sorbents, Sampling, and Thermal Desorption Analysis Procedures for Volatile Organic Compounds in Air

ASTM D4597-03 (2009)

Standard Practice for Sampling Workplace Atmospheres to Collect Gases or Vapors with Solid Sorbent Diffusive Samplers

ISO 16017-2

Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 2: Diffusive sampling

UK Health and Safety Executive MDHS-80

VOCs in Air: Laboratory methods using diffusive solid sorbent tubes, thermal desorption and gas chromatography



UK

Several hundred Thermal Desorption (TD) laboratories and, 5-6 use cans but only for ultra volatile, low concentration background pollution studies. Source: Markes

DENMARK

Extensive monitoring program for indoor air testing using sorbent technology implemented for homes with potential for vapor intrusion. Source: Majbrith Langeland, Grontmij Carl Bro

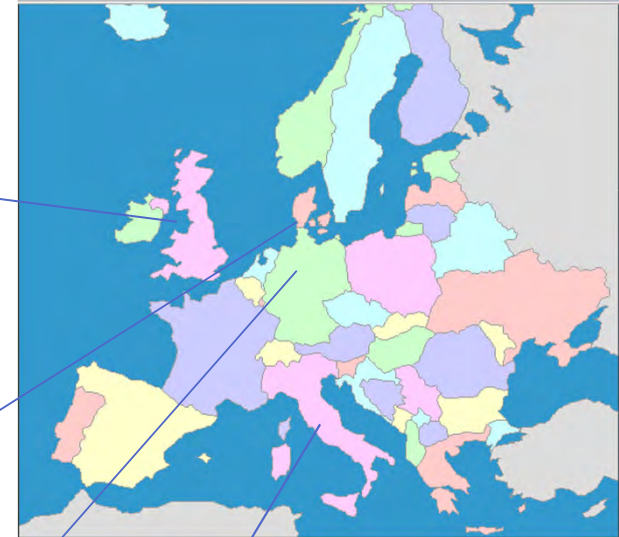
GERMANY

Approximately 170 TD laboratories and Zero labs using canisters for air analysis. Source: Markes and Perkin Elmer

ITALY

Approximately 200 TD laboratories of which 12 labs using canisters for air analysis. Source: Markes and Perkin Elmer

International Perspective



AUSTRALIA

10's of TD laboratories of which approximately half use canisters. Source: Markes International

Uptake Rate, Geometry and Sampler Design Govern Performance

Type	Average Uptake Rate cm ³ /min	Standard Deviation cm ³ /min	Coefficient of Variation
PC	0.237	0.008	0.036
PT	0.148	0.044	0.300
BA	0.149	0.011	0.074
PR	2.024	0.543	0.268

PC- Single Sorbent Tube

PT- Two Sorbent Tube

BA- Axial Two Sorbent Side By Side

BR- Radial Two Sorbent Side By Side

A controlled release of TCE in an indoor air environment allowed for over two orders of magnitude daily concentration variability over the course of the two-week monitoring event. [200 ug/m³ TCE max]

Minimize starvation effects by reducing uptake rate and ensuring minimum air velocity is maintained.

Table courtesy of Beacon Environmental Services, Inc.

Things to Consider



- High flow volumes across sorbent tubes/media. Greater than 100-1000L depending on the compound is limiting.
- Uptake Rates for all Passive Devices-Linear/Non-Linear Effects, Temperature, Humidity and Competitive Effects
- Passive Devices in High Concentration Subsurface Environments
- The use of sorbent technology across the world far exceeds the use of canisters.
- The depletion/starvation depends on two things, uptake rate of the compound as it relates to sampler configuration plus sorbent selection and the airflow. A radial sampler will have a higher uptake rate than an axial sampler thereby depleting the atmosphere more quickly. By limiting the uptake rate, the starvation effect may be avoided.
- Possible use of hyperactive sorbents for measuring transients at the second to minute scales