



Radiello® Passive Samplers and Vapor Intrusion

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Introduction

Vapor intrusion assessments necessitate sampling of soil gas and in some cases indoor air. The traditional method for sample collection relies on Summa canisters for vapor collection and storage as required by EPA Compendium Method TO-15. Other approved active sampling methods include EPA TO-13 and TO-17 which utilize sorbent tubes such as thermal desorption tubes as the sample collection medium (1). Other types of devices such as gas sampling bags are used in addition to, or in lieu of, Summa canisters depending on the compounds of interest. Passive sampling devices such as Radiello have been deployed in numerous studies in the US for sampling vapor intrusion compounds because of their low maintenance, ease of use, and low detection limits. The Radiello VOC samplers such as the RAD130 VOCs/BTEX by Solvent Desorption (Figure 1) and RAD145 VOCs/BTEX by Thermal Desorption are presented.

Figure 1. Radiello Passive Sampler



Sampling soil gas with any passive sampling device has its limitations. Because passive sampling relies on air flow, the device may become “starved” for air at lower face velocities and affect the sampling rate. Radiello diffusive samplers provide reliable results when airflow is 0.1 – 10 m/s and relative humidity is in the range of 15-90%.

Radiello sampling rates (Q) are 2-5 times higher than axial (badge) type samplers (Table 1), due to the radial design of the radiello sampler (Figure 2).

Table 1. Select VOC Sampling Rates for Passive Sampling Devices

Compound	Passive Sampling Rates (mL/min)		
	VOCs by Solvent Desorption RAD130	VOCs by Thermal Desorption RAD145	Typical [▲] Axial Sampling Rates
Benzene	80	27.8	10-16
Perchloroethylene (Tetrachloroethylene)	59	25.4	10-13
1,1,1-Trichloroethane	62	20.0	NA
o-Xylene	65	24.6	8-12
Toluene	74	30.0	8-15
Trichloroethylene	69	27.1	11-15
Methyl tert-butyl ether	65	30.0	9-14
Ethyl benzene	68	25.7	9-13
Naphthalene	25	NA	NA

[▲] Compared to SKC Ultra Samplers for Indoor Air, Publication 1720 Revision 1103 and Ultra III Publication 1804 Issue 1104

NA = Not available

Figure 2. Comparison of Radial Design to Axial/Planar Design

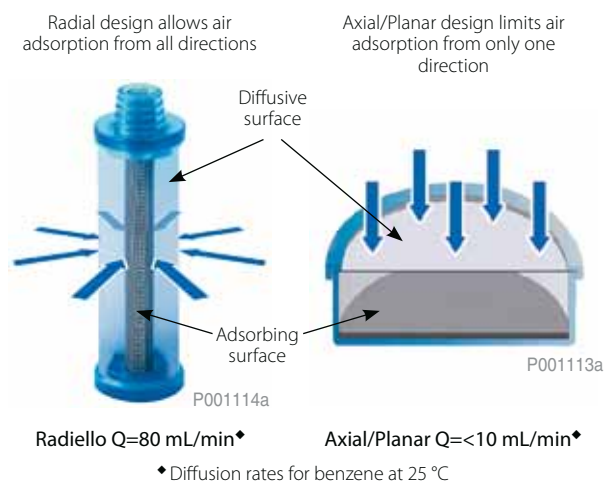


Table 2. Passive Sampling Exposure Time & Limits of Detection

Compound	Exposure Time RAD130 VOCs by Solvent Desorption		Limits of Detection ($\mu\text{g}/\text{m}^3$) LOD	Exposure Time RAD145 VOCs by Thermal Desorption		Limits of Detection ($\mu\text{g}/\text{m}^3$) LOD
	Indoor	Outdoor*		Indoor	Outdoor	
Benzene	15 min-8 hr	7-30 days	Typical Range: 0.05-1.0 $\mu\text{g}/\text{m}^3$	8 hr	7-14 days	0.05
Perchloroethylene (Tetrachloroethylene)	15 min-8 hr	7-30 days		8 hr	7-14 days	0.02
1,1,1-Trichloroethane	15 min-8 hr	7-30 days	<i>Varies by laboratory, please consult your lab.</i>	8 hr	7 days	0.10
o-Xylene	15 min-8 hr	7-30 days		8 hr	7-14 days	0.01
Toluene	15 min-8 hr	7-30 days		8 hr	7-14 days	0.01
Trichloroethylene	15 min-8 hr	7-30 days		8 hr	7 days	0.02
Methyl tert-butyl ether	15 min-8 hr	7-30 days		8 hr	7 days	0.20
Ethyl benzene	15 min-8 hr	7-30 days		8 hr	7-14 days	0.01
Naphthalene	15 min-8 hr	7-30 days		NA	NA	NA

*7 days is ideal but the device can be sampled for 30 days in low concentration environments.

NA = Not available

Exposure Limits

Depending on the concentration of compounds in the sampling environment, radiello devices can be deployed from 8 hours to 7-14 days for thermal desorption and 8 hours to 7-30 days for solvent desorption (Table 2). Radiello has a significantly higher capacity compared to active sampling devices and other passive sampling devices. The Radiello 130 (RAD130) cartridge has a high loading capacity of about 80 mg corresponding to an overall VOC concentration of 3,000-3500 $\mu\text{g}/\text{m}^3$ sampled for 8 hours or 70,000-80,000 mg/m^3 for 14 days. The thermal desorption sampler is more sensitive and applicable for lower concentration VOC environment (<2,000 $\mu\text{g}/\text{m}^3$) but can sample from 8 hours to 7-14 days. Radiello is suitable for both time-weighted average (TWA) and short term exposure limit (STEL) concentrations.

Summary

Radiello is the ideal passive sampler for indoor vapor intrusion environments because of its high sampling rates, high capacity, and low detection limits. It is versatile for sampling from 15 min for STEL sampling and 8 hrs for TWA sampling to 7-30 days depending on the sampling environment. Like other passive samplers, there are limitations to sample vapor intrusion or soil gases such as in micro-wells and like environments. Radiello is suitable for sampling in crawl spaces and indoor air environments to the surrounding outdoor environment (1). In addition to samplers for VOCs, radiello samplers are available for sampling a wide range of compounds such as: aldehydes, hydrogen sulfide, ammonia, nitrogen and sulfur dioxides, phenols, ozone, hydrochloric acid and anesthetic gases. Radiello analytical testing services are available in several US locations, Italy, Canada, Australia, and New Zealand.

References

1. Shamory, Brett; Hayes, Heidi; Mahfood, John; Schultz, Kristen, Radiello Passive Sampling Method for Evaluating Vapor Intrusion, Business of the Brownfields Conference 2009, Pittsburgh, PA
2. SKC Technical Note, Measuring Sub-ppb Levels of VOCs in Indoor Air, Publication 1720 Rev 1103.
3. Ultra III: The Creative Evolution of Indoor Air and Ambient Sampling, SKC Publication 1804, Issue 1104

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Description	Qty.	Cat. No.
VOCs/BTEX by Solvent Desorption (SD)		
Cartridge Adsorbent	20	RAD130
Diffusive Body – White	20	RAD120
VOC/BTEX Starter Kit (SD)	2	RAD130S
BTEX Calibration Kit (SD)	1	RAD405
VOC Calibration Kit (IH environment)	1	RAD406
VOCs/BTEX by Thermal Desorption (TD)		
Cartridge Adsorbent	20	RAD145
Diffusive Body – Yellow	20	RAD1202
VOC/BTEX Starter Kit (TD)	2	RAD145S
BTEX Calibration Kit (TD)	1	RAD407
Radiello Accessories		
Triangular Support Plate	20	RAD121
Radiello Clips	20	RAD195
Bar Code Labels	198	RAD190
Radiello Vertical Adapter		
Threaded for Standard Use	20	RAD122

Each starter kit contains 1 triangular support plate, 1 diffusive body, 1 vertical adapter, and 2 cartridge adsorbents.

Did you know ...

Radiello passive sampling devices are suitable for a wide range of compounds. Download a copy of the Radiello Manual (IYP) from our website - sigma-aldrich.com/radiello - for a complete list of compounds by sampler type.