Vapor Intrusion Risk Pathway Overview & Updates

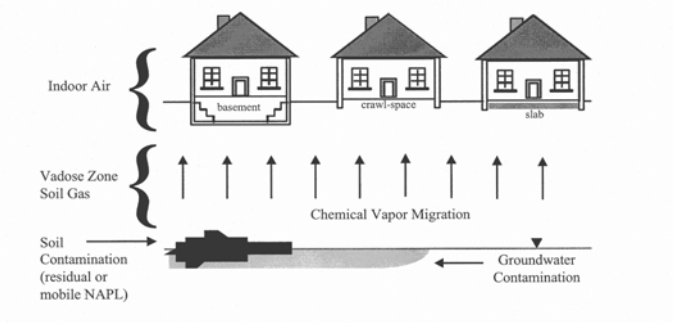
GRA
May 2010

Blayne Hartman
Independent Consultant
H&P Mobile Geochemistry
760-925-7206
www.handpmg.com

This presentation is a condensed version of the vapor intrusion training that Dr. Hartman has been presenting to Federal & State regulatory agencies, DOD facilities, consulting groups, and stakeholders around the country. As of September 2008, this training has been given to over 30 State Regulatory agencies, including ASTSWMO and the State Coalition of Dry Cleaners. Training has also been given to many PRPs such as the major oil companies, Armed Services, & EPRI.

Lecture notes are at the bottom of each slide so that if played out as a hard-copy, the presentation can be a useful reference document.

What Is Vapor Intrusion?



Key Assumptions:

- Risk level (1 in 10,000? 100,000? 1,000,000?)
- Toxicity of Compounds
- Exposure Factors (time, rates, ventilation)

Vapor intrusion refers to the upward migration of contaminants in the vapor phase from groundwater, soil, or soil gas contamination sources.

Key assumptions to the risk determination are the risk level, the toxicity of the contaminant, and the exposure factors. These parameters are often much more important than model parameters such as soil porosity and pressure gradients.

Why Do You Care About VI?

(Risk Often More Perceived Than Real)

- Health & Safety of Occupants
- EPA, ITRC, & State Guidances
- ASTM New Phase 1 Standard
- Attorneys & Citizen Groups
- Future Liability

In some cases, there is a real threat to occupants.

But in the majority of cases, the risk to occupants is exaggerated, hence the perception is greater than the real risk. Nevertheless, you need to worry about it because the EPA has identified it as a risk pathway, numerous states have their own guidance or policies, and citizen groups and of course, attorneys are making it an issue.

Erin Brockovich goes after Shell Oil in Carson

By Gene Maddaus Staff Writer
Posted: 09/22/2009 10:11:13 AM PDT

Environmental activist Erin Brockovich has agreed to pursue litigation against Shell Oil Co. for contaminating a Carson housing tract.

Shell recently discovered elevated levels of methane and benzene underneath the Carousel neighborhood. The contamination has been traced to underground oil tanks the company operated on the site until the 1960s.

Girardi and Keese, the law firm that works with Brockovich, held a meeting with about 300 residents Saturday in Carson to recruit clients for a lawsuit against Shell, which could be filed as soon as November.

Residents were informed that, in some spots, benzene has been detected at 100,000 times the state standard. In some soil gas samples, methane has been found to exceed the explosive threshold.

"You've been exposed to a very high level," said Robert Bowcock, an environmental consultant retained by the firm. "I'm incensed and angry that Shell let this happen."

Brockovich, who lives in Southern California, did not attend, but has pledged to be at a future meeting. Brockovich was the heroine of the movie starring Julia Roberts, which told the story of chromium-6 contamination in Hinkley, Calif. In that case, Pacific Gas & Electric Co. was forced to pay a historic $333 million in damages.

Since the movie came out in 2000, Brockovich has been involved in numerous environmental contamination cases across the country, including several involving Shell.

At the meeting,

Bowcock said that the contamination is "magnitudes greater" than levels found almost two years ago near the ExxonMobil refinery in Torrance. In that case, ExxonMobil agreed to buy 10 homes and offered price protections for the owners of 10 more.

The testing at the Carousel tract is still in its early stages, and Bowcock said it was premature to predict the outcome. But residents said they were growing increasingly alarmed.

Related

OIL

Sep 21: Oil falls below $71 amid weak demand

Sep 17: Oil slips to near $72 on dollar rebound

Sep 2: BP makes massive crude oil find in Gulf of Mexico

Aug 18: Hermosa Beach wins round in Macpherson Oil case

Aug 10: US refineries used stolen Mexican oil, feds charge

HotViews Most Comments

1. Rancho Palos Verdes says no to York's 'event garden' plan
2. Robber caught in Gardena checkpoint freed when Washington won't extradite
3. JOHN BOGERT: All the gun, ammunition laws in the world won't change who we are
4. New Howard's, Kohl's fill two South Bay retail vacancies
5. Families of drunk driving victims giving back in MADD fundraiser
6. DATABASE: LAPD's Most Wanted
7. Trying to resist this latest football Temptation
8. Commentary: Sarkesian sticks to the fundamentals he learned in the South Bay
9. LA councilman flouts DWP's water conservation rules
10. Erin Brockovich goes after Shell Oil in Carson

Questions/Answers

Questions and answers on Daily Breeze stories from readers like you. Submit your own question.

When to Worry About VI?

- If VOC Contamination & Structures Exist:
  - Laterally within 100' (EPA, DTSC)
  - Vertically Within 100' (EPA, DTSC)
  - NY: No Limits!!!
- Complaining Occupants
- Structures With Odors, Wet Basements
- Sites With Contamination & Future Use
- Attorneys & Communities
- Even Animals, Fruits, Vegetables

The EPA & many State guidances use the distance criteria listed above to screen sites needing to assess the pathway. At sites with existing contamination but no current buildings, the pathway will need to be assessed when development is proposed. Attorneys and community activist groups can expand these criteria beyond the EPA limits. In some recent cases, concern about the safety of burrowing animals, and fruits & vegetables has been the reason to assess the vapor intrusion pathway.

EPA-OSWER Draft Guidance

- Tier 1: **Primary** Screening
  - Q1: VOCs present?
  - Q2: Near buildings?
  - Q3: Immediate concern?
- Tier 2: Secondary Screening
  - Q4: Generic screening
  - Q5: Semi-site specific screening (alphas from charts & tables)
- Tier 3: Site-Specific Pathway Assessment
  - Q6: Indoor air (and/or subslab)

The current EPA draft VI guidance consists of 3 tiers, consisting of 6 questions. Tier 1 is essentially a screening survey asking basic questions such as whether volatile compound contamination exists and whether buildings exist.

Tier 2 consists of 2 questions/steps: Q4 & Q5. Question 4 is so restrictive (i.e., very low fail levels) that just about every site fails, similar to a vortex or hopper. Question 5 allows more sampling options, is not as conservative, and may be the best tier/question to work within.

Tier 3, question 6, allows for only two investigatory methods, indoor air or sub-slab soil gas, and has very restrictive (i.e., very low fail levels) criteria. Once at this level, it is extremely hard to get out and requires expensive and repeated sampling.

Newest Changes (2010?)
EPA OSWER VI Guidance

- Tier 1: **Primary** Screening
  - Q1: VOCs present?
  - Q2: Near buildings?
  - Q3: Immediate concern?
- Tier 2: Source Screening
  - Generic screening using near-source samples
- Tier 3: Pathway (Building) Assessment
  - Multiple lines of evidence (sg & gw)
  - Must go inside???

The changes currently being considered by the EPA would make the vapor intrusion pathway even more stringent. Few sites would screen out and indoor sampling (sub-slab or indoor air) is required in most cases.

DRAFT Exterior Decision Matrix		Concentration in Groundwater		
		Well above level of concern	Around level of concern	Well below level of concern
Concentration in Soil Gas	Well above level of concern	Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation
	Around level of concern	Interior sampling or mitigation	Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation
	Well below level of concern	Consider geologic setting[1], verification sampling in select locations	Consider geologic setting[1], verification sampling in select locations	NFA unless nearby property has unacceptable risks (verification, monitoring)

[1] Review subsurface startigraphy, depth to water, to determine presence, integrity, effectiveness of geologic barriers to vapor migration.

This is one idea being contemplated by EPA for site screening using only exterior data. As you can see, there is only one box that does not require any further action in this matrix. This is still very much in the draft stages and is being discussed by EPA with experts and stakeholders.

Slide courtesy of Henry Schuver of EPA

Guidance Updates

- Fed EPA (OSWER & Superfund)
  - Moving to sub-slab & indoor air
  - 30 day indoor air sampling period
- EPA-OUST: Guidance for HCs by 9/2010
- States With Draft Guidances
  - WA, AK, MA, MI, OH
- States With Updated Guidances/Policy
  - NJ, IL, MO, MT, NC, KS, CA, OR
- States Pondering
  - WY, FL, AL, IA, NV

Here is a summary of existing Federal & State guidances as of January 2010.

CA Agencies

- CA-DTSC (& LA-RWQCB)
  - Soil Gas, VI, & Mitigation "Advisory"
  - CHHSLs (thanks to OEHHA)
- EPA Region 9
  - Follows the EPA Draft VI Guidance
  - Adopted Region 3 Screening Levels
- SF-RWQCB
  - ESLs include aliphatics!
- Central Valley Boards
  - Want Residential Criteria Applied Regardless of Site Use

Here is a summary of the vapor intrusion policy/guidances for some California regulatory agencies. DTSC has soil gas collection & analytical guidance document, a vapor intrusion guidance document, and recently issued a mitigation document. The San Francisco Water Board has issued their own ESLs. The Central Valley & some Bay Area agencies are requiring residential criteria at all sites, whether current use is commercial or residential, to avoid hassles of deed restrictions and future monitoring of property use.

Proposed DTSC Changes

- Preference for Sub-slab Samples
- Collect Exterior SG Samples At Source
- Repeated Sampling of Soil Gas
- Preference for Gaseous Tracers
- Raising Sub-slab AF to 0.1 (10x stricter)
- Tougher Methods for Naphthalene
- Lower RBSL for Ethylbenzene - done
- A Decision Matrix??

Some changes DTSC proposed in their forums in June 2009

Uh-Oh

E-mail received on 9/15/09:

I wanted to provide a heads up that R2 (SF) is poised to modify its Environmental Screening Levels (ESLs) with respect to the vapor intrusion pathway ...
the consequence of this change would be much lower groundwater ESLs for this pathway (20 to 30x lower for most VOCs and over 200x lower for biodegradable VOCs such as BTEX) ...
details below ... cheers

The SF-RWQCB is considering lowering screening levels which will suck in more sites.

The Net Widens: ASTM VI Standard

- Focus on Property Transactions
- Prescriptive Screening Distances
- No RBSLs (RBC)
- No Assessment Recommendations
- Legal Standards
- Mitigation
- Released March 3, 2008

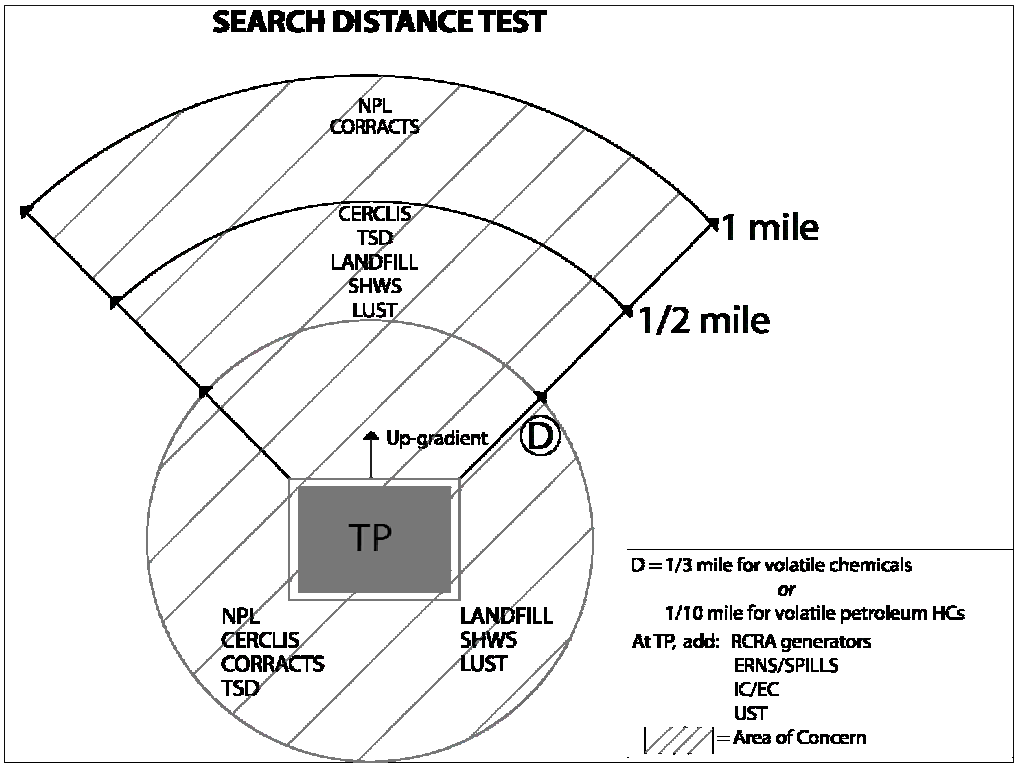
ASTM convened a technical workgroup in 2005 to write a standard for vapor intrusion as it applies to property transactions. The standard was released on March 3, 2008.

ASTM VI Standard

Vapor Intrusion Condition (VIC) *is defined as* ***"****the presence or likely presence of any volatile chemical of concern in existing or planned structures on a property resulting from an existing release or a past release from contaminated soil or groundwater on the property or within close proximity to the property,* ***at a concentration that presents or may present a human health risk****."*

The Standard defines a new term/arconym: the Vapor Intrusion Condition.

Slide courtesy of Anthony Buonicore, Chairman ASTM VI Task Group



The Standard identifies the following search distances. Note the long distances.

Slide courtesy of Anthony Buonicore, Chairman ASTM VI Task Group

Liability Concerns

- Phase I Environmental Consultant
- Prospective/Current/Past Property Owner
- Property Lender
- Property Insurer

Liability concerns is a big part of vapor intrusion. Those at risk include consultants, property owners (past, current & future), lenders, and insurance companies.

Slide courtesy of Anthony Buonicore, Chairman ASTM VI Task Group

Methods to Assess VI

- Indoor Air Sampling
- Groundwater Sampling
- Soil Phase Sampling
- Predictive Modeling
- Measure Flux Directly
- Soil Gas Sampling
- Supplemental Tools/Data

In this part of the seminar, we will discuss the primary techniques/tools used to assess the vapor intrusion pathway, including the pros & cons of each.

Ingredients for Effective VI Assessments

- Investigatory Approach
- Determine Correct Screening Levels
- Sample & Analyze Properly
- Know & Use Supplemental Tools
- Demonstrating Bioattenuation

The keys to effective vapor intrusion assessments are picking the proper approach, determining the correct screening levels, sample & analyze correctly and efficiently, know when and how to use supplemental assessment tools, and to know how to demonstrate bioattenuation if petroleum hydrocarbons are the COC.

Some Key VI Assessment Issues

- Experience of the Collector/Consultant
  - Have they done this before?
  - Do they understand RBSLs?
  - Quality/experience of field staff? Sr or Jr?
- Get Enough Data Near/Around/Under
- Legal Perspective
  - How conservative to be or not be?

The most important ingredient for cost effective and efficient VI investigations is the experience of the person/firm doing the collection. Is the collection being done by a firm that has prior experience? Is it a routine part of their services or an occasional part? Do they put experienced people in the field who can think or junior staff who aren't well versed? This applies to the consultant and their subcontractors.

Soil gas, like soil, is not homogenous in most cases. So you need enough data to give decent coverage near, around, or under the receptor. Simpler collection systems with small volumes are advantageous as there is less to go wrong and enable higher production per day (20+ samples per day). Less expensive analytical methods (8021, 8260) enable more analyses for reasonable cost. Real-time data can be extremely helpful to track soil gas contamination laterally and vertically.

Legal considerations often dictate what additional work needs to be done at what standards.

All of these issues affect the investigation progress.

Most Common VI Bloopers

Unit Confusion:

- Assuming ug/L equivalent to ppbv
- Assuming ug/m3 equivalent to ppbv
- Vacuum units: in Hg to inches H20

Screening Levels:

- Comparing to CHHSLs
- Not calculating correct levels

Approach Generalizations

- Indoor Air
  - Always find something
  - Multiple sampling rounds: extra time & $
- Groundwater Data
  - Typically over-predicts risk
- Soil Phase Data
  - Typically not allowed; over-predicts risk
- Soil Gas Data
  - Transfer rate unknown
  - Sub-slab intrusive

Each investigatory approach has pros and cons that must be considered before choosing the one to use at a site.

Indoor Air

Consumer Products Containing PCE

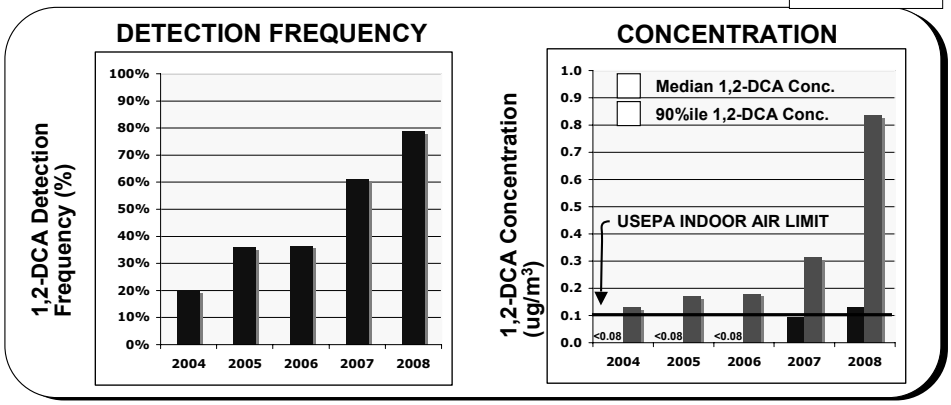
Product	PCE Concentration
ARAMCO Art and Crafts Goop	Not Specified
Aleenes Patio & Garden Adhesive	70%
Gumout Brake Cleaner	50 - 90%
Liquid Wrench Lubricant w/ Teflon	65 - 80%
Plumbers Goop Adhesive	67.5%
Hagerty Silversmith Spray Polish	30.5%
Champion Spot it Gone	20 - 25%

KEY POINT: **Wide variety of consumer products still contain high concentrations of PCE.**

Contaninants in indoor air may be from household products, not vapor intrusion.

Slide courtesy of Dr. Tom McHugh, GSI, Houston, TX

New Indoor Source of 1,2-DCA



KEY POINT: **Indoor concentration of 1,2-DCA increasing over time. New indoor source = molded plastic (e.g., toys, Christmas decorations).**

A recently discovered source for 1,2 DCA: molded plastics from China!

Slide courtesy of Dr. Tom McHugh, GSI, Houston, TX

Target Compounds				
4) Chloromethane	2.002	50	4813	
7) Chloroethane	2.561	64	3991	
8) Trichlorofluoromethane	2.817	101	2070	
11) Acetone	3.317	43	14416174	894
12) Isopropyl alcohol	3.317	45	94670	385
13) Methylene Chloride	3.680	84	6533	
16) Diisopropyl ether*	4.264	45	1756282	81
17) 1,1-Dichloroethane	4.091	63	52909	2
18) Ethyl-t-butyl ether*	4.710	59	501954	25
19) 2-Butanone	4.871	72	36815	86
22) Chloroform	4.859	83	22151	
23) Bromochloromethane	4.728	128	217	
26) 1,1-Dichloropropene	5.109	75	2475	
29) 1,2-Dichloroethane	5.151	62	1445	
30) TAME* (2-methoxy-2-met...	5.347	73	5913	
31) Benzene*	5.264	78	2724469	75
32) Trichloroethene	5.705	95	1454	
33) 1,2-Dichloropropane	5.847	63	109116	14
34) Bromodichloromethane	6.008	83	127010	8
35) Dibromomethane	5.961	93	794	
36) cis-1,3-Dichloropropene	6.336	75	3448	
38) Methyl Isobutyl Ketone	6.520	43	737901	196
39) Toluene*	6.592	92	7153783	274
40) trans-1,3-Dichloropropene	6.651	75	14157	1

58) 1,1,2,2-Tetrachloroethane	8.568	83	91292	180.66 ng
59) 1,2,3-Trichloropropane	8.616	75	112180	168.59 ng
60) n-Propylbenzene	8.616	91	8054470	1288.03 ng
62) 1,3,5-Trimethylbenzene	8.741	105	6061679m	1318.01 ng
63) 2-Chlorotoluene	8.681	91	6809750	1789.21 ng
64) 4-Chlorotoluene	8.741	91	1265341	322.07 ng
65) tert-Butylbenzene	9.027	119	1891115	435.53 ng
66) 1,2,4-Trimethylbenzene	9.027	105	8143013m	1879.66 ng
67) sec-Butylbenzene	9.027	105	8143968	1416.03 ng
68) p-Isopropyltoluene	9.253	119	54681	11.06 ng
71) n-Butylbenzene	9.562	91	27682	5.95 ng
76) Naphthalene	11.033	128	869	0.69 ng
79) Ethanol	2.978	45	983528	207445.35 ng
80) t-Butanol *	3.317	59	432657	9715.81 ng

Approach Generalizations

- Indoor Air
  - Always find something
  - Multiple sampling rounds: extra time & $
- Groundwater Data
  - Typically over-predicts risk
- Soil Phase Data
  - Typically not allowed; over-predicts risk
- Soil Gas Data
  - Transfer rate unknown
  - Sub-slab intrusive

Each investigatory approach has pros and cons that must be considered before choosing the one to use at a site.

Probe Considerations

- Tubing Type
  - Rigid wall tubing ok (nylon, teflon, SS)
  - Flexible tubing not (tygon, hardware store)
  - Small diameter best (1/8" or ¼")
- Probe Tip
  - Beware metal tips (may have cutting oils)
- Equilibration Time
  - Effects by air knife, rotary, air percussion, sonic
- Equipment Blanks
  - Need to collect blank through collection system

Some of the issues that need to be considered when installing probes include:

Tubing Type: Small diameter tubing offers advantages over large PVC pipe. Flexible tubing tends to leak.

Probe tip: Metal tips may have blanks due to the cutting process.

Equilibration time: How long to wait, especially if air knives are used to clear holes or larger drill rigs are used?.

Equipment blanks: need to collect blank through the collection system. Trip blanks not enough.

Soil Gas Sampling Issues

- Sample Size
  - Greater the volume, greater the uncertainty
  - Smaller volumes faster & easier to collect
- Containers
  - Canisters: More blank potential. Higher cost
  - Tedlars: Good for ~2 days. Easier to collect
- Flow Rate
  - Really not imp. But most agencies < 200 ml/min
- Tracer/Leak Compound
  - Crucial for sub-slab & larger sample volumes
  - Gases (He, SF6, Propane) & Liquids (IPA)

Lower detection levels requires more careful protocols. Important sampling considerations include sample volume, container type, flow rate, and leak testing to ensure valid samples are collected.

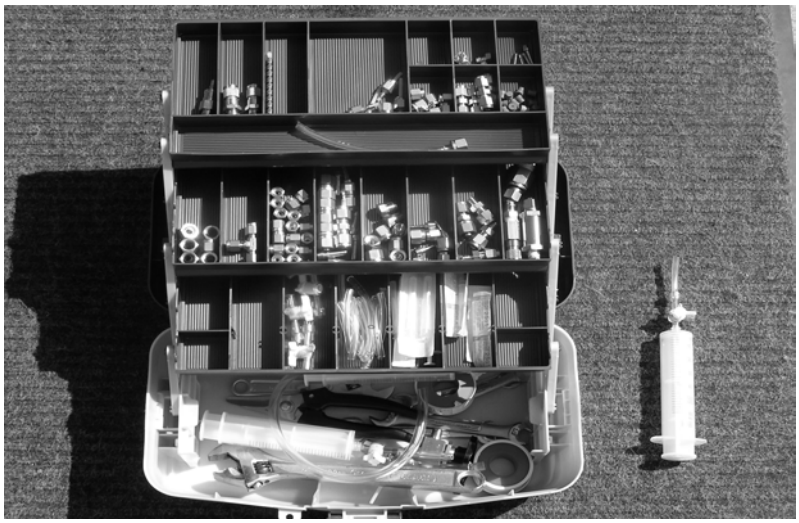
Smaller volumes require less complicated sampling systems and minimize the chances for leakage from the surface and desorption off soil. Recent studies have shown no difference in soil gas values regardless of whether small (0.5 L) or large (100 L) volumes are collected.

Sample containers must be inert, clean, and handled properly (no cooling or heat). Canisters have longer holding times, but have the potential for blanks (carry-over from previous samples), cost more, and can be trickier to fill. Tedlar bags are good for ~2 days, are less expensive, and suitable for concentrations of 1 ppbv or higher.

Sample flow rate is of concern to many agencies, but recent data are showing it not to be a factor.

Tracer/leak compounds are generally required to ensure sample integrity because small leaks can create significant effects at such low concentrations. The larger the volume extracted and the more complicated the sampling system, the greater the potential for leaks.

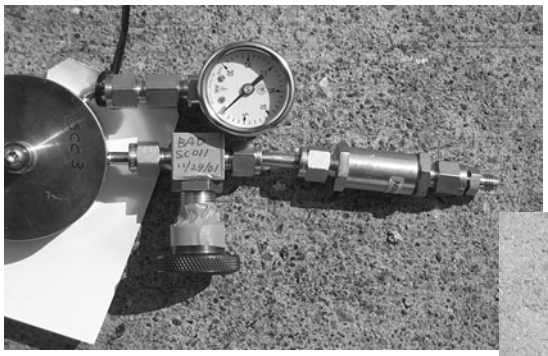
Beware of the Hardware



The tackle box on the left shows the required hardware to collect soil gas samples in Summas.

The syringe to the right is the only collection device required for on-site analysis of soil gas.

Poor Hardware



Canister sampling is hardware intensive. Only use labs that have good, well-kept hardware.

Container Issues

Large vs. mini-canisters

Filling a tedlar bag with syringe

Issues currently being debated.

On-site TO-15 Scan/SIM

- Simultaneous Scan/SIM mode enables
  < 10 ug/m3 for All VOCs &
  ~ 1 ug/m3 for subset of compounds.
- Only 2cc of Sample. Eliminates Hardware
- Real-time Analysis in Structures: Control!
- Two "Mobile Air Labs" Now Operational
- Can Go Into Automated Mode

New equipment allows on-site TO-15 analyses. New GC/MS equipment enables simultaneous Scan/SIM mode meaning you can measure for all VOCs (>60 compounds) at DLs < 10 ug/m3 while simultaneously measuring for a subset of compounds at lower detection levels (<2 ug/m3). Only 2 cc of sample are required for analysis, so much of the sampling hardware can be eliminated, reducing chances of false positives.

This capability enables real-time analysis in structures. This might eliminate need for unsupervised time-integrated sampling.

Don’t Forget 8021

- Can get to 1 ug/m3 for TCE, CCl4, PCE
- Can get to ~25 ug/m3 for Benz & Napthalene
- 5 minute run time for benzene, TCE & PCE
- Cost ~ 1/5 of TO-15

Method 8021 is the forgotten method out there, but it has great sensitivity and offers many advantages over the other analytical methods if only a few target compounds exist.

Supplemental Tools/Data

- Site Specific Alpha Using Radon
  - Factor of 10 to 100. $100/sample
- Indoor Air Ventilation Rate
  - Factor of 2 to 10. <$1,000 per determination.
- Soil Physical Properties
  - Moisture content the key parameter
- Real-Time, Continuous Analyzers
  - Can sort out noise/scatter

There are some other inexpensive tools/data that can be applied to better evaluate some of the default model parameters and the vapor intrusion pathway. These tools/data have much more influence on the resulting risk than measurement of soil porosity and cost about the same.

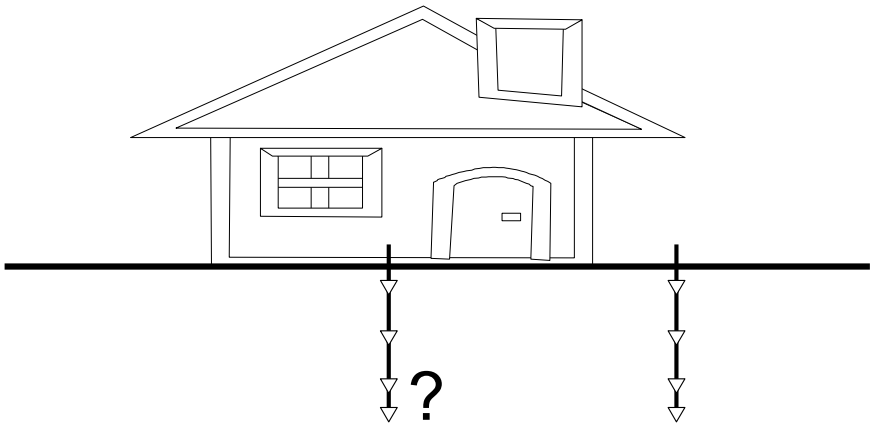
Radon can be used to determine a site-specific alpha that may be 10 to 100 times lower than the default alpha allowed.

Tracers can be used to measure the room ventilation rates and may give values 2 to 10 times higher than the default value, especially for commercial sites.

Real-time analyzers can be used to locate problem houses, preferential pathways into structures, or sort out background scatter. Pressure measurements are helpful with indoor air data to possibly show a background source.

Soil moisture is an important parameter in the model output.

Sub-Slab vs. Near-Slab Samples



Are sub-slab samples necessary to collect? This issue is highly contested around the country and has huge ramifications. Sub-slab samples are much more intrusive, require access agreements, and often attorneys get involved, especially for private residences.

Soil Gas Sampling for HCs

- Might Need to Sample <5' bgs
  - If samples >5' bgs exceed allowable levels
  - How to know? On-site analysis best
  - If not, collect samples anyway
- Always Collect Oxygen Data
- Might Need Soil Phase Data

There are some differences in soil gas sampling for petroleum hydrocarbon VOCs than for chlorinated solvents. If samples at deeper depths exceed allowable values, shallower samples may need to be collected to document the effect of bioattenuation. Oxygen data should always be collected to document presence of the aerobic zone. Soil phase data may be needed to document the presence of a clean soil layer.

DTSC VIMA

(Vapor Intrusion Mitigation Advisory)

- Draft Version – June 2009
- Requirements:
  - Routine Operating System Monitoring
  - Indoor Air Monitoring
  - O&M Contingency Plan
  - Five-Year Reviews
  - Cover DTSC Costs
  - Financial assurance
  - Access Agreements
  - Land Use Covenant & Discharge Permits

DTSC has drafted guidance for vapor intrusion mitigation. The requirements are long and burdensome and will be extremely costly for structures going down this path.

Vapor Intrusion Mitigation Options

	Existing	New
Vapor Barrier/Spray Liner		●
Spray Liner Retrofit	●	
Sub-Slab Depressurization		
Active	●	●
Passive	●	●
Pressurization, Maintain/Increase	●	●
Floor/Walls/Cracks/Seams Sealing	●	●
Indoor Air Filtration	●	
Increase Room Ventilation Rate	●	●
Building Location		●
Reassign/re-designate building use	●	
Intrinsically-Safe Building Design		●

SCREENING INDOOR PLANTS FOR VOLATILE ORGANIC POLLUTANT REMOVAL EFFICIENCY

Yang, D.S. and S.V. Pennisi (Univ. of Georgia); K.-C. Son (Konkuk Univ., Seoul, Korea); S.J. Kays (Univ. of Georgia).
HortScience, Vol 44, p 1377-1381, Aug 2009

Twenty-eight ornamental houseplant species were screened for their ability to remove five volatile indoor pollutants: aromatic hydrocarbons (benzene and toluene), aliphatic hydrocarbon (octane), halogenated hydrocarbon (trichloroethene [TCE]), and terpene (alpha-pinene). Five houseplants exhibited high rates of contaminant removal via phytoremediation. The purple waffle plant, English ivy, variegated wax plant, and Asparagus fern had the highest removal efficiencies for all pollutants, and purple heart displayed superior removal efficiency for four of the five VOCs (i.e., benzene, toluene, TCE)

Method 8021 is the forgotten method out there, but it has great sensitivity and offers many advantages over the other analytical methods if only a few target compounds exist.

Previews of the VI Future

- VI Likely to be a Concern at Your Sites
- Variable Regulatory Guidance Makes Assessment Tricky & Slow
- New EPA & DTSC Guidance to be Stricter
- ESLs to Go Lower?
- Hydrocarbons to be Less of a Concern

Here are some predictions & previews of the vapor intrusion pathway for the next few years.

Want to Know More?

- Battelle Conf. – Monterey CA – 5/24/10
- ITRC 2-day VI Training – 2010
  - July 12: Boston
  - October 4: Atlanta
- AWMA 2-day – Chicago 9/29/2010
- AEHS –MA: PVI Workshop – Oct 2010

Upcoming vapor intrusion training in 2010

Existing Documents & Training

- Soil Gas Sampling SOPs
  - Soil Gas Sampling, Sub-slab Sampling, Vapor Monitoring Wells/Implants, Flux Chambers (www.handpmg.com)
- Other
  - ITRC VI Guidance (www.itrcweb.org)
  - API Soil Gas Document (api.org)
  - ASTM E2600-08: Good Summary Table in App X

More documents.

VI Documents

- Overview of SV Methods (www.handpmg.com)
  - LustLine Part 1 - Active Soil Gas Method, 2002
  - LustLine Part 2 - Flux Chamber Method, 2003
  - LustLine Part 3 - FAQs October, 2004
  - LustLine Part 4 – Soil Gas Updates, Sept 2006
  - LustLine – VI For Petroleum Hydrocarbons, May 2010
- Robin Davis' Articles on Bioattenuation:
  - Lustline #61 May 2009
  - LustLine #52 May 2006 (www.neiwpcc.org)

A summary of some existing documents.

HARTMAN
ENVIRONMENTAL GEOSCIENCE

Blayne Hartman
Hartman Environmental Geoscience
H&P Mobile Geochemistry
858-925-7206
www.handpmg.com

H&P Mobile Geochemistry Inc.