A Novel Downwind Odor Sampling Strategy for Transient Events

D. Wright – Don Wright & Associates, LLC
F. Kuhrt & A. Iwasinska – Microanalytics-MOCON
D. Eaton – Epsilon Company
J. Koziel – Ag and Biosystems Engineering, Iowa State University

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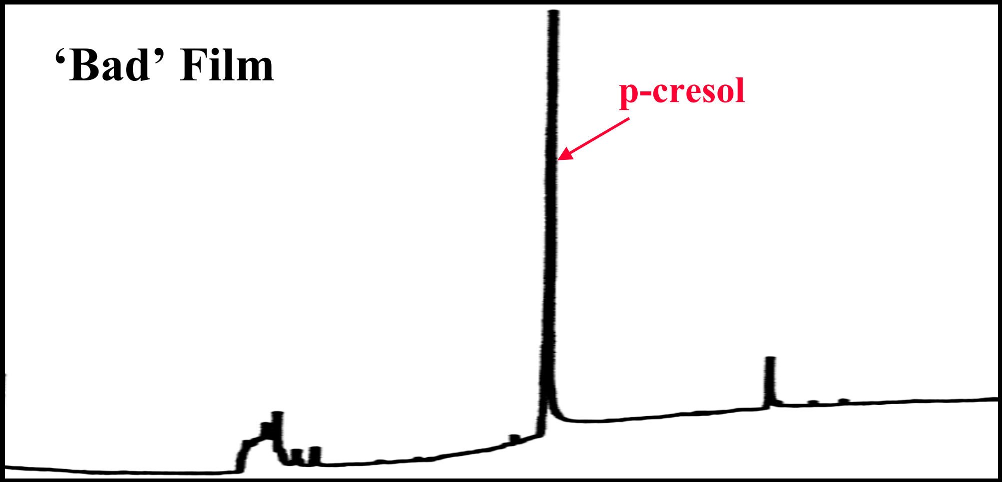
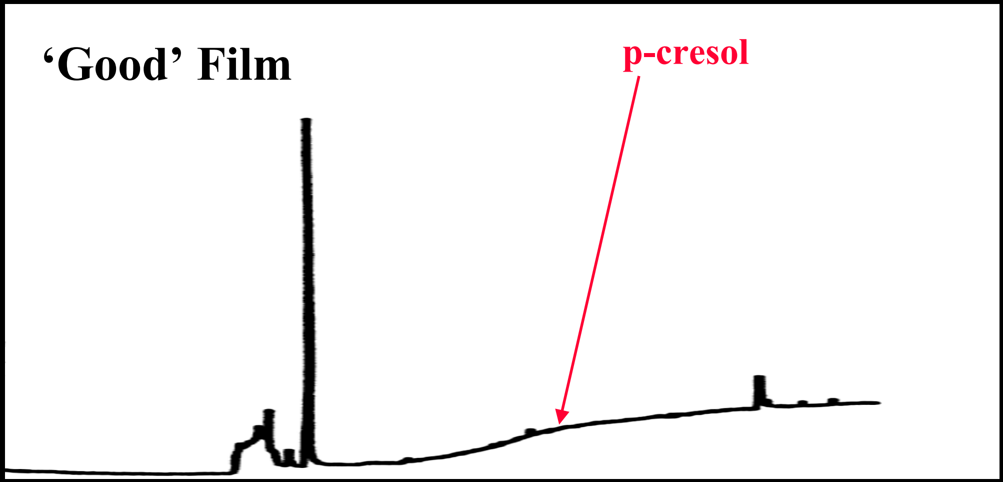
However

Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the author and do not necessarily reflect the view of the US Department of Agriculture

Cereal Packaging Film – 'Barnyard' Malodor





Conclusions from Project Report into Swine CAFO Study - 1996

- It appears that p-cresol may be a priority odor impact compound relative to the swine-barn application.
- If this is proven correct, sampling these environments with plastic bags is ill-advised.
- The priority impact shown for phenol is believed to be a cross-contamination artifact; unrelated to the targeted swine-barn source.

Published References Addressing the Issue of Odorant Loss in Tedlar Bags

Keener et. al.; 2002; *Evaluation of thermal desorption for the measurement of artificial swine odorants in the vapor phase;* NC State, Transactions of the ASAE.

Koziel et. al.; 2005; *Evaluation of sample recovery of malodorous livestock gases from air sampling bags, SPME fibers, Tenax TA sorbent tubes and sampling canisters;* Texas A&M, JAWMA.

Trabue et.al.; 2006; *Bias of Tedlar bags in the measurement of agricultural odorants;* USDA-ARS Iowa, J of Environmental Quality.

Whole-Air Sample Bag Materials Optimization

Comparative p-Cresol Loss; Tedlar™ Versus m-FEP

Film Type	Temperature °C	Hold Time (min)	% Loss
Tedlar™	75	30	75
m-FEP	75	30	34
m-FEP	75	30	32
m-FEP	23	1	14

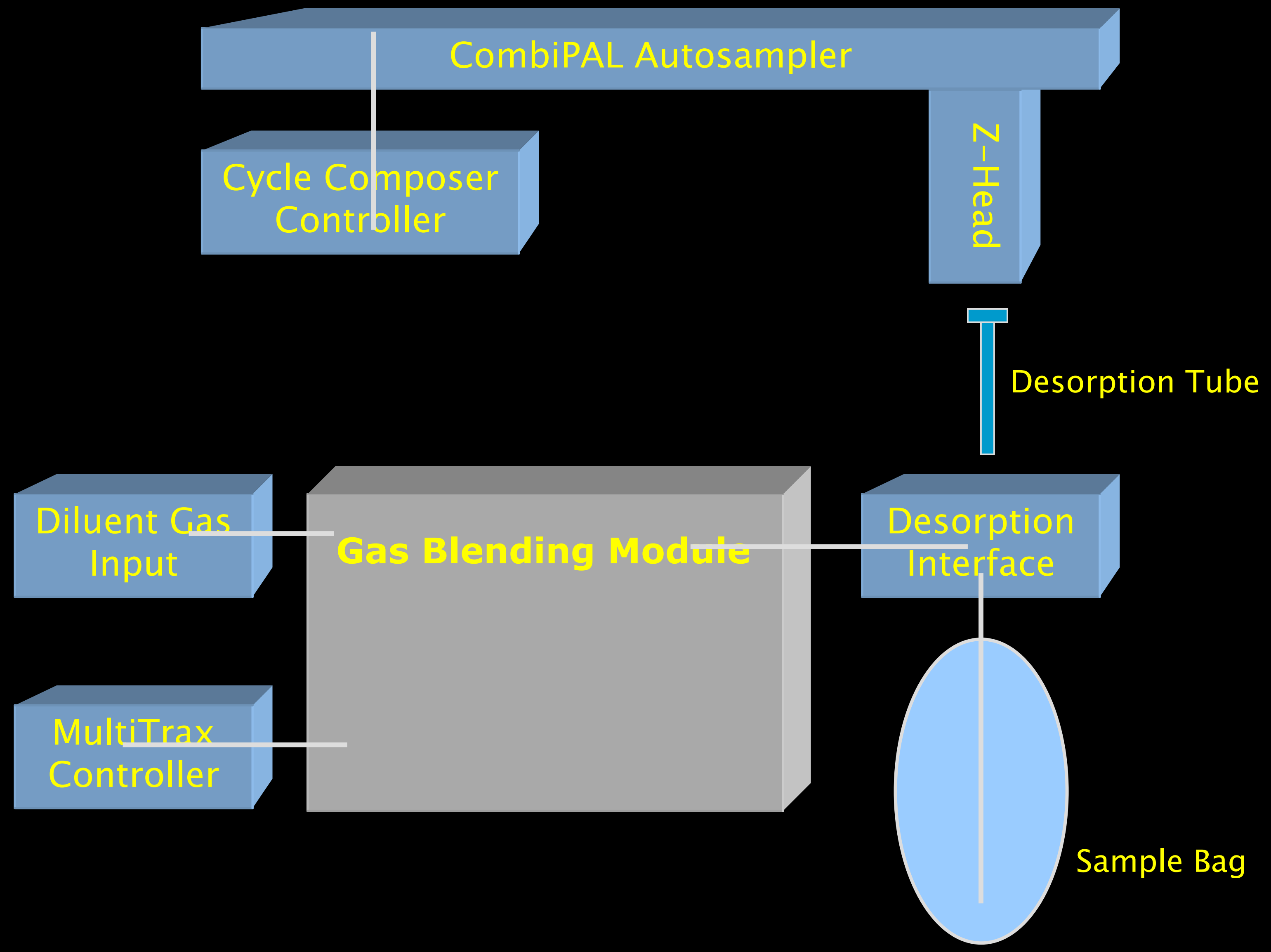
Prototype Inverted Metalized Film Sampling Bag

Comparative Phenol Loss Percentages for Various Films and Foils

Storage Time	M-FEP	Inverted Aluminum	Inverted Inc / Ag w BHA	Inverted Inc / Ag w/o BHA	Nickle Foil
T=0 + 1.5 min	22	29	33	38	59
T=0 + 2.75 hr	50	40	43	49	75
T=0 + 22 hr	75	62	72	68	97

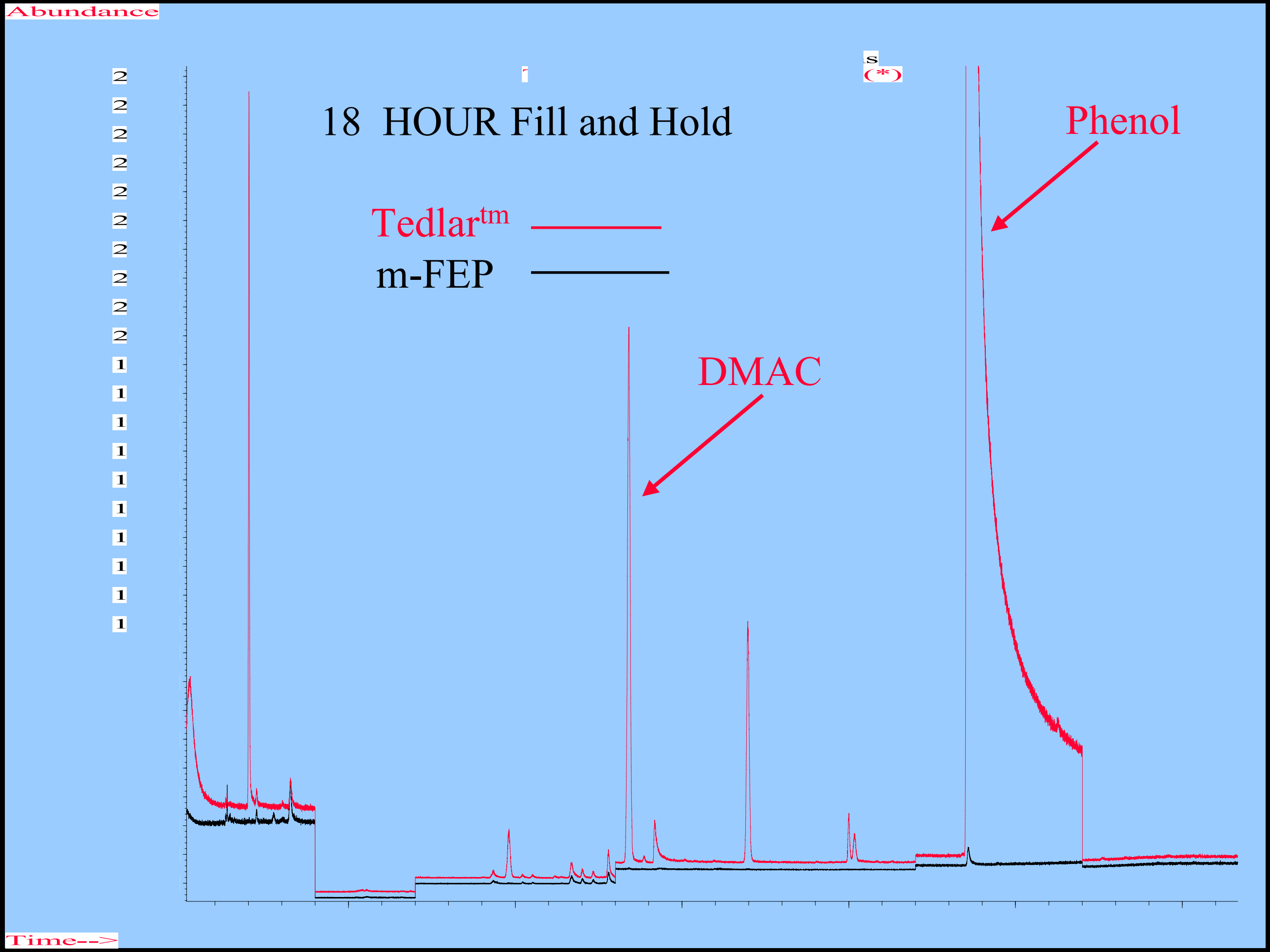
Sorbent Tube to Whole-Air Sample

Thermal Reconstitution


CombiPAL Autosampler
Cycle Composer Controller
Z-Head
Desorption Tube
Diluent Gas Input
Gas Blending Module
Desorption Interface
MultiTrax Controller
Sample Bag

Prototype Thermal Reconstitution System

Background Comparison: Tedlar™ vs Metalized FEP



Phenol Response Precision Out of Tedlar

Short-term – Same Day

Series	Mean (ppb)	**SD** (ppb)	%RSD	n
1	8.7	.11	1.26	3
2	9.5	.20	2.11	3
3	8.2	.23	2.80	3

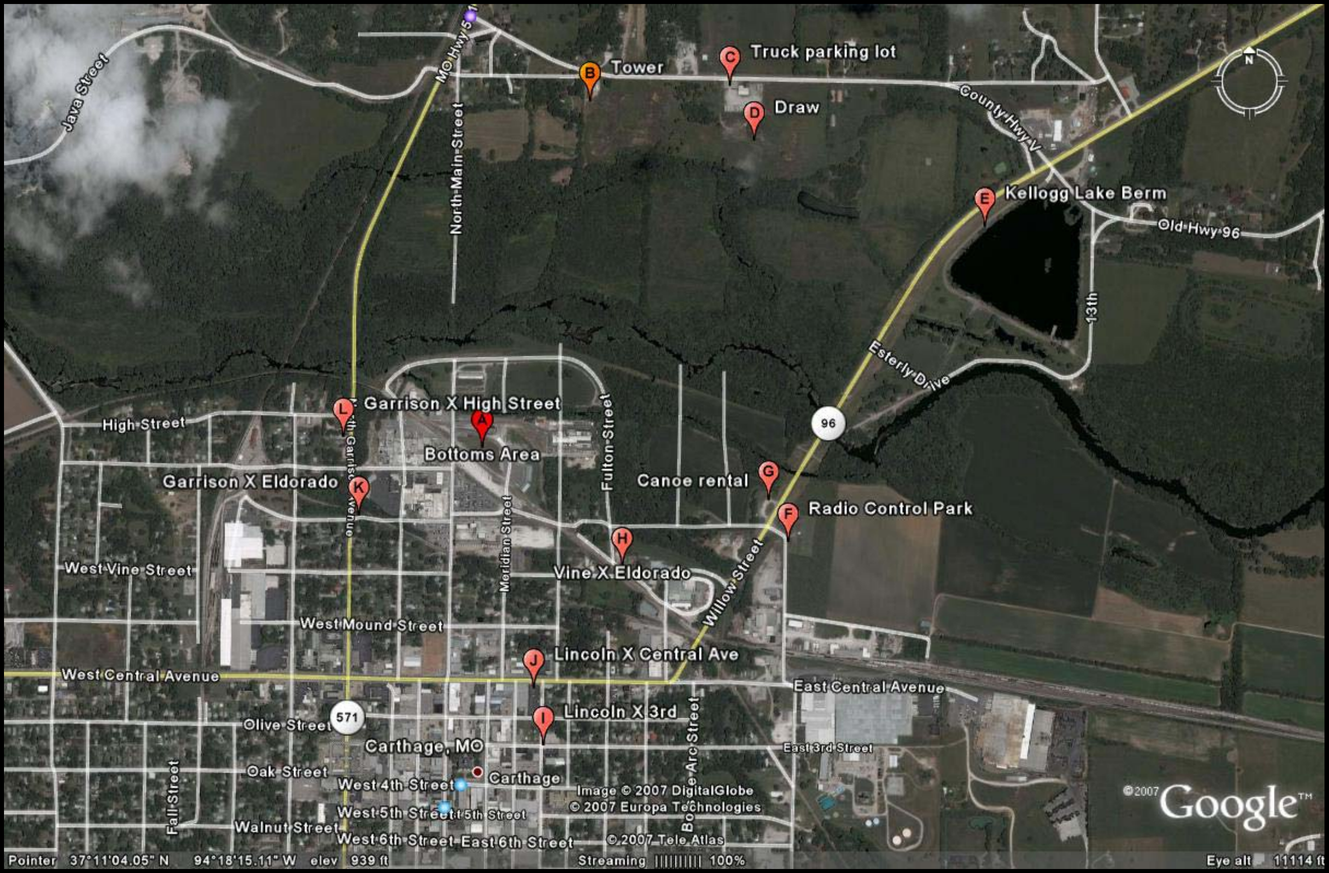
Long-Term – 21 Day

Day 1	Day 7	Day 14	Day 21	Mean	%RSD
8.2	8.7	9.5	8.2	8.6	7.1

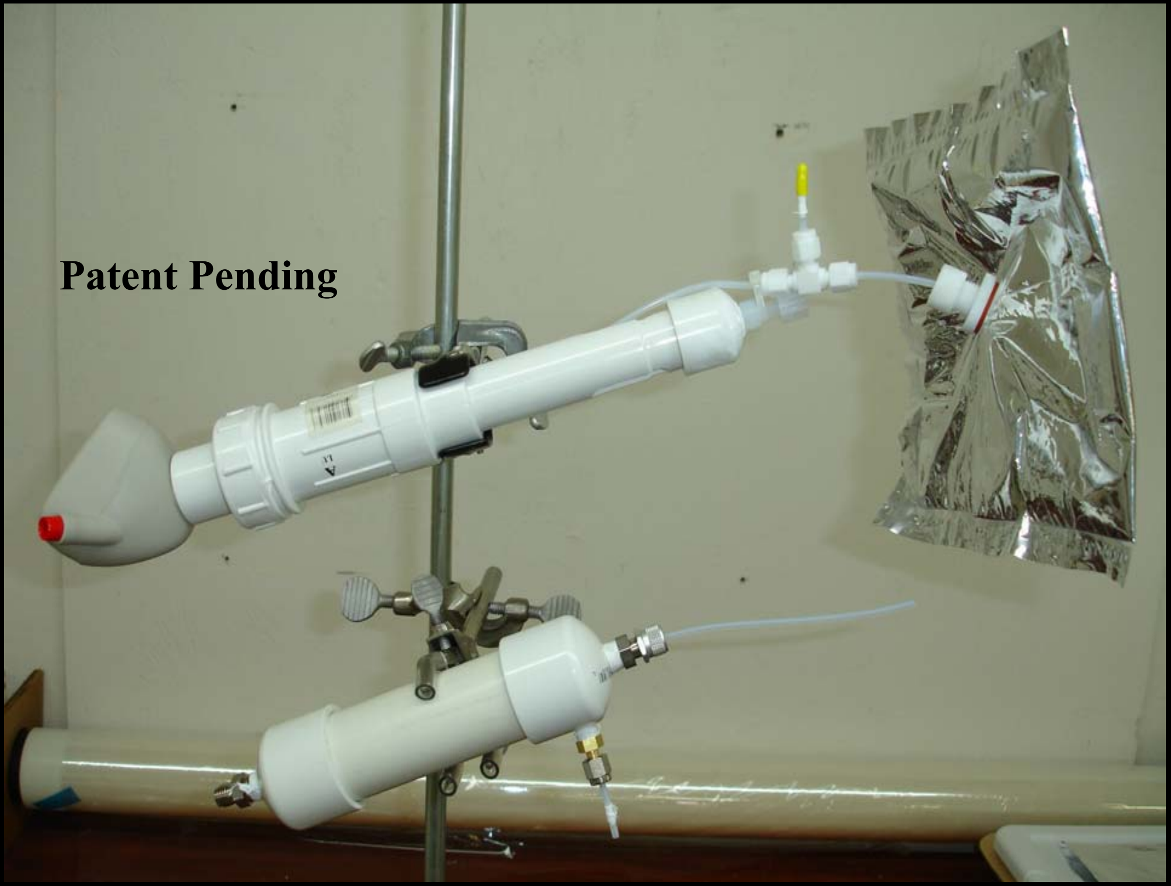
Comparative Phenol Loss: Direct m-FEP Bag Versus Sorbent Tube; Freezer Stored & Reconstituted

Time	Direct Day 1	Reconstituted Day 1	Reconstituted Day 7	Reconstituted Day 14	Reconstituted Day 21
T=0+1.5 min	22				
T=0+10 min		34	34	31	X
T=0+2.75 hr	50	51	48	48	54
T=0+23 hr	75				

Carthage Industrial Bottoms Area



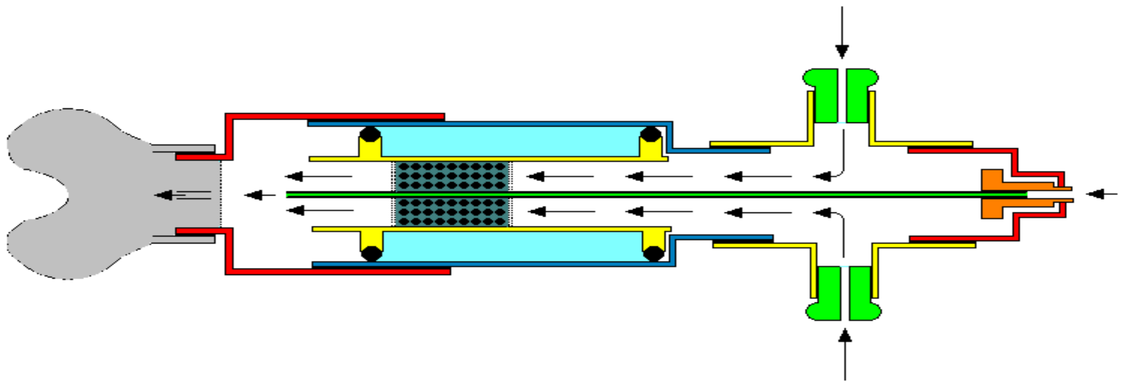
Prototype, Low-Cost Field DDO Device



Field DDO Device; Continuously Variable Dilution Ratio

6 liter / min = 11:1 dilution ratio

16 liter / min = 8:1 dilution ratio



Patent Pending

Prototype, Field DDO ‘Screening’ Device; Continuously Variable, Audible Alarmed

Summary

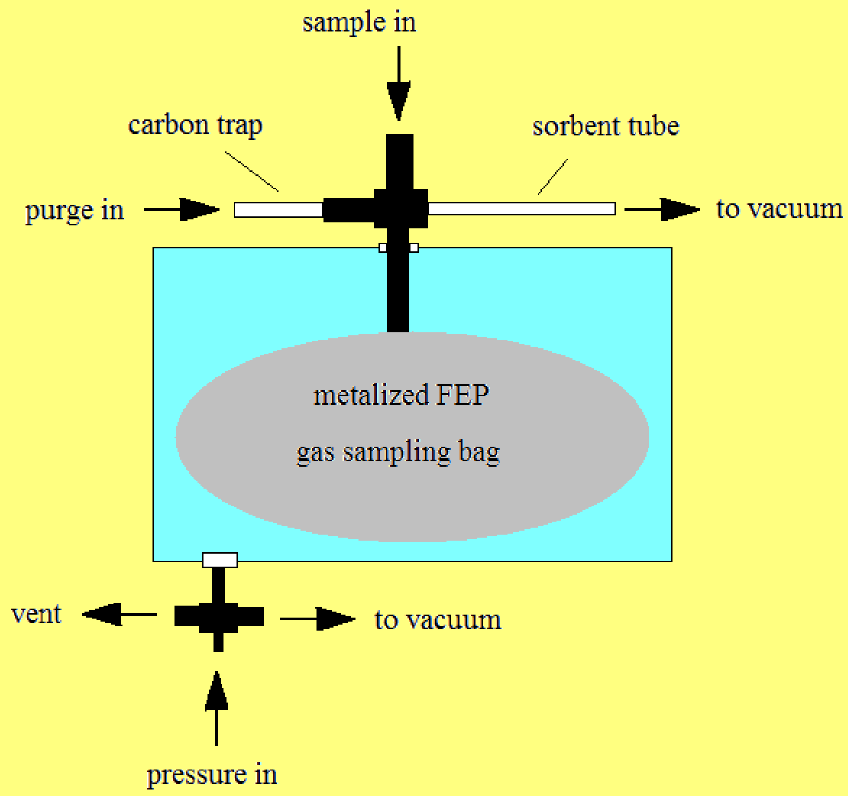
- Regardless of source, odor analysis is, first and foremost, chemical analysis; carrying the same constraints and limitations with respect to sample handling and storage.

- While always carrying the 'potential' for extreme complexity, the odor response to real world odor sources is often remarkably simple; with both positive and negative impacts primarily driven by very small subsets of the total source emission. Sampling strategies should be biased toward those highest-impact odorants.

- Regardless of surface treatment, extended storage of polar, high-impact semi-volatile odorants in the gas phase is ill-advised. An optimized whole-air odor sampling strategy is presented whereby odorants are field collected onto an adsorbent bed, shipped and stored under refrigeration in advance of gas phase reconstitution; just prior to analysis or composite sensory assessment.

Post-Phase I
Transient Event Sampling
Strategy Development

Proposed High-Speed Odor Event Sampler System



Odor Cued ‘Beep-Ball’

Comparative Naphthalene Yields: m-FEP Gas Bag Grab Sample With Sorbent Tube Transfer

(MS SIM area count responses)

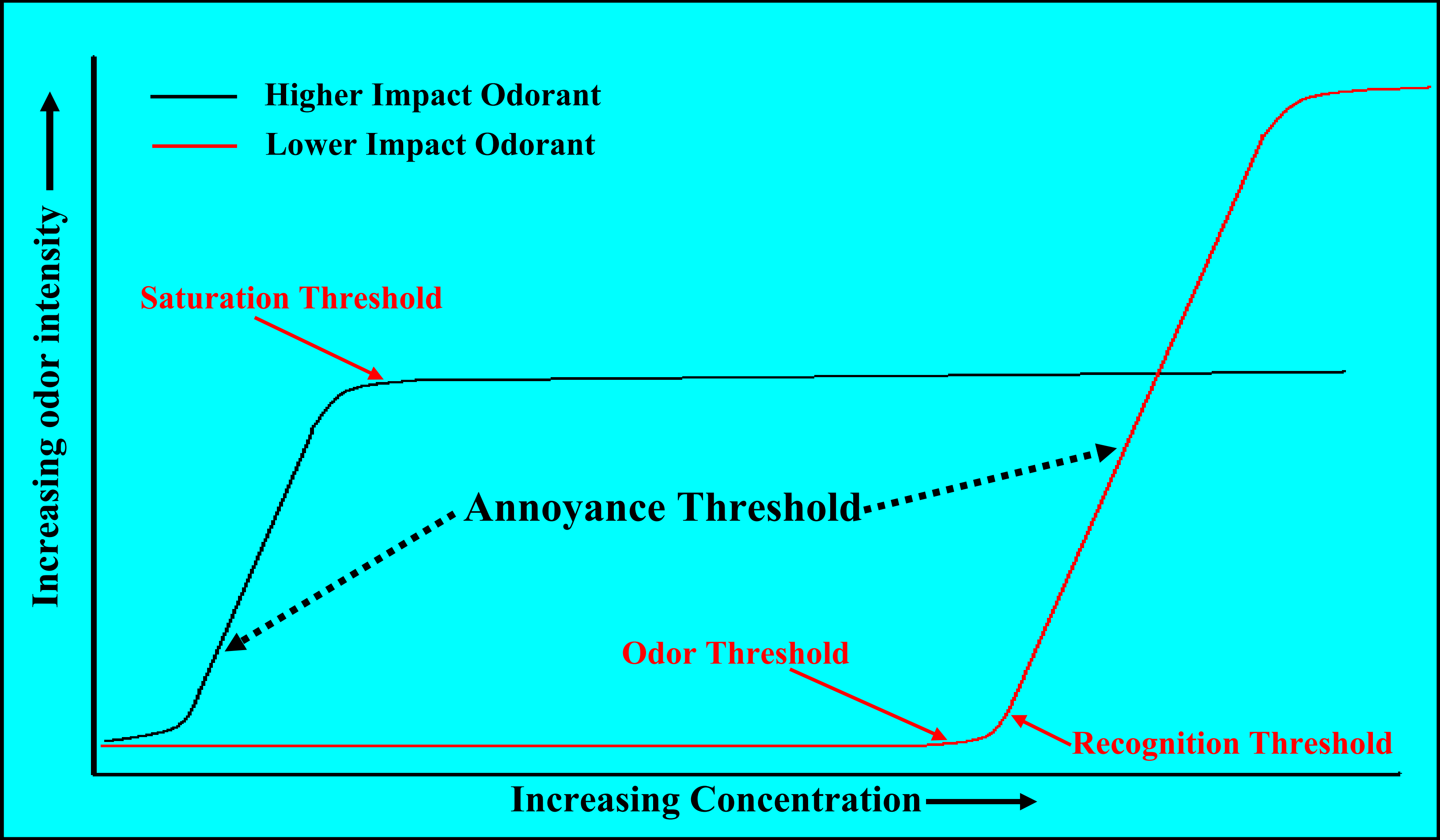
Indirect 'Peak' Series

Run #1	83,915 count	
Run #2	54,851 count	
Average	69,383 count	11X 'Lull'

Indirect Interim 'Lull'

Run #1	6,216 count	**.07X 'Peak'**

Representative Odor Threshold Curves



Odor Point-Source Prioritization Utilizing Tracer Gas Injection

Integrated Multi Point-Source Transient Odor Event Generator System

Odorant / Tracer Pair Response Ratio Precision

Run Number	Naphth / CCl3 Response Ratio
Run #1	.84
Run #2	.98
Run #3	.96
Run #4	.95
Run #5	1.07
Mean	.96
sd	.082
% RSD	8.56
n	5

Transient Event Sampling with Tracer Gas Injection for Point-Source Prioritization

(MS SIM area count responses)

'Mothball' Event	Naphthalene	CCl3	DMB
Run #1	220,450	200,750	6,592
Run #2	653,343	650,217	390
Run #3	584,887	386,036	480
Mean	486,227	412,334	2,487

'Bluebonnet' Event	Naphthalene	CCl3	DMB
Run #1	26,522	<dl	4,203
Run #2	35,053	5,580	84,373
Run #3	17,428	2,988	3,771
Mean	**26,334**	**2,889**	**30,782**