



Multi-Site Evaluation of the Exposed Waste Odor Neutralizer (ExWON) System Using QuikAir V for Mitigating Working Face Odors at Municipal Solid Waste Landfills

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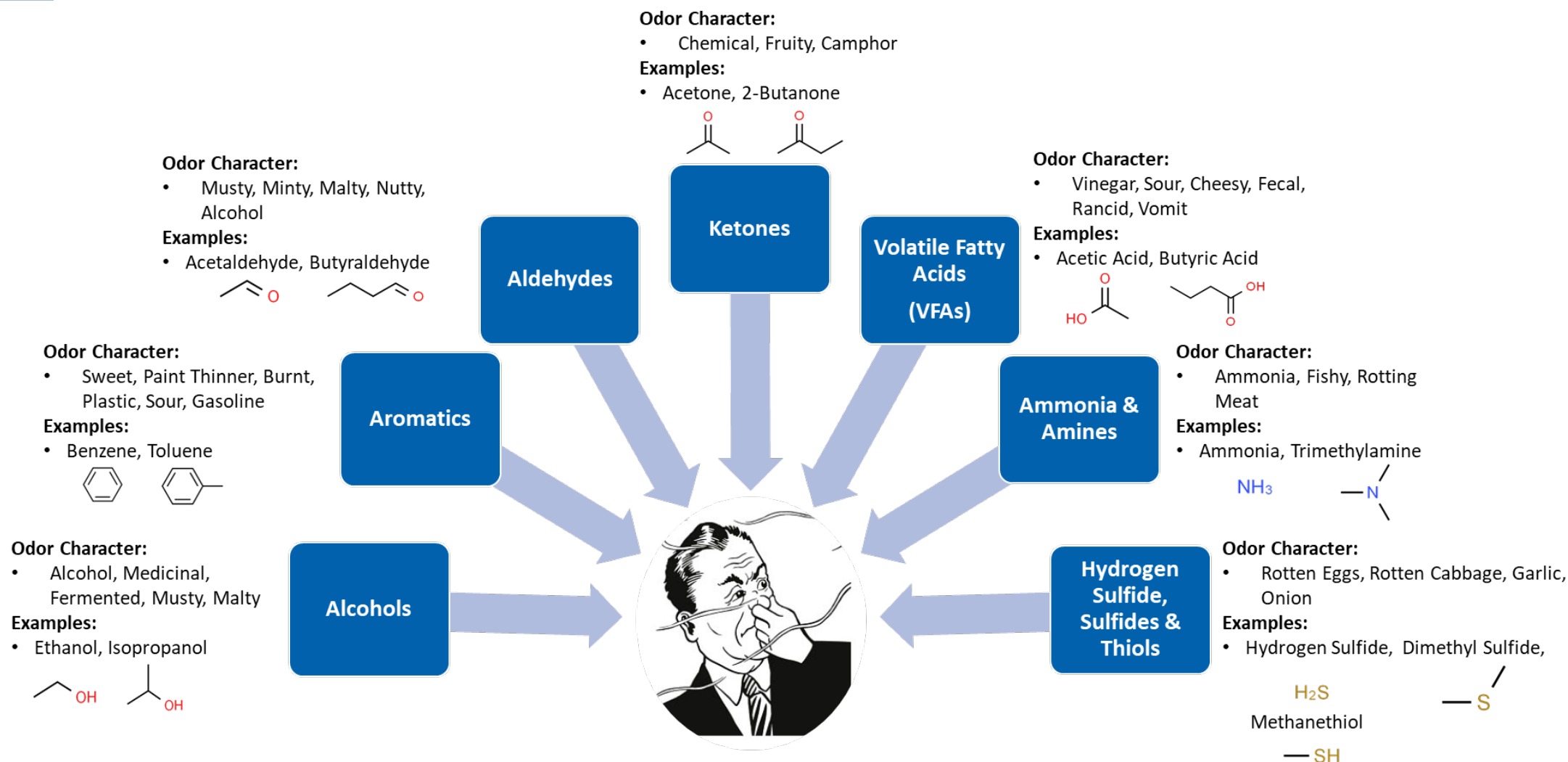
Objective

Utilize a targeted air sampling approach to:

1. Identify working face compounds
2. Evaluate the performance of Exposed Waste Odor Neutralizer (ExWON) odor control systems installed on working face equipment (i.e., Compactors & Dozers) at Landfills



Odorous Compounds: What Are They?



Ambient Air Sampling Techniques

Sampling Bag



Summa Canister



Sorbent Tubes



Whole-Air
Sampling

Advantage:

- \$ (Cheap)
- Multiple volumes

Limitations:

- Potential loss or alteration in chemical composition
- Short storage time < 24 hrs.

Advantage:

- Longer storage time than sampling bags
- Multiple volumes
- Reusable

Limitations:

- \$\$\$\$ (Expensive)
- Analyte loss due to wall effect, matrix effect, condensation
- Difficult to clean and evacuate

Advantage:

- Storage time
- Commercially available tubes targeting different compounds
- Can be reusable

Limitations:

- Possible loss of certain compounds in the sampled air
- Risk of breakthrough on sorbent bed
- Interference when sampling air with high humidity and ozone levels
- \$\$ Higher initial cost than sampling bags

Standardized Methods



- Sorbent-Trapping Technique
- Ion Chromatography
- **Ammonia**



- Whole-Air Sample Technique
- Gas Chromatography
- Requires Pre-concentrator
- **Aromatics**
- Other nonpolar constituents



- Whole-Air Sample Technique
- Gas Chromatography Mass Spectrometry
- Requires Pre-concentrator
- **Alcohols**
- **Aromatics**
- **Ketones**
- **Sulfur (Carbon disulfide)**
- **Aldehydes***

- Sorbent-Trapping Technique
- High-Performance Liquid Chromatography
- **Formaldehyde**
 - May be modified to include other Aldehydes



- Sorbent-Trapping Technique
- Gas Chromatography
- **Acetic acid**
 - May be modified to include other VFAs



- Whole-Air Sample Technique
- Gas Chromatography
- Requires Sulfur Specific Detector
- **Sulfur Panel**

WCG Targeted Sampling Approach



Whole-Air Sampling



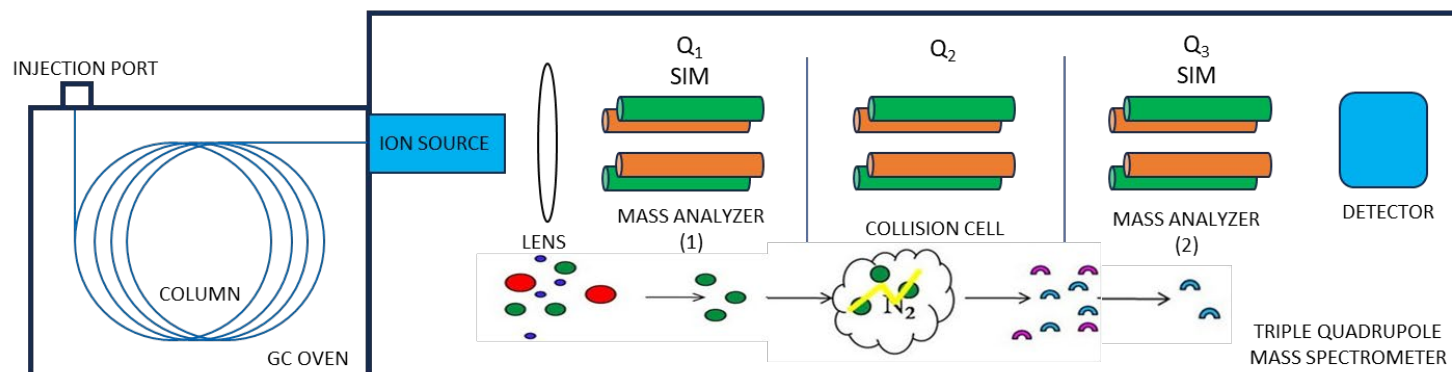
- SilcoCans
- Preserves Samples
 - Alcohols
 - Aromatics
 - Aldehydes
 - Ketones
 - VFAs
 - Nitrogen's
 - Sulfurs

Sample Introduction



- Pressure Lok® Syringe
- Manual Injection
- **Does not** require pre-concentrator

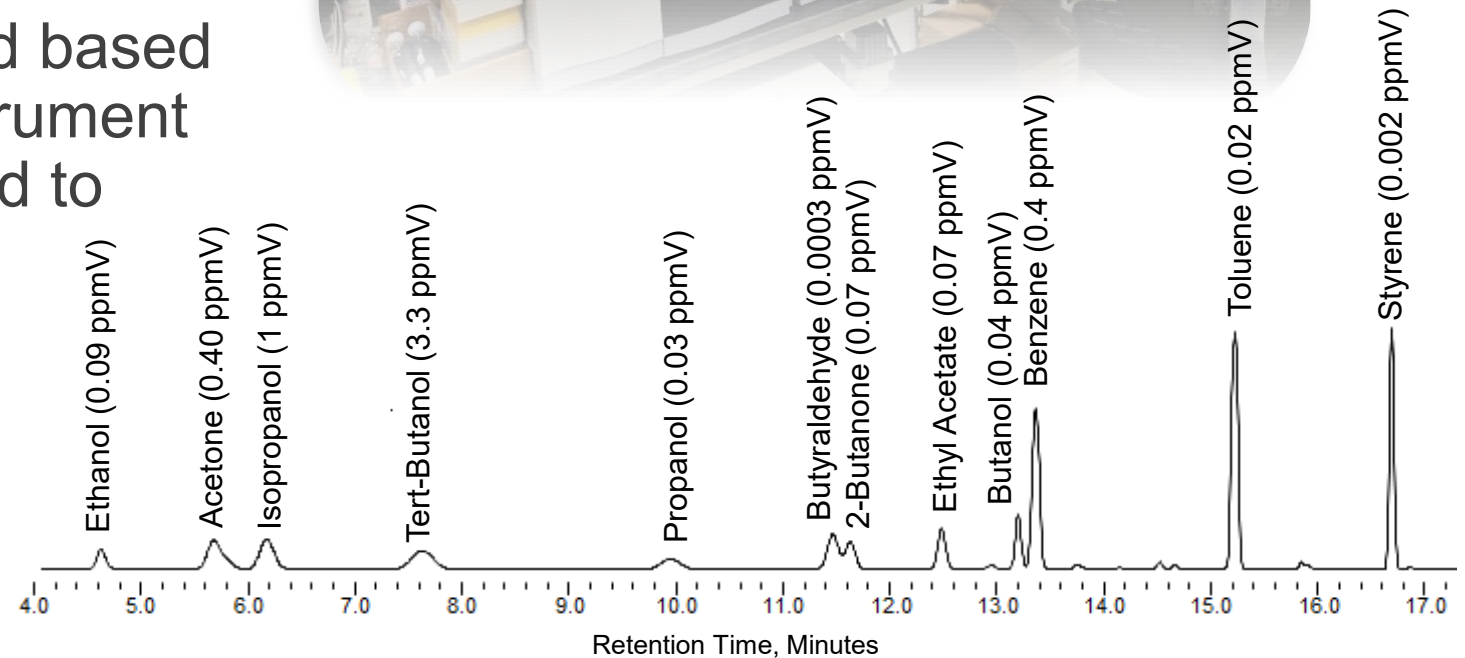
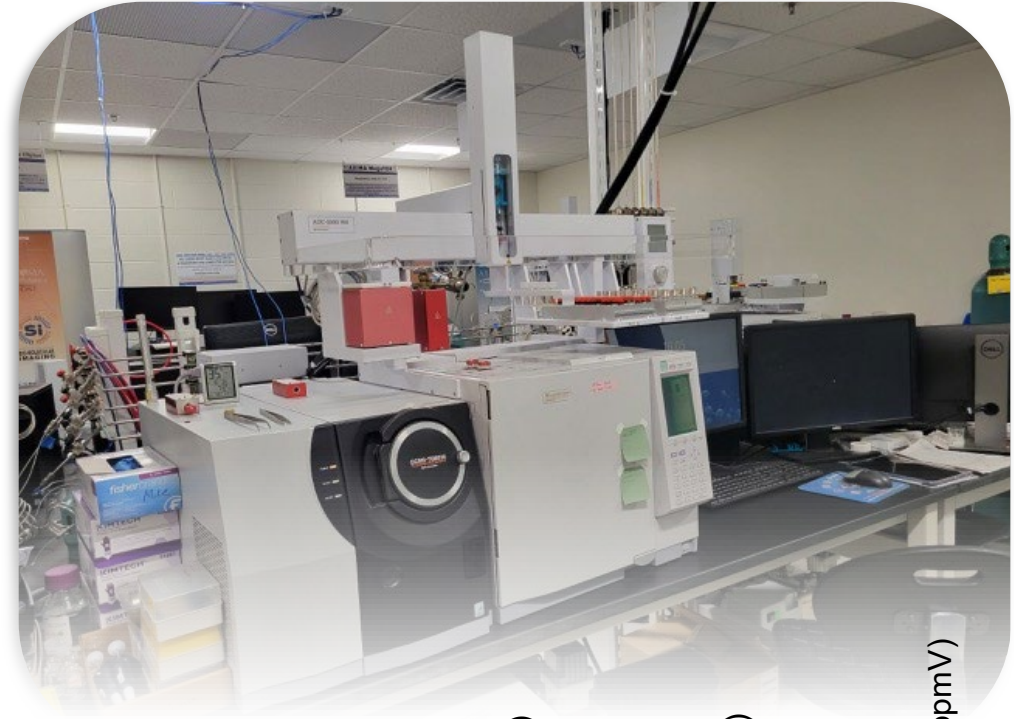
Gas Chromatography Triple Quadrupole Mass Spectrometry



- Multiple Reaction Monitoring (MRM)
 - Analyte specific fragmentation transition
- **One instrument** for the analysis of targeted odorous compounds

Sample Analysis

- Air samples were analyzed at the University of Texas at Arlington by gas chromatography triple quadrupole mass spectrometry (GC-TQMS).
- The results were summarized based on instrument response. Instrument response is directly correlated to amount of analyte present.



Air Sampling Event Details (3 Sites)

- A total of 5 air samples were collected.
- All samples were collected from the same location downwind, within 100 feet from the edge of the working face.



Sampled for 43 Typical Solid Waste Odorous Compounds



20 Odorous Compounds Detected

Word Cloud Key

0 Sites 1 Site 2 Sites 3 Sites

Working Face 20 Odorous Compounds Detected

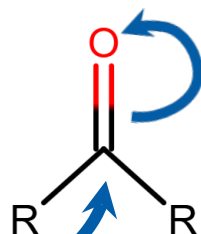
Working Face Detections	Odor Character
Acetaldehyde	Ethereal, Fresh, Fruity, Minty, Musty, Pungent, Suffocating
Ethanol	Alcohol, Ethereal, Medicinal, Sweet, Vinous
Acetone	Apple, Chemical, Etherous, Minty, Pear
Propanal	Alcohol, Cocoa, Earthy, Fruity, Nutty, Pungent
Isopropyl Alcohol	Musty, Rubbing alcohol, Sharp, Woody
Dimethyl Sulfide	Asparagus, Cabbage, Cooked Corn, Cowy, Disagreeable, Gasoline, Putrid, Radish, Sharp, Sulfurous
Carbon Disulfide	Cabbage, Ether, Herbaceous, Medicinal, Sulfide, Sweet, Vegetable
1-Propanol	Alcohol, Fermented, Musty, Whiskey
Butanal	Malty, Musty, Pungent
2-Butanone	Acetone, Camphor, Ethereal, Mint, Sharp, Sweet
Ethyl Acetate	Etherous, Fingernail Polish, Solvent
Butanol	Alcohol, Balsam, Floral, Malty, Medicinal, Oil, Sweet, Whiskey, Wine
Acetic Acid	Pungent, Vinegar, Sour
Iso-butyric Acid	Cheese, Sour Milk, Rancid
Sulfur Dioxide	Irritating, Metallic, Pungent, Sulfur
Dimethyl Disulfide	Asparagus, Cabbage, Cooked Corn, Cowy, Disagreeable, Gasoline, Putrid, Radish, Sharp, Sulfurous
Diethyl Disulfide	Pungent, Foul, Garlic
Benzene	Aromatic, Solvent
Toluene	Benzene, Burnt, Floral, Mothballs, Paint Thinner, Pungent, Sour, Sweet
Styrene	Balsam, Floral, Gasoline, Plastic, Rubber, Sharp, Solvent, Sweet

QuikAir V: Chemistry



Ketones

QuikAir V

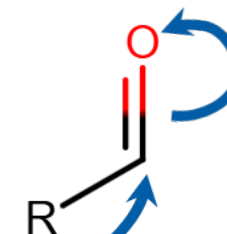


- Adsorption
- Encapsulation
- Partitioning

Aldehyde

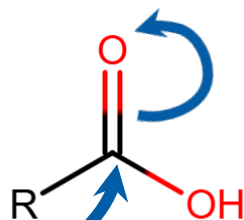
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QuikAir V

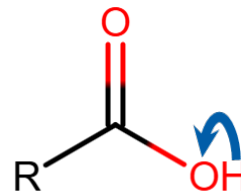


VFAs

QuikAir V



or



Sulfurs

QuikAir V



ExWON System



Air Sampling Event Details (3 Sites)

- A total of 5 air samples were collected.
- All samples were collected from the same location downwind, within 100 feet from the edge of the working face.





**Continual Reduction in Odorous
Compounds as they Contact QuikAir V™
Discharged by ExWON™**

51% Overall Reduction
within 100-ft Downwind
of Working Face



Acetaldehyde
Ethanol
Acetone
Propanal
Isopropyl Alcohol
Dimethyl Sulfide
Carbon Disulfide
1-Propanol
Butanal
2-Butanone
Ethyl Acetate
Butanol
Acetic Acid
Iso-butyric Acid
Sulfur Dioxide
Dimethyl Disulfide
Diethyl Disulfide
Benzene
Toluene
Styrene

Overall System Performance

$p = 0.001$
System On Significantly Reduces Total Instrument Response

75% Avg. Reduction

49% Avg. Reduction

46% Avg. Reduction

QuikAir Laboratory Performance	Detected Odorous Compounds	System Off	System On	Percent Reduction	System Off	System On	Percent Reduction	System Off	System On	Percent Reduction
		Total Instrument Response	Total Instrument Response		Total Instrument Response	Total Instrument Response		Total Instrument Response	Total Instrument Response	
95%	Acetaldehyde	569	0	100%	10041	4432	56%	5990	4482	25%
95%	Ethanol	25662	8499	67%	985034	380567	61%	105963	73627	31%
94%	Propanal	1399	2938	0%	1198	653	45%	3309	2314	30%
97%	Acetone	18931	616	97%	148212	101437	32%	80808	71300	12%
99%	Isopropanol				112809	45216	60%	16665	12842	23%
99%	Propanol							3058	1178	61%
89%	Ethyl Acetate				62546	90584	0%	3736	2566	31%
95%	2-Butanone	405	0	100%	14999	12784	15%	4262	3681	14%
32%	Benzene	446	250	44%	742	536	28%			
89%	Butyraldehyde							1941	672	65%
99%	Butanol	341	0	100%	432	607	0%	3814	1364	64%
43%	Toluene	17654	5003	72%	274952	162805	41%	22152	21254	4%
70%	Styrene	4858	2548	48%	3376	4661	0%	228	671	0%
92%	Dimethyl Sulfide				630	0	100%	355	0	100%
90%	Sulfur Dioxide	1768	2344	0%						
13%	Carbon Disulfide	300	0	100%	1895	2481	0%	1288	271	79%
69%	Dimethyl Disulfide	510	0	100%	1478	717	51%	2677	0	100%
78%	Diethyl Disulfide	484	331	32%						
99%	Acetic Acid	2403	1472	39%						
99%	Iso-butyric Acid	325	605	0%						

Summary



Identified Odorous Compounds from WF

- 20 Compounds Detected From WF
- 10 Present at All Sites

Evaluated the Performance of ExWON using QuikAir V

- Results: 51% Overall Reduction Across 3 Sites
- $p = 0.001$ Significantly Reduces Overall Odor Compound Signal



Thank You

