

Choosing the Most Effective Odor Measurement Technique

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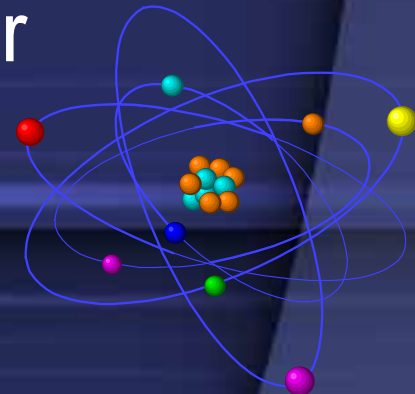
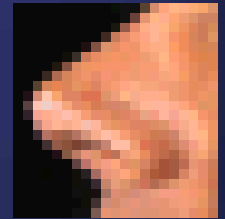
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Introduction

- Problem:
 - There are many different methods for evaluating odors
 - Choosing the most effective technique is critical
- Objective:
 - Develop a method to solve your odor problem
 - Sampling
 - Analysis, and
 - Quantification

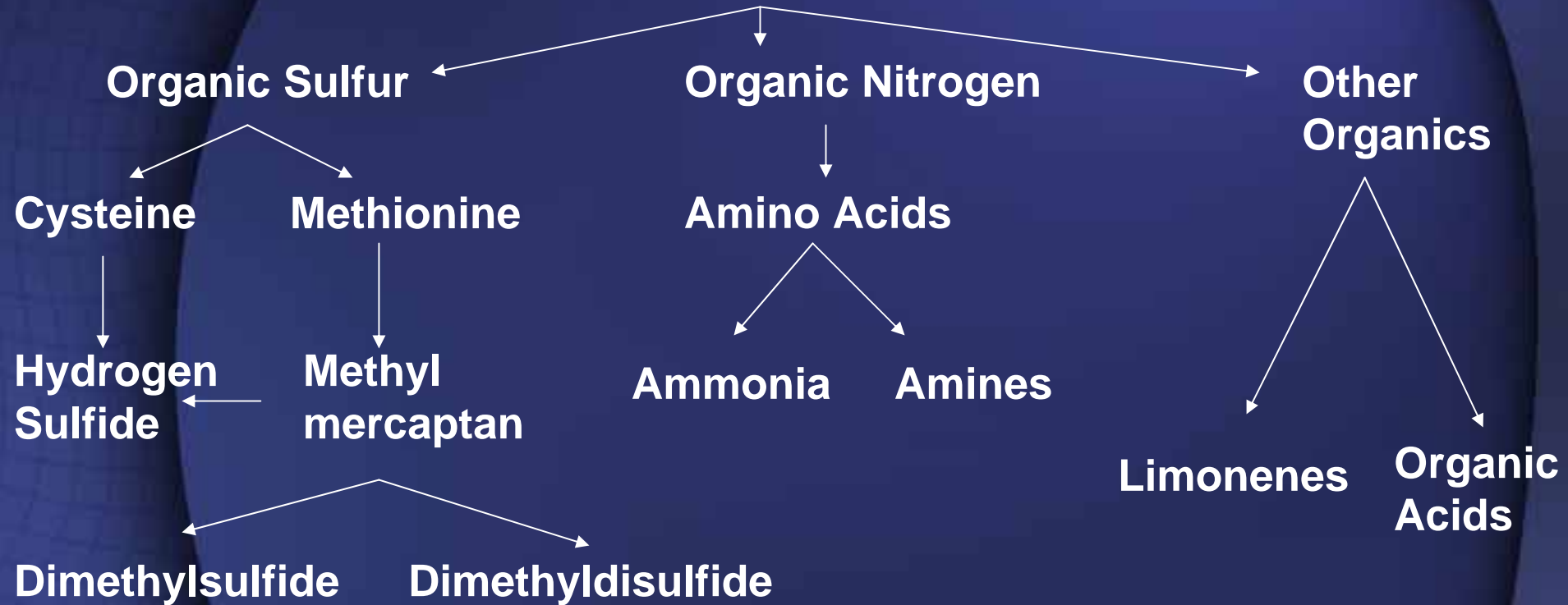
Terminology

- Odor - perception experienced when one or more chemicals come into contact with receptors on the olfactory nerves
- Odorant - any chemical in the air that is part of the perception of odor



Odor Generation

Waste Water Solids



Odor Characteristics

- Character
 - ◉ Mental associations, type of smell
 - ◉ Subjective
 - ◉ Hedonic tone
- Intensity
 - ◉ strength of smell
 - ◉ butanol odor units or dilutions to threshold (D/T)
- Duration
- Frequency

Measurable odor characteristics

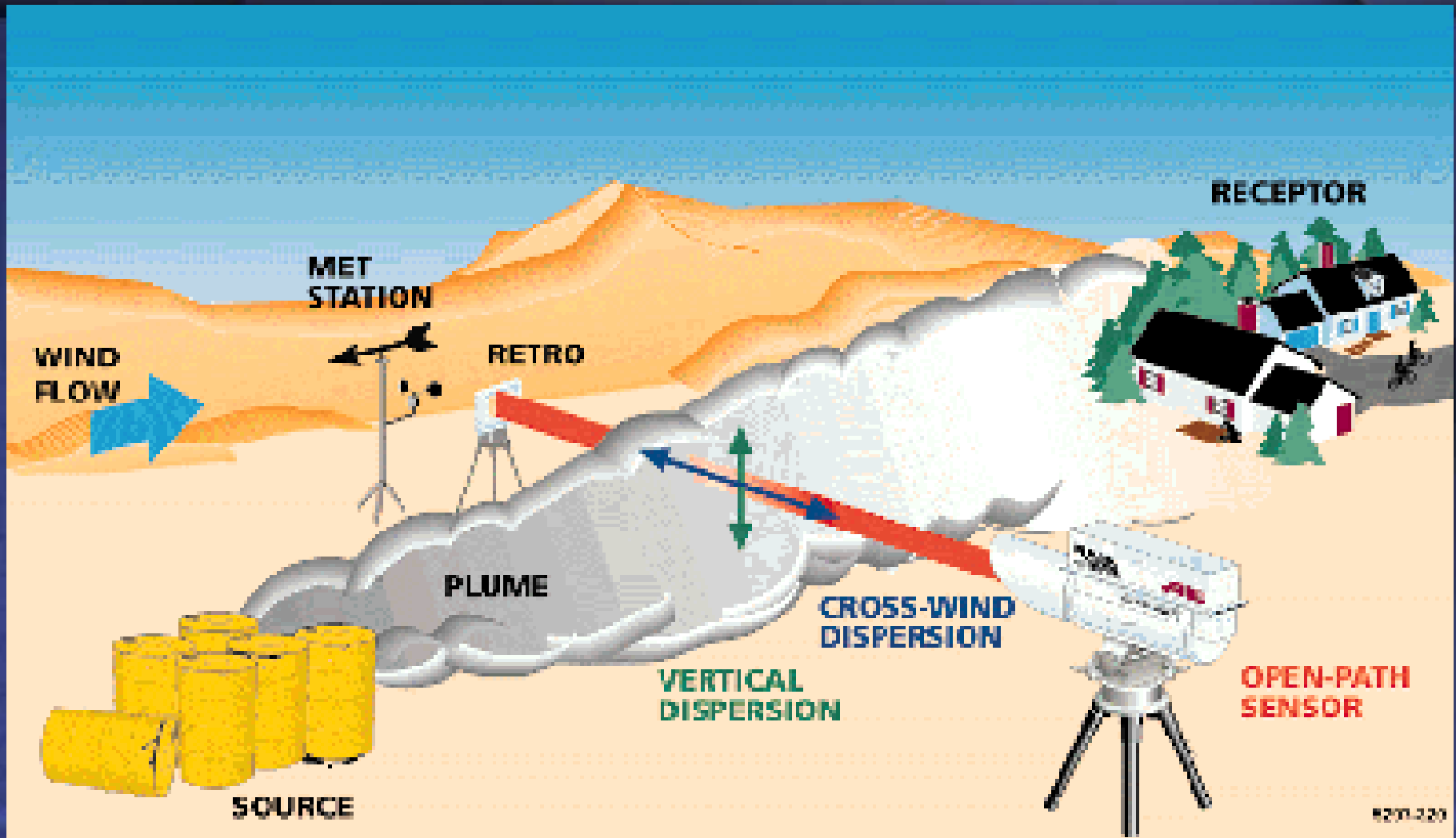
- Chemical Qualities
 - ⊗ Chemical composition
 - ⊗ Chemical concentration
- Physiological Qualities
 - ⊗ Odor Threshold
 - ⊗ Recognition Threshold
 - ⊗ Complaint/Annoyance Threshold



Sampling methods

- Ambient sampling
- Flux chamber analysis
- Headspace analysis

Ambient sampling

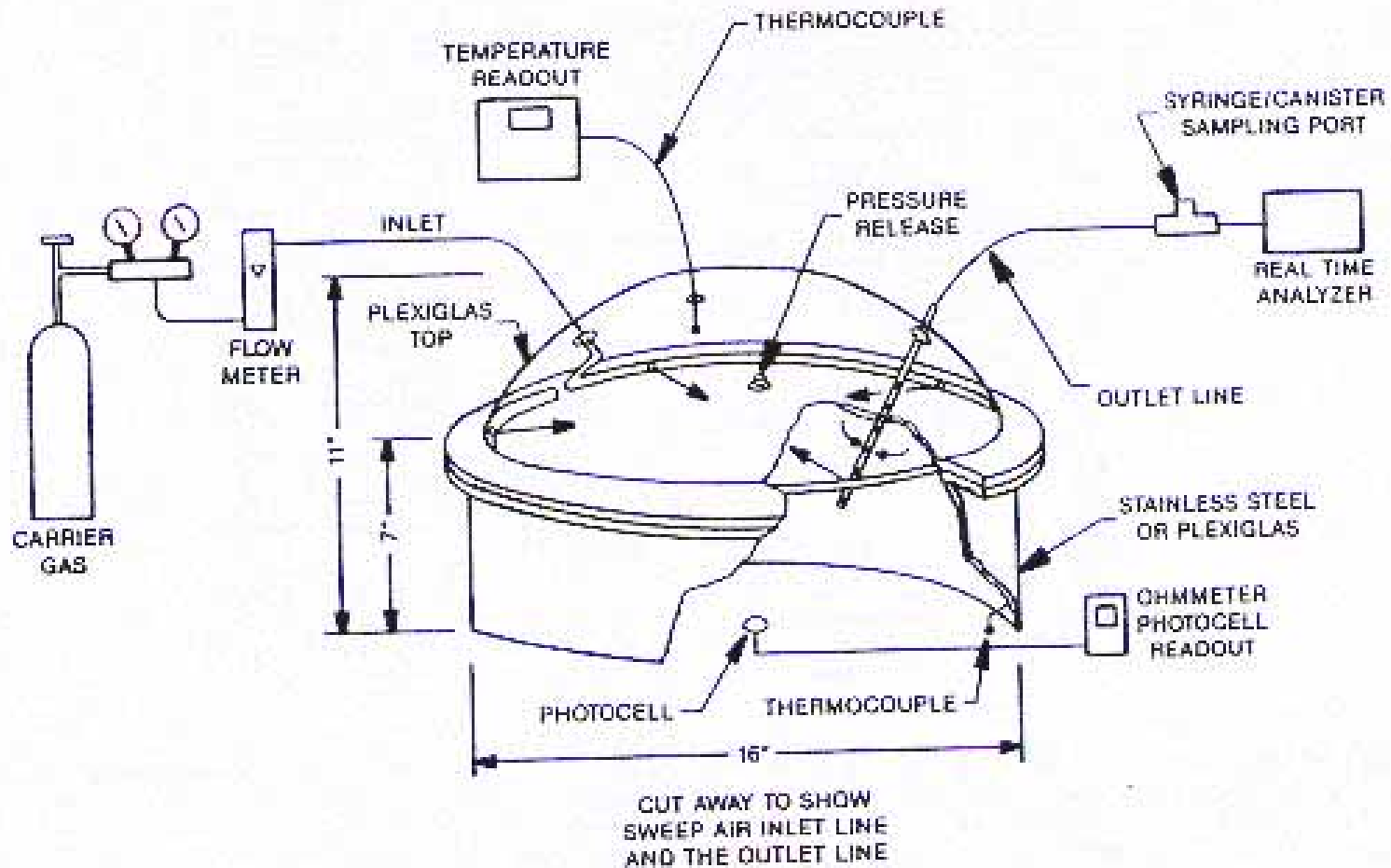


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- <http://www.kassay.com/mopftir.htm>

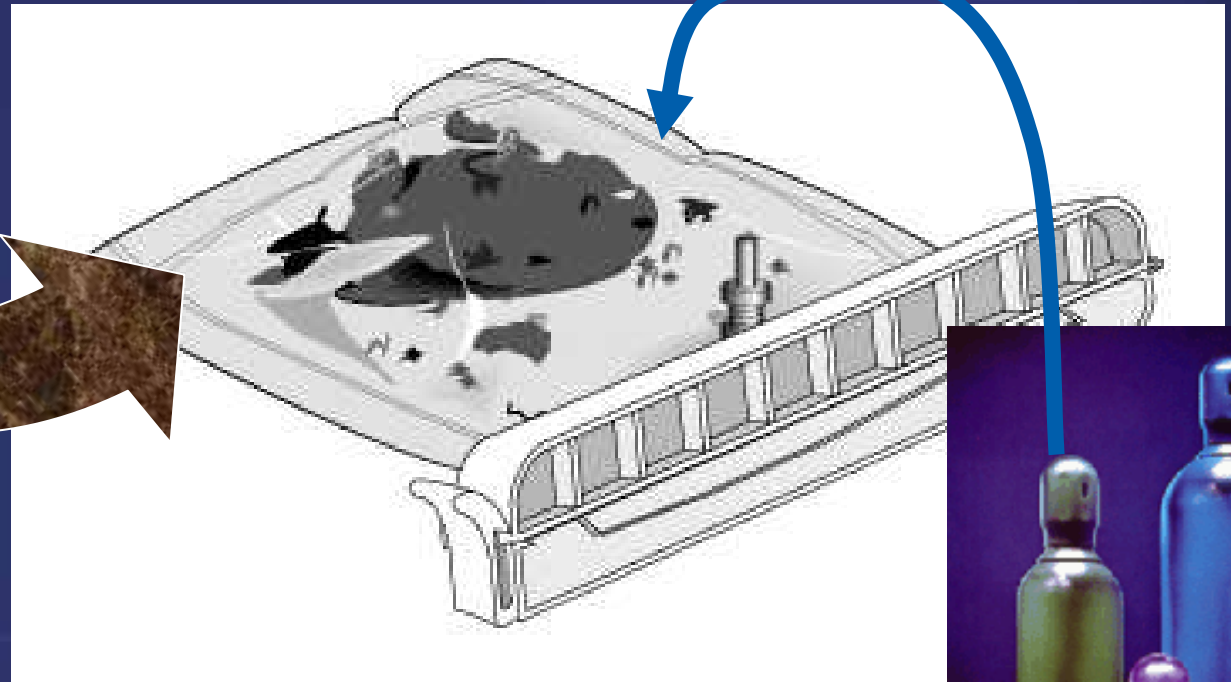
Flux chamber

- Linking physiological response to the chemical odorants that cause the problem









Headspace analysis

- Prepare Tedlar Bag
- Transfer Sample to Tedlar Bag



- Purge with Appropriate Gas
- Allow Time for equilibration of Headspace

Sampling summary

	Ambient	Flux Chamber	Headspace
Odor			
Odorants			

Two General Methods of Measuring Odors



*Olfactometry
(Odor Panel)*



Analytical

Methods of Odor Analysis



Gas sample for
Odor analysis

Sensory
Testing

Analytical
Testing

Odor
Intensity
(strength)

Odor
threshold
(detection)

Odor
quality
(descriptors)

Hedonic
Tone
(annoyance)

GC
analysis

GC/MS
analysis

individual
gas
sensors

Open
Path
FTIR

Olfactometry



Uses an odor panel to determine intensity of odor



Sample is introduced to trained panel members at different concentrations to determine the strength of the odor



Concentrations are estimated based on statistical analysis during the test



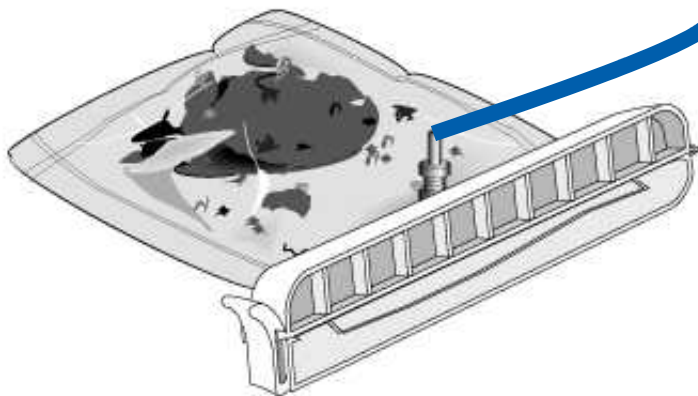
- <http://www.fredericksburg.com/Photo/Gallery/020304%20week>

- Connect sample to cryoconcentrator

- Cryoconcentrator feeds sample to GC

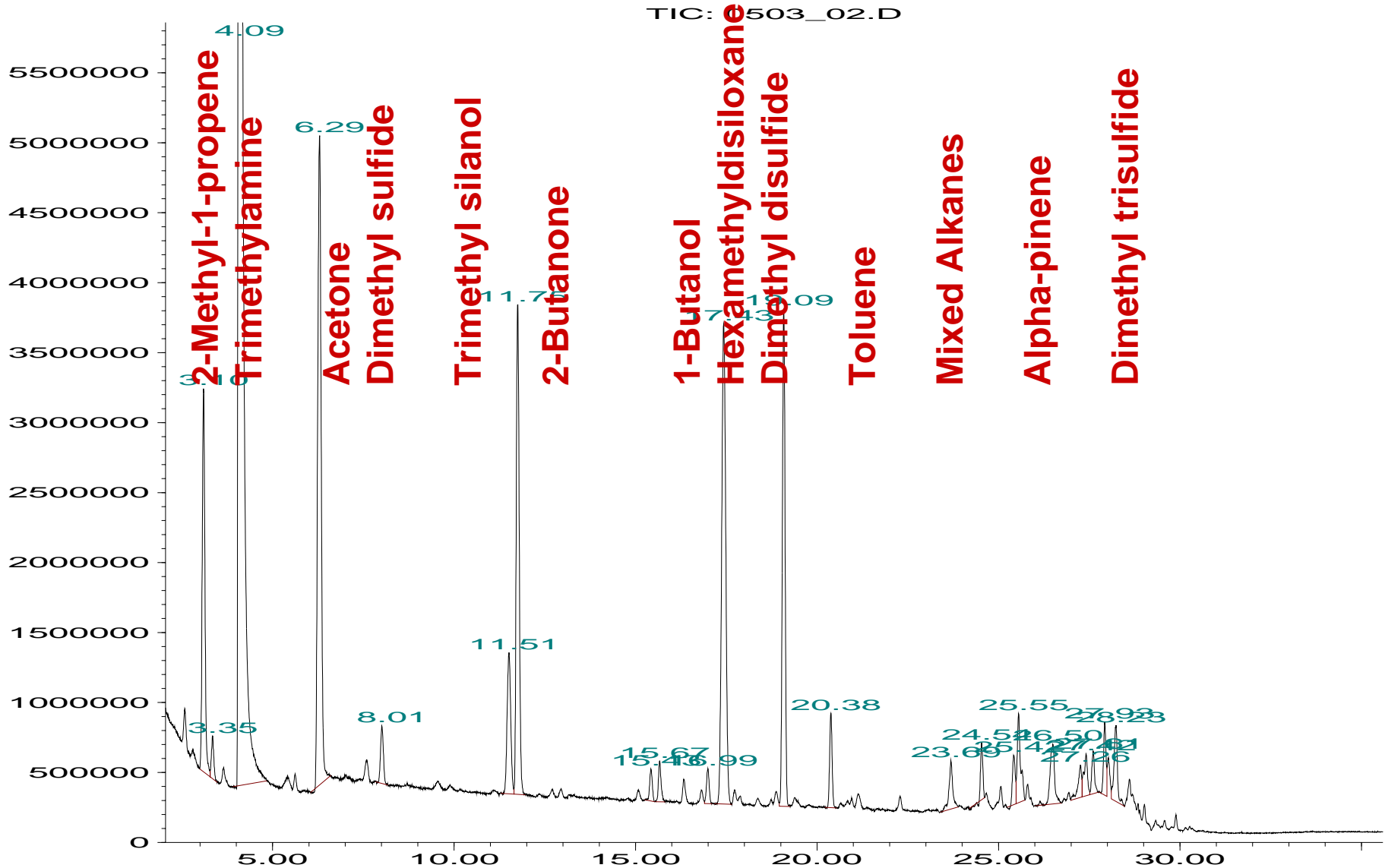
- GC separates compounds prior to analysis with Mass Spectrometer

Analytical Methods



Lime Treated Class A Windrowed Biosolids

Abundance



Odor Index Values (ODI)

- Relates analytical concentration to referenced physiological responses

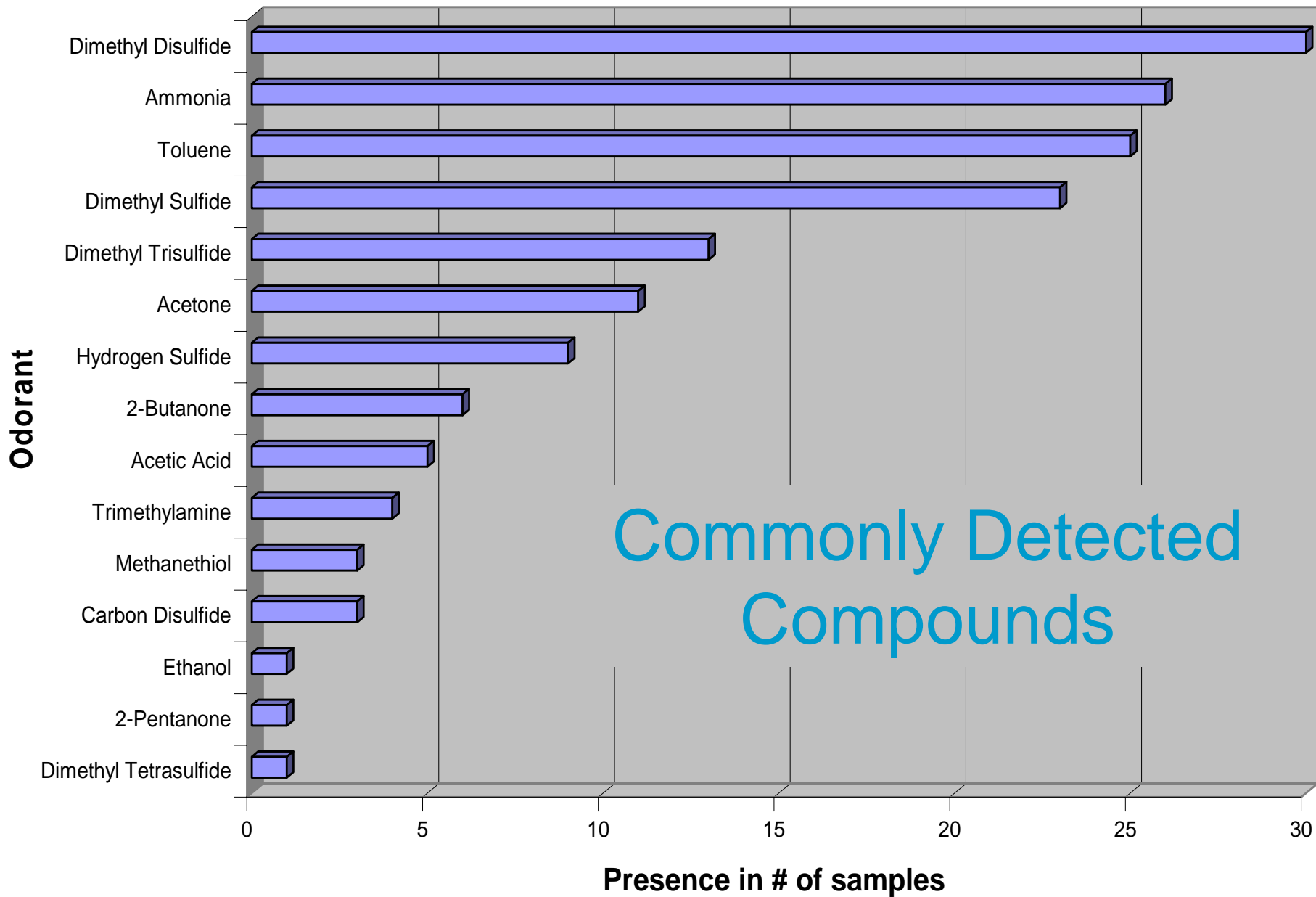
$$OdorIndex = \sum \frac{\text{odorant} - \text{concentration}}{\text{threshold} - \text{value}}$$

- Used as a relative indicator of odor intensity















Testing Protocol at Solids Handling Facilities

- Eight facilities in the Mid-Atlantic Region participated
- Represent a broad range of stabilization processes

Average Flow {MGD}	Wastewater Process	Stabilization Process	Pathogen Reduction	Vector Reduction
33	RBCs	Lime	B – A2 - Lime	O6 – pH adjustment
33	Aerated Activated Sludge	Lime	B – A2 - Lime	O6 – pH adjustment
0.65	Extended Aeration	Aerobic Digester	B – A1	O4 – SOUR Test
1	Oxidation Ditch	ATAD	A – A1- Heat	O5 – Time & Temp
<1	Extended Aeration	Chlorination or Lime	B – A1 - Lime	NA
	Extended Aeration	Anaerobic Digester	B – A1	O1 – VS Reduction
	Extended Aeration /Membrane Diffusion	Anaerobic Digester w/ humus addition	B – A1	Volatile Solids Reduction
	RBCs	In vessel composting	A – A5 - composting	O5 – Composting



Analytical Summary

	Odor Quality	Odor Quantity	Odorant Quantity	Modeling	Fence-line Odor	Process Management	Control
Olfactory Analysis							
Analytical Analysis							

Summary

- **Determine your objective**
 - Odors and/or odorants
- **Base sampling methods on objectives**
 - Odor Modeling
 - Process Evaluation
- **Determine the right level of analysis for your objective**
- **Apply experience to data interpretation**