Today's Discussion

- Discussed:
  - NEWS FLASH!! There are odors from your landfill that nearby residents are complaining and threatening a lawsuit
  - Sulfur and/or garbage odors in your Landfill Gas could impact your air permitting & compliance.
  - What are the sources of the odors – garbage, hurricane debris, landfill gas, incoming waste?
  - Where are the odors coming from and where are they headed? Odors can be detected in the ppb range.
  - What can be done to minimize the odors?

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Typical Landfill with Working Face

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What are the types of odors?

- Rotten egg?
- Garbage odor?
- A Gray Line between nuisance odor and health effect odors

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What is Odor?

- Odor is often caused by a mixture of chemical substances
- Perception based "contaminant"
  - Two odors can be completely different
  - What you smell is not what I smell
  - "If it smells bad, it must be unhealthy"
    - Who decides if it smells bad?
    - Bad smell does not necessarily mean it is unhealthy
- Complicated because of adaptation – our sensitivity drops with exposure

Quantifying Odor

- Because odor is **subjective**, based on presence of a combination of many compounds in the air, it cannot be measured using conventional units of concentration (ppm, $\mu g/m^3$)
- The "odor unit" was established as a reference measure based on the principle of "dilutions" and detection limits

Quantifying Odor (Cont.)

- "Odor units" are used as an attempt to objectively quantify odor concentrations
  - It is a dimensionless measure of odor strength developed on a principle of dilution thresholds (volume/volume)
  - 1 odor unit (OU) represents the dilution at which 50% of the normal population can begin to detect an odor

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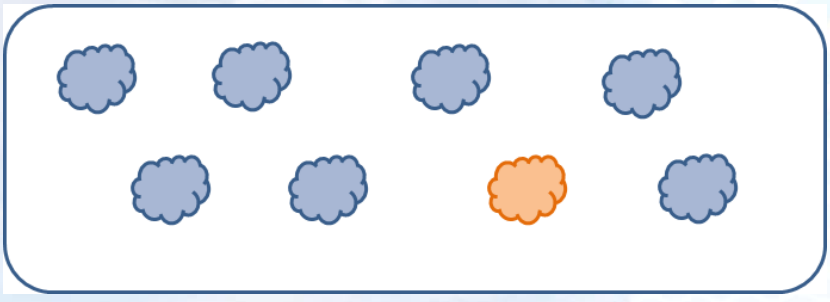
Visualizing 7 Odor Units (OU)



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8-Point Butanol Scale

N-Butanol Odor Intensity (ppm)

- 1 (12 ppm)
- 2 (24 ppm)
- 3 (48 ppm)
- 4 (96 ppm)
- 5 (194 ppm)
- 6 (388 ppm)
- 7 (775 ppm)
- 8 (1550 ppm)

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Methods for Determining Concentration of Odors at Receptors

- Surveillance in surrounding areas using Nasal Rangers or similar filtering devices
- Electronic Detectors
- Panel of Olfactory People
- Model Odor Units using EPA's AERMOD program

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Ways to Measure Odor

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Olfactory Assessors

- Be free of colds or physical conditions that may affect the sense of smell ;
- Not chew gum or eat at least 30 minutes prior to the odor panel;
- Refrain from eating spicy foods prior to the odor panel;
- Not wear perfume, cologne, or aftershave the day of the odor panel;
- Wear unscented deodorant the day of the odor panel;
- Avoid other fragrance cosmetics, soaps, etc. the day of the odor panel;
- Have their hands clean and free of odors the day of the odor panel;
- Have their clothes odor free the day of the odor panel;
- Keep the odor panel work confidential; and
- Not bias the other panelists with comments about the observed samples.

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State	Regulated Odor Limit
Colorado	7 OU/m^3 – Residential/Commercial 15 OU/m^3 – All other areas
Connecticut	7 OU/m^3; 3 samples in 1 hour
Illinois	8 OU/m^3 (scentometer scale); Residential
Kentucky	7 OU/m^3; 2 samples in 1 hour
Missouri	7 OU/m^3; 2 samples in 1 hour
Nevada	8 OU/m^3
North Dakota	7 OU/m^3 – Residential/near public receptor
Wyoming	7 OU/m^3; 2 samples in 1 hour

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Methods to Minimize Odors

- Minimize the working face with daily cover
- Designation of certain types of odorous waste
- Misting systems to spray deodorizers during certain time of day and wind direction and wind speed
- Application of agents (e.g., nutrients) onto the surface of the landfill
- Landfill gas collection and control system
- Maintenance of leachate and condensate system
- Landfill gas treatment

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Deodorizing Mist System

Odor Boss

Odorizing Misting System

Application of Odorizing Agent, such as Neutralizing Nutrients

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Typical Landfill Gas Well with Condensate Pump

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H2S Treatment of Landfill Gas

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For C&D Landfills without LFGCS

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Maintenance of Landfill

- Daily and Final Cover
- Leachate Pumps and Treatment
- Condensate Pumps
- Landfill Gas Collection System
- Removal of H2S or SO2 on Landfill gas

EPA on Fugitives

"…the use of collection technology by other landfill sources, whether or not subject to EPA's proposed requirements or to State implementation plan or permit requirements, creates a presumption that collection of the emissions is reasonable at other similar sources. If such a system can reasonably be designed to collect the landfill's gas emissions, then the emissions are not fugitive and should be considered in determining whether a major NSR permit is required."

---*John Seitz memo 1994 (Classification of Emissions from Landfills for NSR Applicability Purposes)*

This is significant (PSD)

- Carbon Monoxide: 100 TPY
- Nitrogen Oxides: 40 TPY
- Sulfur Dioxide: 40 TPY
- Particulate Matter: 25 TPY
- PM_{10}: 15 TPY
- $PM_{2.5}$: 10 TPY
- Ozone: 40 TPY (VOC or NOx)
- Pb: 0.6 TPY
- Fluorides: 3 TPY
- Sulfuric Acid Mist: 7 TPY
- Hydrogen Sulfide: 10 TPY
- Total Reduced Sulfur: 10 TPY
- Reduced Sulfur Compounds: 10 TPY
- Municipal Waste Combustor Organics: 3.5 E-6
- Municipal Solid Waste Landfill Emissions (NMOC): 50 TPY
- All Other NSR Pollutants: Any Emission Rate!!

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Why do I care about this?!

- NNSR Applicability
  - Lowest Achievable Emission Rate (LAER)
  - Compliance certification
  - Emission Reductions (Offsets)
  - Alternative Siting Analysis
- PSD Applicability
  - Best Available Control Technology
  - Source Impact Analysis
  - Additional Impacts Analysis
  - Evaluate Impact on Class I Areas

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Flare Emissions

Typical Flare Emissions		
	Open Flare	Enclosed Flare
PM2.5	11.17	11.17
PM10	11.17	11.17
SO2	64.46	64.46
NOx	45.21	39.89
VOC	3.44	2.63
CO	206.11	132.98
Notes:		
-Based on 5000 cfm of LFG (50% CH4) to Flare		
-Assumes 300 ppm Sulfur in LFG		

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The Sulfur Take Home…

- If BACT/LAER for SO2 (cost is considered for BACT)
  - Gas Treatment for Sulfur Removal?
  - SO2 Removal via scrubbing?
  - What is cost effective? <$20K/ton removed?
- If BACT for Sulfur Fugitives
  - Early installation of LFG Collectors (pre-NSPS)?
  - Increased Gas Collection Efficiency? How?

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The Sulfur Take Home (x2)

- PSD Applicability for SO2
  - Modeling of combustion emissions
    - This is not a "box checking" exercise
    - NAAQS issues could drive control (if BACT analysis did not)
- PSD Applicability for TRS/H2S
  - Modeling, Monitoring, Public Participation?
- NNSR Applicability for SO2
  - Offset Purchases
    - Availability could be major issue

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And you think that Stinks…!

- Formaldehyde emissions from LFG combusting engines and turbines are an agency focus nationwide
  - Can assume engines have approximately 0.4 g/bhp-hr of formaldehyde emissions (or higher)
  - A single CAT 3520 can potentially make the facility a major source of HAP (i.e., 10 TPY)
  - These formaldehyde emissions are VOC emissions!
  - Risk Based Modeling may yield unacceptable public risk at sensitive receptors
    - How close are engines to property line/receptors?

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CNN - May 13, 2019 Durian fruit stink prompts university evacuation

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Thank you!!

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