Odor Source Evaluation Against Offsite Impacts: Modeling and Carolina Case Studies

November 2017
Agenda

- Odor source types
- Odor emission projections
- Odor control goal setting
- Full-scale dispersion modeling
- Screening techniques
- North Carolina case studies
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Odor Source Types

- Point Source Examples:
  - Odor control units (scrubbers)
  - HVAC outputs of odorous buildings
  - Fugitive emissions
  - Characterized by a measurable velocity
  - Easiest to model
Odor Source Types

Area Sources

- Area Source Examples:
  - Liquid tanks or ponds
  - Piles of solid material
  - Emission rate calculation is challenging
  - Can be overstated in models
Odor Source Types

- Room emissions to atmosphere:
  - More significant than fugitive emissions
  - Inconsistent airflow rate
  - Emission rate calculation is complicated
  - Sometimes ignored in models

Volume Sources
Sometimes significant sources are ignored when odor control is installed...

Fugitive emissions can increase total odor emissions from the overall process area.

Treated air emissions may be very low.

Fugitive emissions due to poor foul air capture.

**BOTH** should be considered in an odor dispersion model.
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Two types of odor emission projections:

**Compound-Specific Emission Rate Calculations**

- Compound emissions rates are calculated in units of grams per second
- Modeled offsite odors are expressed in units of parts per million by volume (ppmv)

**Hydrogen Sulfide**

**Ammonia**
Two types of odor emission projections:

**Odor Emission Rate Calculations**

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>Detection Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Stack</td>
<td>10,000</td>
</tr>
<tr>
<td>10-Stack-Dup</td>
<td></td>
</tr>
<tr>
<td>1-Screens</td>
<td>2,300</td>
</tr>
</tbody>
</table>

- Odor emissions rates are estimated using source airflow rate and converting unitless odor values to concentrations (“g”/sec)
- Modeled offsite odors are expressed in odor units, also referred to as dilutions-to-threshold (D/T)
Advantages and disadvantages of methods of dispersion modeling

- Compound-specific modeling limits impacts to only one odorous compound:
  - Could be ok if that compound dominates the odor profile
  - Hydrogen sulfide in a raw wastewater pump station
  - Ammonia in a sludge storage lagoon

- Odor modeling input is only a measurement of how “detectable” an odor is as measured by an odor panel:
  - Not all odors are equally offensive
  - Some odorous compounds can be detected at much lower concentrations than others
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Boundary setting (literally...)

- Goal setting
  - Determination of property fenceline
  - Consideration of uninhabited “green space”
  - Identify model area (standard or expanded)
  - Identify odor threshold
  - Identify exceedence threshold

**Example:** plant emissions shall not exceed 10 D/T beyond the fenceline for more than 1% of the year
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AERMOD is the EPA accepted dispersion model

- **Source Inputs**
  - Airflow rate
  - Stack dimensions (if applicable)
  - Odor units (D/T) or compound concentration
  - Source area (if applicable)
  - Building volume (if applicable)
  - Meteorological files
  - Terrain and building data

- **Model Outputs**
  - Offsite odor contours
  - Fenceline source impacts
AERMOD is the EPA accepted dispersion model

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- **Model Outputs**
  - Offsite odor contours
  - Fenceline source impacts
What makes odor contour outputs different?

Wind Rose

Buildings
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Reality Check #1: Emissions and Impact

- Strong odor source
- High localized impacts
- Source may not need to be modeled
  - Small source
  - Distance to receptor
- Proof: Screening Models
  - SCREEN3
  - AERSCREEN
Reality Check #2: Source Size Impacts

**Issues**

- Emissions high dependence on surface area
- Difficult to input an accurate source air velocity

1% Odor Contour (1999)

1% Odor Contour (2004)
Reality Check #3: Source Odor Compounds

• Based only on OU and surface area, aeration basins had large impact

• Scrubber contributing odor compounds:
  • Hydrogen sulfide (ppmv)
  • Organic sulfides (ppmv)

• Aeration basins contributing odor compounds:
  • Hydrogen sulfide (low ppbv)
  • Organic sulfides (low ppbv)

**Lesson Learned:** moderate to high OU does not necessarily link to offensiveness
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North Carolina Case Studies
Odor Source Evaluations for Offsite Impacts: Dispersion Model Applications
North Carolina: Case Study #1
Somewhere west of here...

Potential Concern: there are a LOT of secondary clarifiers...

- Screening models may show:
  - Low OU
  - High surface area
  - Still minimal offsite impacts

- As a result, can eliminate from model
North Carolina: Case Study #2
Somewhere southwest of here...

- Screening models may show:
  - High OU
  - Fugitive emissions
  - Still minimal offsite impacts due to distance to receptor

- Consider **need** for dispersion model to predict offsite impacts

**Potential Concern:** this decision would disregard onsite odor impacts to staff
North Carolina: Case Study #3

Somewhere close to here...

- Source is raw wastewater overflow
  - High OU, very large area
  - Intermittent source
- Public outcry over this source odors; area development
- O&M staff are not in entire agreement on offsite impacts
- Full AERMOD model needed:
  - Cannot disregard a source of public complaints
  - Challenge incorporating intermittent nature of source

Potential Concern: large area sources extend model run time