Implementing Vapor Phase Odor Control on Large Diameter Interceptor Systems

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Overview

- Collection System Odor Control
- Ventilation Dynamics
- Fan Testing
- Govalle Tunnel Case Study
- Conclusions
Collection System Odor Control

- Inorganic Odor Compounds & VOCs
- Design Parameters Influence Odor Emissions
  - Anaerobic Conditions, Turbulence, Ventilation Dynamics
- Liquid Phase Treatment
- Vapor Phase Treatment
Vapor Phase Odor Control in Collection Systems

- **Variety of Technologies**
  - Physical, Chemical, and Biological

- **Advantages**
  - Treat Areas of Chronic Odor Emissions
  - Treats H₂S and Sewer Pressurization

- **Disadvantages**
  - Sizing Based on Ventilation Dynamics
  - Increased Footprint
Ventilation Analysis

- Determine location and magnitude of ventilation & odor emissions
- Model Ventilation Dynamics
  - Calculate the capacity for airflow due to friction drag
- Identify Sources of Pressurization
  - Recommend effective odor control solutions and/or reasonable design changes
Ventilation Dynamics

- Sewers Convey Airflow
- Airflow Causes Headspace Pressurization
  - Results in odor release
- Friction Drag is Primary Motive Force
  - Basis of Empirical Models
Sewer Pressurization

- Headspace has a limited capacity for airflow
- Changes in slope, hydraulic restrictions impede natural airflow
- Pressurization results when the capacity for airflow is reduced
Dropshaft Eduction

- Friction drag due to acceleration of falling wastewater
- Formation of droplets increases surface area
- Additional airflow forced into tunnel
  - “Eduction”
Ventilation Modeling

- Estimates natural ventilation dynamics in open channel flow (gravity sewers)
  - Inputs include pipe size, shape, slope, and wastewater flow
- Assumes primary motive force is friction between headspace air and the moving wastewater
- Identify hydraulic condition at which worst case airflow is predicted to occur
Eduction Calculations

- $V_{\text{Drop}} \leq 26 \text{ fps}$
- Air/Water Ratio
  - $A/W = 1 - A_{\text{WW}}/A_{\text{Shaft}}$
- Eduction Factor
  - $1 @ A/W = 0.5$
  - $0 @ A/W = 1.0 \& 0.0$
- $Q = V_{\text{Drop}} \times EF \times A/W \times A_{\text{Shaft}}$
Fan Testing

- Air extracted at potential OCF site
  - Varying airflow to determine optimum capacity
- Pressure monitoring before, during, and after test
- Data provides basis to determine the zone of influence the OCF will have
Pressure Monitoring

- Pressure differential between sewer headspace and atmosphere
- Differential pressure reflects sewer ventilation dynamics
- Monitors record pressure in the range of +/- 2.0 inH2O
Instrumentation
Govalle Tunnel (GVT)

- 96” Diameter Tunnel in Austin, TX
  - 8.5 Miles in Length
  - Surcharged due to influent LS operating levels.
- Five Dropshafts
  - Monitoring Conducted at each shaft
- Two Fan Tests
  - Montopolis Shaft
  - Canterbury Shaft
Methodology

- Two 12,500 cfm Fans @ 8” S.P.
  - Speed controlled using VFDs
- Testing Conducted at Four Speeds
  - Varied every 30 minutes to 1 hour
  - 50% - 100% Speed
- Airflow Measured Using Hotwire Anemometer
Fan Test Setup
Govalle Tunnel Fan Test

![Graph showing differential pressure (in. WC) over time for different elevations and speeds.]

- Canterbury
- Montopolis
- Lockheed
- Highway
- Bergstrom
- Low Speed
- Mid Speed
- High Speed
- Full Speed
- Fans Off
- LS2 Elevation†
<table>
<thead>
<tr>
<th>Fan Speed</th>
<th>Average Airflow (cfm)</th>
<th>Pressure (inH2O) @ Canterbury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Montopolis</td>
<td>Lockheed*</td>
</tr>
<tr>
<td>Low</td>
<td>16611</td>
<td>15971</td>
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<tr>
<td>Mid</td>
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<td>22888</td>
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<td>27728</td>
</tr>
<tr>
<td>Full</td>
<td>32515</td>
<td>30836</td>
</tr>
</tbody>
</table>
Do the math…

- Required Airflow = 34,000 cfm
  - GVT Friction Drag Airflow = 3,000 cfm
  - Surface Sewer Airflow = 5,500 cfm

- $34,000 - 3,000 = 31,000$ cfm
- $34,000 - 2 \times 3,000 = 28,000$ cfm
- $34,000 - 3,000 - 5,500 = 25,500$ cfm
Dropshaft Design
Recommendations

- 40,000 cfm Centralized OCF
  - Majority attributed to dropshaft eduction
- Dropshaft Modifications
- Wet Well Operating Conditions
GVT Biofilter Design

BIOFILTER SECTION

SCALE: 1"=10'=0"
GVT Construction
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QUESTIONS?