Soil Gas Sampling for Natural Gas Pipeline Releases from Condensate Drips

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Investigation of Condensate Drips

- Thousands of drips in natural gas field
- Spread over more than 1,000 square miles
- Possible preferential failure at drips
- Field under vacuum – leak detection more difficult
- Planned on excavating drips to inspect for failures
Natural Gas Pipeline Condensate

- Forms as a result of natural gas extraction/compression
- Liquid removed periodically
- Surface and subsurface releases observed
- Subsurface release hard to detect
Natural Gas Pipeline Condensate

- API Gravity: 65
- SP Gravity: 0.72
- Benzene: 0.2 %
- Toluene: 0.9 %
- Ethylbenzene: 0.2%
- Xylenes: 1.4%
- Paraffins: 30%
- Isoparaffins: 32%
- Naphthenics: 31%
- Aromatics: 5%
- Olefins: 0.5%
Failure Concerns

- **Environmental Concerns (original concern)**
  - Soil, Groundwater, Surface Water, Ecologic impacts

- **H&S Concerns**
  - Employee exposure
  - Physical damage/fire

- **Operational Concerns**
  - Elevated oxygen concentrations (on vacuum lines)
  - Preferential corrosion (increased oxygen)
  - Well shut in for line failures

- **Economic Concerns**
  - Lost revenue
  - Cleanup costs
  - Public relations concerns
Original Investigation Strategy

- Landowner Contact/Compensation
- Utility Locate
- Drip Excavation
- Soil Sampling
- Backfill & Restoration
- Sample Analysis
- Reporting

- Approximately one man-day per site
Original Implementation Costs

- Utility Locate: $50/drip
- Investigation (excavation/restoration): $650/drip
- Soil Analytical: $250/drip
- Landowner: $250/drip
- Management: $50/drip
- Reporting: $100/drip
- Estimated Cost per Drip: $1,350/drip
THE AGI SGM Module

- Universal – sample soil gas, air, sediment and groundwater
- > 50 Presentations and published papers
- >4,000 surveys worldwide
- Federal, state regulator acceptance/international acceptance

Note: GORE Survey and GORE Modules were acquired by Amplified Geochemical Imaging, LLC. in May 2013
Successful Grid Application
AGI Soil Gas Survey
Revised Investigation Strategy

- Use Passive SGMs
  - Avoid landholder issues, utility locates, excavation, and site restoration
- Install SGMs at 10% of sites per year
- One SGM per drip, 18-inch burial depth, 3 days
- Innovative data management
- Analyze for BTEX, C_4-C_8, and C_9-C_14 alkanes
- Soil sampling for chlorides (brine release)
- Compare data to select soil sampling results to develop correlation
AGI Soil Gas Module Deployment

- Rapid, unobtrusive
- Use of hand tools
- 1.5 foot install depth
- 5-15 minutes to place
- 3 day exposure time
- 20-40 placed per day
- iPad App created for data collection and management
  - SGM Placement Data
  - Physical Site Data
  - Soil Sampling Data
  - Photographs
  - GPS Coordinates
  - Real-time Project Progress
  - Auto Report Generation

- 450,000 data points/60,000 photographs
SGM Analytical Results
Indicative of Condensate

Non-Detect

Detection
SGM Analytical Results Indicative of Lube Oil Non-Detect Detection
Conducted during first year only

Soil sampled at 71 drips

- 58 drip line sites based on high petroleum constituents (above 85th percentile in TPH concentration)
- 13 drip line sites that were non-detect for petroleum constituents were sampled to ensure no false negatives

Benzene determined to be driver/indication of release

False negatives/positives not observed
Year 1 SGM Results
Soil Sampling Sites in Red

TPH, µg

Likely Release

Surface Release?

Non-Detect

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Year 1 & 2 Results

- Total TPH sites investigated: 1150
- Total Chloride sites investigated: 377
- Sites with TPH detections: 928
- Sites with Chloride exceedances: 8 (2%)
- Sites recommended for investigation: 23 (2%)

Failure identified before release!
Field 1 Investigation Locations

Spatial Trend?
Field 2 Investigation Locations

Spatial Trend?
Actual Implementation Costs

- Utility Locate: $0/drip
- SGM Placement/Removal: $125/drip
- SGM Analytical (plus QA/QC): $250/drip
- Landowner: $0/drip
- Management: $25/drip
- Reporting: $50/drip
- Actual Cost per Drip: $450/drip
Cost Savings

- Original Program Cost: $8,100,000
- Revised Program Cost: $2,700,000
  - Cost Savings per Drip: $900
  - Total Project Savings: $5,400,000

- Reduction of ~3,500 man-hours per year
Summary and Conclusions

- **PSG process:**
  - Simple and easily implemented
  - Avoids landowner involvement, utility locates, excavation and site restoration
  - Effective at identifying drip failures
  - Useful at differentiating condensate from lube oils
  - Accurate predictor of line failures
  - Reduced investigation costs by 67%
- **Most releases small (<500 yd³)**
- **One large cleanup (>25,000 yd³)**
Questions

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