Fundamentals of Odorization and Odor Level Testing

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Presented at NGA 2007
Course Objective

- To prepare the NGA student for any and all odorant questions received on the NGA Jeopardy Challenge.
- To give student basic understanding of odorant systems and odor level testing needed for Operator Qualification.
Topics

- History of odorization
- Types of chemicals
- Types of odorizers
- Installation of systems
- Codes & standards
- Odorant level testing
- Special equipment
- A complete program
Why Odorize & Monitor Odor Levels?

- Public Safety
- Code Required (49 CFR 192.625)
- Company Liability
How Did Odorization Begin?

- New London, TX School Disaster
- March 18, 1937
- Killed 237 Students & Teachers
- Worst school disaster ever
- Due to unodorized gas
New London School Disaster

- The aftermath
What was done?

- Chemicals were developed to act as warning agent and fulfill developing codes.

- Laws requiring odorization were adopted.

- Odorization sampling was required by code.
Chemicals Developed for Odorization

- Odorous chemicals were determined as best warning agents in government studies.
- Of over 6,000,000 known compounds, only less than 25 chemicals meet the requirements of code and have good olfactory strength!!!!!!
- Relatively non-toxic, chemically similar to rubbing alcohol
Chemicals Developed for Odorization

- Most Common:
  - Tertiary Butyl Mercaptan (See Guinness)
  - Isopropyl Mercaptan (good antifreeze for blends.)
  - Thiophane (THT)
  - Normal Propyl Mercaptan
  - Dimethyl Sulfide
  - Ethyl Mercaptan (almost exclusive to LP)
Guinness Book of World Records

- Lists Tertiary Butyl Mercaptan as Strongest Smelling Substance in the world
- Smells like garlic, rotten eggs, and cabbage (yum!)
- Know the odor of gas
- It’s not hydrates !!!
Odorant Suppliers

- Natural Gas Odorizing (800) 874-7249
  Out of business

- Chevron/Phillips Chemical (800) 858-4327
  – playing the price gouging game!!!

- Elf/ Atofina (201) 307-1135 distributed by Odor Tech in U.S. – Tommy Tucker
Methods of Delivery & Transfer

- Bulk transfer
- Cheapest
- Safest
- Requires a minimum 1500 gallon total purchase
- Pool with other users
Methods of Delivery & Transfer

- Drums
- Moderately expensive
- Not pressure vessels!!
- Potentially odorous
- Disposal problems
- Only 55 gallons can be handled at a time
- May need flare
Methods of Delivery & Transfer

- D.O.T. Cylinders
- Great for low volume usage
- Most Expensive
- Transportation and demurrage costs
- Handling considerations
- May need flare
Flare

- Utilized to remove saturated vapors w/o odors
- Pilot source
- Crack in vapors into pilot
- Ensure gas free area and proper pressure regulation
Other Venting Methods

- Vapor compressor – bulk tanker
- Flare – cylinder transfer
- Scrubber - minimal
- Bleach solution – beware of vapors
- Atmosphere – use extreme caution
Stationary Tanks

- Six basic functions
- Level (80-95% max)
- Vapor return
- Liquid fill
- Pressurize
- Liquid to odorizer
- Pressure relief (ASME)
- Containment
- Labelling
Stationary Mounted D.O.T. & ASME Cylinders

- 120 Gallon Capacity
- 250 PSI Rating
- Transfer from suppliers 57 or 120 gallon cylinders
- 7 year retest on D.O.T.
- No transport of ASME
Vertical ASME Tanks

- Good for area with small amount of real estate
- Be wary of bottom & side penetrations
- Level indication expensive
- Site glass – point of failure
Horizontally Configured Tanks

- Preferred method of storage
- Common, relatively inexpensive construction
- No bottom penetrations
Placarding

- Required by NFPA
- Health, flammability, and reactivity
- Post on tank, door, and fence.
- Must be visible from road
- DOT covers portable
- UN # Recommended
Types of Odorizers

- Wick (for single services)
- Pitot Tube (generally single services)
- Bypass
- Pulse Bypass
- Bourdon Tube
- Pneumatically driven pump
- Electrically driven pump
- Electronic system
- Motorized drip systems
Wick & Pitot Tube Odorizer

- For single services
- Usually used on farm taps
- Spun cylinder filled with odorant
- Wick or pitot tube allows vaporization into gas stream
Meter Driven Bypass Odorizer

- First by Peerless in 1938 after New London, TX
- Utilized gas meter and differential pressure
- Operated at line pressure
- Continual adjustment
Bourdon Tube Odorizer

- Utilized magnetic relay tied to Bourdon tube.
- Length of deflection controlled by micrometer
- Flow controlled by P/I
- Lots of parts!!!
Early Pneumatic Pumps

- Simple design
- Double check principle
- Direct plunger into odorant
- Seal failure created odorant leakage to air
- Not a system!!!!
Early Mechanical Odorizer

- Mechanized pumps
- Threaded fittings – odorous
- No SCADA integration
- Continual manual adjustment
1980’s Pneumatic Odorizer

- Diaphragm isolated
- Pneumatically actuated
- Used gear/piston meter
- Full SCADA integration difficult
- Odorous maintenance
Modern Odorant Injector

- Closed loop purge and prime
- Integral controller
- Diaphragm isolated pump
- Verifying meter
- SCADA integration
The New Kid On the Block

- Z-9000 by Zeck Systems
- Introduced in 2003
- Simplified approach to odorization
- Good for flows from 5 MCFH to 1500 MCFH at 0.5 LBS/MMCF
Simple construction includes:
- Inlet valve
- Motorized 20 turn needle valve
- Optical array to measure size and frequency of drip
- Tank needs to be over line pressure
- Bristol CW Micro Controller
Shipping and containing soiled odorant materials

- Pelican Cases are air tight
- Approved for airline travel with proper placarding
- Make sure to keep o-ring clean, and vacuum valve tight
Connecting & Containing Odorant Equipment

- Utilize quality stainless steel materials
- Compression fittings
- Proper valve compatibility
- Weld fittings
- Machined threads
- Teflon paste and tape
Compression Fitting

- Swagelok the “Best” Compression Fitting
- Double ferrule fitting
- Follow proper makeup
- Follow proper remake
- Cut, clean and debur tubing properly
Tubing

- Utilize 316 Stainless
- Seamless
- Bright
- Annealed
- 0.035” Wall
- Conforming to ASTM A269
Valves

- Ensure Viton B, Teflon or Kal-Raz Elastomers
- Whitey Series 60
- Solid three piece design
- Great compatibility and function
- Expensive
Weld Fittings

- Welding eliminates all chance of leakage
- Use orbital or socket
- Ensure similar grades of S.S. from tubing to fittings
- Leave breakpoints
- Ensure proper procedures and quals
Threaded Connections

- Minimize
- Usually source of leak
- Don’t provide perfect mechanical repeatability
- Utilized Cajon or similar machined thread
Thread Sealant

- Teflon (PTFE) is most resistive
- Utilize Virgin (PTFE)
- Make a tape and paste sandwich
- SWAK is preferred past
- Strip Teeze is preferred tape
Alternate Fittings

- VCO and VCR
- Utilize a replaceable O-ring or metal gasket as a seal
- Usually welded in
- More expensive than compression
- Last almost indefinitely
Proper Tool for The Job

- Stainless Cutter
- Bender
- Deburring Tool
- Gauge tool
- Tee Wrench
- Brackets
- Combination Wrenches or Ratchets
Always Leak Test

- Soap – Really Cool Snoop by Swagelok
- Helium leak detector
- Die penetrant for welds
- Gas test
- MSA Mercaptan monitor
Neutralizers and Masking Agents

- Four Major Types
- Bacteria
- Mask (petroleum based)
- Mask (water based)
- Oxidizer
Bacteria

- Trade Name LAB 236
- Liquid Alive
  Bacteria, Natural Solutions
- Bacteria
  “Digests” mercpatan
- Pleasant smell
- Takes a long time
Petroleum Based Masks

- NI-712 by Neutron Industries
- Strong olfactory power
- Orange, Apple, Mint
- Expensive
- Flammable (good and bad)
Water Based Masks

- NI-712 Neutron Industries
- Spice, Bahama, Breeze, Lemon
- Freezes in winter (add methanol)
- Non-flammable
- Not as strong or expensive as petrol
Oxidizers

- NaOCl – bleach is most common
- Breaks down mercaptan molecules fully (& everything)
- Toxic fumes
- Do not use on liquid odorant
- Do not use over 7.5%
Removing Old Equipment

- Chemical oxidation works best on site.
- Thermal oxidation off site is cleanest.
- Call the folks at Material Resource Recovery (MRR) – they are the experts
- (800) 224-6812.
Personal Protective Equipment (PPE)

- Safety glasses
- Rubber gloves
- Fire extinguisher when flaring
- Respirator when neutralizing
- Rags
- Neutralizers
- Soap – leak check!!!
Codes and Standards

- 49 CFR 192.625
- ASTM D.03
- State Codes
  - Approx 31 states have their own.
  - Most follow D.O.T.
  - MA and NY far more stringent
  - COMPANY O&M!!!
What does the code say?
49 CFR 192.625

- All gas in distribution system (and classified trans.) must be readily detectable at 1/5th L.E.L. = 1.0 % Gas/ Air (MA = 0.15 %, NY = 0.5 % !!!)
- Must not be toxic
- Must not be deleterious to pipe
- Must be consumed in combustion
- Must not be greatly soluble in water
- Must be introduced in proportion to gas flow
- Must be sampled PERIODICALLY!!!!
- Performance driven language!!!!!!!!!
Mass vs. DOT

- 7 Times stronger
- 1% vs. 0.15% Gas/Air
How Do We Comply?

- Unique – all transmission gas in New England Odorized
- Lots of Class 3 & 4
- Additional odorant injected 0.25 – 1.0 lb/MMCF
- Odor level testing
So Just How Much is 0.5LBS./ MMCF?

- 19,894 ft of 8” pipe at low pressure
- 3,979 ft of 8” pipe at 60 psi

VERSUS

One Dunkin Donuts large of odorant
ASTM Gaseous Fuel Standard

- Procedurally written
- Annual Calibrations
- Follow manuf. Inst.
- Locations for testing
- Take threshold and distinct readings
- Operator common sense (eating, gum, smoking, rest, etc.)
Company O&M – Specific Language

- Determine frequency
- Determine who tests
- Determine locations
- Determine calibration period
- Determine training re: Spell out test procedures
- Post accident/incident
WHATEVER YOU SAY
YOU’RE GOING TO DO IN
YOUR O&M......
YOU BETTER DO IT!!!!!

- Don’t be excessive
- Must meet minimum code requirements
- Look at standards and best industry practices
- Use schools as forums to learn from your neighbors!!!!
- Don’t drop the ball!!!
Testing

- Whether you odorize or not you are required to test in distribution.
- Olfactory testing is the only code recognized test procedure.
- Chromatographs and analyzers are good indicators only!!!
Early Years of Testing

- Texas Railroad Commission Test
  - Utilized controlled volume room
  - Introduced measured effluent into room and plotted vs. time
  - Occupants noted changes in odor and recorded time noted
  - Calculated volume of gas required to smell
  - Not portable, expensive, not practical
Early Portable Field Testers

- Original by Ordorgraph
- Next unit by Oronite sold to J&W
- Currently manufactured by Bacharach with several improvements
- Currently 3 players
Portable Field Tester – Theory of Operation

- Regulated gas source
  4 psi max!!!!
- Precision valve
- Flow meter
- Air from constant speed fan
- Mixing chamber
- Sniff chamber
- Readout

Test in Process

Diagram:
- Gas Inlet
- Flow Valve
- Flow Sensor
- Fan/Mixing Chamber
- Sniff Chamber
- Air Inlet
- Air
- (opening)
Bacharach - advantages

- Simple, rugged construction
- Easy to use
- Few moving parts
- Strong effluent
- Accurate over wide range
Bacharach - disadvantages

- Older AC and variable DC models
- Individual calibration curves required
- Inconsistency in valve operation
- Operator can see reading during test
Heath Odorator – Advantages

- First electronic unit
- Quality regulating valve
- Operator can’t see reading during test
- Regulating fan
- Long battery life
Heath Odorator - Disadvantages

- Difficult to utilize accurately in lower thresholds.
- Requires unit sensitive conversion chart.
- Tipping unit effects fan rotors.
YZ DTEX Odor Level Tester - Advantages

- Solid state electronics
- Rugged case, long lasting battery
- Test is computer controlled
- Results seen AFTER test is completed
- Computer interface
YZ DTEX - Disadvantages

- Level of skill needed to program and operate
- Must focus on training
YZ Reporting Software

- Electronically captures all information
- Sorts by all categories
- Prints trend graphs
- Simplifies reporting
Quality Odor Level Test
Procedures

- Follow ASTM and Manufacturers’ standards and procedures
- Don’t exceed 4 psi at sample point – regulate.
- Allow for purging hose without deadening senses (consider Bunsen Burner.)
- Define operators behavior – eating, drinking other than water,) gum, tobacco, etc.
- Define sufficient rest period to prevent olfactory fatigue.
- Take Threshold and Distinct Readings
Quality Odor Level Test Procedures - continued

- Define avoiding and noting extraneous odors. Establish “Red Flag” procedure.
- Note day, date, time and serial number of test unit on results – adds credibility.
- Define test locations, and frequency.
- Establish post accident/ incident procedure.
- Define training and calibration schedule
- Define the extras !!!!! BE PROGRESSIVE
Red Flag Procedure

- You can’t smell gas
- Check source connection
- Check operation of machine
- Have another, “Nose,” try.
- Try another machine
- Notify supervision
Utilize Quality Hose

- Utilize hose material that won’t readily trap odors (NO RUBBER):
- Teflon lined stainless
- Tygon - least expensive, good resistance to odor
- Smell hose before each test – replace !!
Test Locations

- Free from wind and drafts (prefer indoors)
- Accessible 24 hrs (post accident/ incident)
- Free of extraneous odors
- Provides for easy connection
- Connected to flowing source
- System extremities
Order of Preference

- Fire stations
- Police Stations
- Gas Co. Facilities
- Municipal Buildings
- Schools
- Churches
- Store 24
- Chart box, meter set
Test Location

- Try to establish at extremities of system.
- Make sure all feeds are sampled.
- Try to sample in every city and town in distribution system(s.)
Test Connections

- Swagelok
- Quick Connect
- Pete’s Plug
- Hose barb
- Burner Spud - stove top is great place for fresh sample – beware of odors and heat!!
Ideal Test Connection Locations

Sample from a leg that isn’t stale
- Burner spud – no cost
- Valve on water heater drip leg – always on
- Connection on other continuously running appliance
- Meter set area
Continually Train

- At least annually (state in O&M and follow.)
- Provide 3rd party input and documentation.
- Reinforce techniques continuously
- Supervisory checks
- Olfactory qualification using Sensonics – scratch and sniff for gas utilities
Test Your Supplier Prior to Adding Odorant

- You may already be in compliance.
- You still are responsible for odorant levels (unless tariff dictates.)
- Bolsters record keeping
- Gate Station sampling
Utilize Shift Workers

- Adds to pool of users
- Free test every shift = up to 26,280 tests/yr.
- Permanently mount older tester in control room or dispatch area
- Don’t forget to train and calibrate!!!
Conduct Intensity Rating

- Conduct with customer service and distribution personnel
- No equipment needed
- Sniff and rate gas odor once every day and document
- Notify gas supply if gas doesn’t smell right
Other Testing Devices

Use to bolster your program – do not replace olfactory testing (code and masking and fading issues: )
- Stain tubes
- Sulfur sensitive chromatographs
- Lead acetate tape
- Mercaptan Analyzers
- Sulfur titrators
Masking and Fading

- **Masking** – another chemical counteracts the odorant (odorant is all there – you just can’t smell it.)

- **Fading** – odor quantity in pipeline diminishes (odor strength diminishes) after injection due to adsorption to pipe wall and/or contaminants.
REAL LIFE EXAMPLE OF MASKING AND FADING IN NEW YORK STATE

Local Production Wells with No Odorant

Odorizer

1.0 #

Gate Station

River

District Regulator Station

Chromatograph

0.98 #

SCADA

NO ODOR!!!!!!

School w/ new boiler
Electronic - Artificial Nose

- Developed by NASA.
- Utilized on space shuttle mission to detect warning agents.
- Differentiates up to 25 items, & rates intensity.
- www.jpl.nasa.gov/pictures/tech/enose
Work With Local Officials

- Fire departments can be instrumental in providing test locations.
- Make them aware of what you do and why during annual training.
Educate the Public

- General Gas Safety
- Tell the public what gas smells like
- Scratch and sniffs
- Document mailout
Summary

- We have the public’s safety in our hand.
- Develop procedures and policies that have common sense, creativity, and can be achieved.
- Follow 49 CFR 192.625, ASTM D.03, State Codes, and Company O&M.
- Continually train and monitor.
- Be innovative.
When in Boston visit La Dolce Vita.
In the North End on the Freedom Trail.
Try the stuffed veal.
Tell Chef/Owner Franco the, “Gas Guys,” sent you.
Thank You For Your Attention