Ammonia Sensor Overview

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Purpose of Sensors

- Personnel protection
  - Why?
    - 300 ppm IDLH
- Property protection
  - Why?
    - Ammonia is flammable between 16-25%† by volume

† 160,000-250,000 ppm

Common Sensor Types

- Electrochemical
  - Up to 1,000 ppm
  - Primarily for toxic ranges

- Solid-state
  - Up to 1-2%† by volume
  - Either toxic or combustible ranges
- Infrared
  - Up to 1-2%† by volume
  - Primarily for combustible ranges

† 10,000-20,000 ppm

Sensor Comparison

Electrochemical

- Strengths
  - Toxic gas monitoring (<1,000 ppm)
- Weaknesses
  - Shorter sensor life
  - Calibration frequency
  - Decreased sensitivity over time

Solid-state

- Strengths
  - Higher concentration ranges (>1,000 ppm)
  - Longer sensor life
- Weaknesses
  - Cross-sensitivity
  - High LOD

Specifications Comparison

	Electrochemical	Solid-state	Infrared
Temperature:	-40 to 150ºF	-40 to 150ºF	40 to 112ºF
Humidity:	5 - 95% (NC†)	0 - 95% (NC†)	0 - 90% (NC†)
Range:	0-500 ppm	300-10,000 ppm	0-20,000 ppm (0-2%)
Accuracy:	+/-5% of full scale	+/-3% of full scale	+/-5% of full scale
Response time:	<30 seconds	<30 seconds	<90 seconds
Cross-sensitivity:	H_2S	Solvents, other reducing gases	-
Calibration frequency:	1-3 months	6-12 months	6 months
Sensor life:	1-3 years	5-10 years	8-10 years

† Non-condensing

Method of Gas Sampling

- Diffusion
  - Most common
  - Each point requires a sensor
- Extraction
  - Requires tubing and sampling pump
  - Can use a single sensor to monitor multiple points
  - Condensation/moisture management is an issue.

Ammonia Sensor Market

- A Growing market ...
  - Applications
    - Refrigerated spaces
    - Production spaces
    - Relief valve piping
  - Functionality
    - Personnel protection
    - Emergency equipment shutdown control
    - Machinery room ventilation control
    - Safety relief monitoring

Emerging Technologies

- Emerging sensor types
  - Capacitive
  - Hybrid chemisorption (solid-state)
  - Pellistor (catalytic bead)

Specifications Comparison

	Capacitive	Hybrid Solid-state
Temperature:	-40 to 150ºF	-31 to 100ºF
Humidity:	0 - 100% (NC)	0 - 99% (NC)
Range:	0-1,000 ppm	30-1,000 ppm
Accuracy:	+/-10 ppm + 20% of reading	+/-10% of reading
Response time:	<90 seconds	<10 seconds
Cross-sensitivity:	-	Propanole, Benzole, SO_2
Calibration frequency:	12 months	12 months
Sensor life:	? years	5 years

Application Considerations

- Coolers/freezers
  - Mount near:
    - Evaporators (valve side)
  - Keep away from:
    - vapor from defrosting evaporators (below the fog line in penthouses and small rooms)
    - high air velocity

Application Considerations

- Machinery rooms
  - Mount near:
    - Exhaust inlet
    - Areas prone to leaks (seals, etc.)
  - Keep away from:
    - High air velocity

Operations & Maintenance

- Regardless of sensing technology
  - Calibrate per manufacturer's requirement
  - Monitor the integrity of the detection system
- Integrate the detection system with your plant's PSM program
  - Calibration intervals
  - Insure continued acceptable operation with emergency controls and alarms

Conclusions

- Expanding sensor options and applications
- A functioning ammonia sensing SYSTEM is important to personnel safety and property protections
- New technologies are emerging to address weaknesses in existing technologies

Other resources

- *Ammonia Sensor Overview*, 2001 IRC Members Deliverable
- *Hazardous Gas Monitors*, Jack Chou
- TRRF Report #127, *Ammonia Sensors* (Phase I & II)