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Gas Detection in the 2020s: Gas Sensors, IOT and Big Data

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Dave Wagner

Director of Application Engineering
& Product Knowledge


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Our Vision —
Industrial Scientific people are dedicating their careers to eliminating death on the job by the year 2050.

Gas Detection On, Below and …

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…Above the Earth

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Today's discussion will cover

- Pros and Cons of various sensing technologies used in real-time gas monitors
- Role of gas detection and big data in IIOT (Industrial Internet of Things)

Purpose

- According to a 2018 United Nations special report on toxic gases, every 30 seconds a worker dies from toxic gas exposure in their workplace.
  https://qz.com/1564995/toxic-exposure-at-work-kills-one-worker-every-15-seconds/

- A pipeline carrying combustible products catches fire every 4 days, results in and explosion every 11 days, an injury every 5 days and a fatality every 6 days.
  https://www.nrdc.org/experts/amy-mall/pipeline-incident-statistics-reveal-significant-dangers

It is critical that we understand the capabilities of the technologies used to detect these hazards everyday in order to make proper choices and understand how these technologies can be better used to protect workers

Combustible Gas Sensing Technology

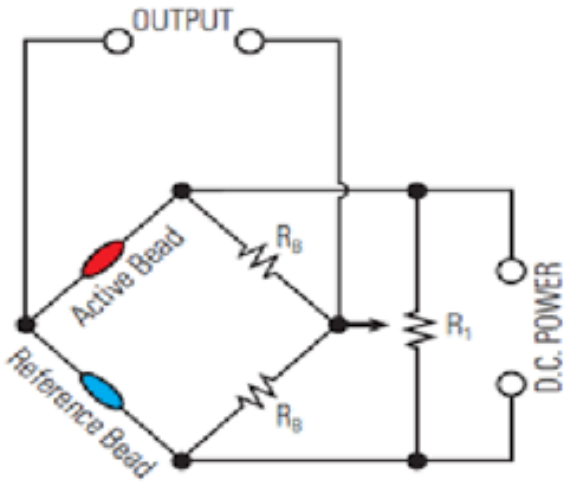
Catalytic Bead

- Gold Standard
- Capable of assessing any combustible gas or vapor
- Linear output
- Very easy to implement

Combustible Gas Sensing Technology

Catalytic Bead shortfalls

- Can’t speciate
- Requires oxygen for accurate detection
- Susceptible to poison
  - Silicone, sulfurs
- Can be influenced by changes in humidity
- High power budget



Combustible Gas Sensing Technology

- Infrared (NDIR, ULPIR)
  - “cure all” for combustible gas sensing
  - ☺ no O2 requirement
  - ☺ no poisoning
  - ☺ low power consumption
  - ☺ Long life

Infrared is the hottest “new” technology in gas detection

Combustible Gas Sensing Technology

- Infrared (NDIR, ULPIR) shortfalls
  - ☹ no hydrogen detection
  - ☹ no acetylene detection
  - ☹ poor linearity
  - ☹ poor correlation between gases

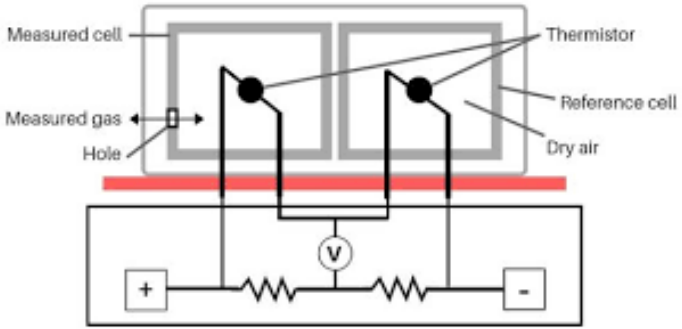
Combustible Gas Sensing Technology

- MOS/Thermal Conductivity Sensors
  - broad spectrum detection
  - wide measuring ranges
  - VOC exposure to percent volume levels
  - low cost
  - Can be setup in arrays and characterized to speciate gas

MOS/Thermal conductivity sensors useful beyond “leak” detection

Combustible Gas Sensing Technology

- MOS/Thermal Conductivity Sensors - shortfalls
  - ☹ Detect anything
  - ☹ Susceptible to changes in RH
  - ☹ Can still be susceptible to poisoning



MOS/Thermal conductivity sensors useful beyond “leak” detection

Combustible Gas Sensing Technology

CNT based gas sensors

- ☺ Very low power combustible gas detection
- ☺ Can speciate gases
- ☺ no oxygen, no poisoning
- ☹ No proven field history

Toxic Gas Sensing Technology

Electrochemical Gas Sensors

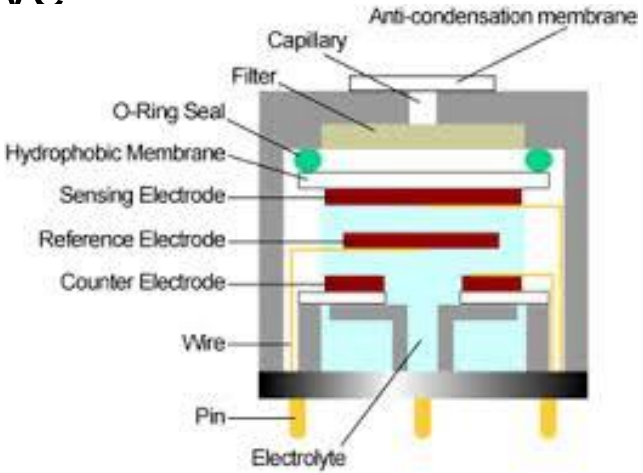
- Standard in toxic gas detection
- Highest level of specificity
- Relatively long life
- Low to moderate cost

MOS/Thermal conductivity sensors useful beyond “leak” detection

Toxic Gas Sensing Technology

Electrochemical Gas Sensors

- ☹ Cross interferences can be positive or negative
- ☹ Not available for all gases
- ☹ Detection limits are insufficient fo today's TLVs
- ☹ Very susceptible to adverse environmental conditions



Toxic Gas Sensing Technology

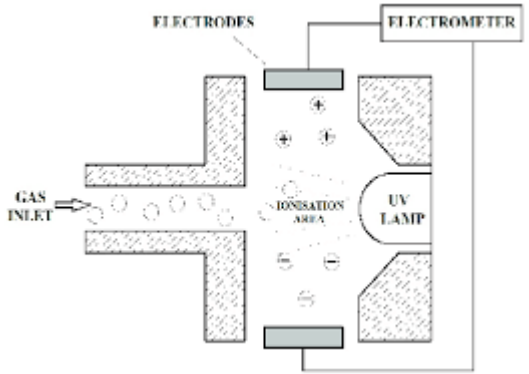
Photo Ionization Detector (PID)

- Very low level detection of VOCs and other gases (PPM-PPB)
- Broad range detection
- Clear definition of what it does and does not detect
- Multiple lamp voltages available

Toxic Gas Sensing Technology

Photo Ionization Detector (PID)

- ☹ Cannot speciate, but widely misunderstood b/c of RFs
- ☹ Long warm-up time when not used regularly
- ☹ Some models very sensitive to RH
- ☹ 11.7 lamps are very expensive w/very short life



Oxygen Sensing Technology

Galvanic fuel cell

- ☺ Long standard in oxygen detection
- ☺ Easy implementation
- ☺ No power consumption
- ☹ Very finite lifetime
- ☹ Lead based

Oxygen Sensing Technology

Oxygen pump

- ☺ Standard electrochemical sensor for oxygen detection
- ☺ Long life
- ☺ Lead free
- ☹ Voltage biased operation

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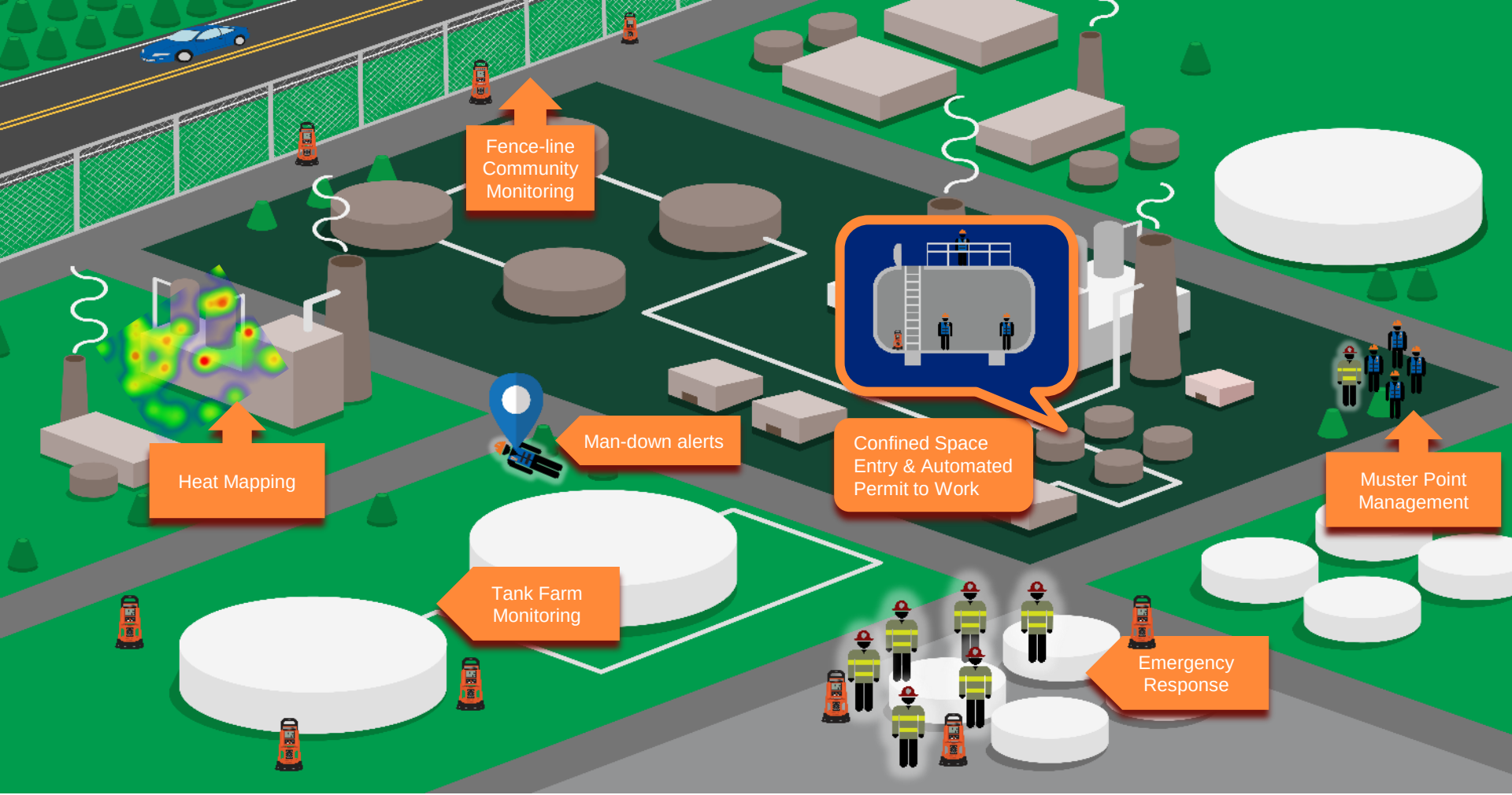
Gas Detection and the IOT

Gas Detection and the IOT

Gas detection focus is changing from self-reporting and datalogging to connectivity, live-monitoring and real-time data

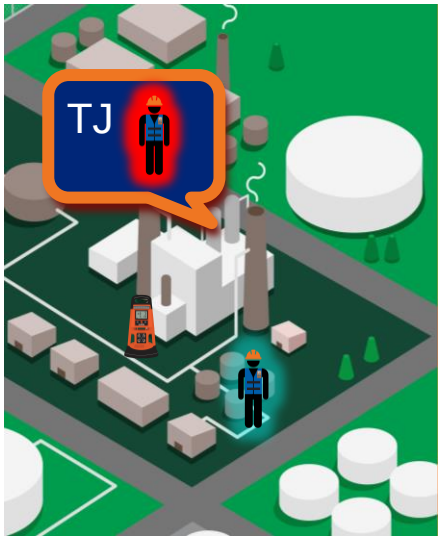
- Team-based safety
- plant-wide monitoring and tracking
- lone worker safety
- e-permitting


Fence-line Community Monitoring
Heat Mapping
Man-down alerts
Confined Space Entry & Automated Permit to Work
Muster Point Management
Tank Farm Monitoring
Emergency Response

Gas Detection and the IOT

Benefits of IOT and Live Monitoring

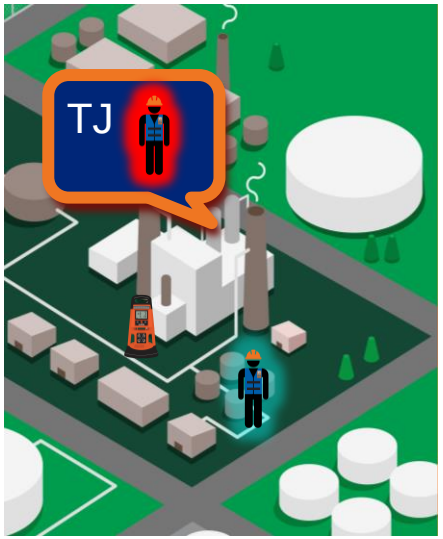
- Faster emergency response
- Enhancing worker health, wellness and productivity
- Diagnosing, predicting and preventing future incidents
- High risk identification



Gas Detection and the IOT

Challenges of IOT and Live Monitoring for Safety

- Reliable connectivity
- Data privacy/security
- Data storage/retention/backup



Questions?

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Thank You