
BW
Technologies
by Honeywell

Welcome NIPAS

- GAS BASICS
- PRODUCT REVIEW:
  - GAS ALERT MICRO
  - GAS ALERT MICRO 5 PID
  - MICRODOCK II & QUATTRO
- PRODUCT – MAINTENANCE
  - SENSORS, CALIBRATIONS

Honeywell Analytics

- Who We Are:
  - BW/Lumidor - Portable gas detection solutions
  - City Technology, Sensoric & Sixth Sense – world's leading supplier of electrochemical cells
  - Sieger – innovative catalytic bead, electrochemical cell and infrared detection technologies
  - MDA Scientific & MST – low level toxic gas detection to the semiconductor industry
  - Vulcain – gas detection for commercial and light industrial properties
  - Manning – The market leader in industrial refrigeration gas detection

Why is Gas Detection Important ?

5 died trying to save each other

By Mike Martindale
News Staff Writer

MENOMENEE, Mich. –

Bill Hofer was the first to collapse in the dark manure pit.

Inhaling a combination of toxic gases, he quickly lost consciousness and slipped down into the pool of murky liquid in the bottom of the 12-foot hole.

Then one after another, the four men at the top of the pit scrambled in, trying first to save Hofer, and then each other, from the deadly fumes.

Within five minutes all were dead or dying in what is believed to be the worst farm accident in Michigan history.

Killed yesterday along with the 63-year-old Hofer were his uncle, Carl Theuerkauf, Sr., the 65-year old patriarch of the centennial farm; two of Theuerkauf's sons, 37-year old Carl Jr. and 28-year old Tom; and Carl Jr.'s 15-year old son, Daniel.

"I'm sure that when one person slipped or fell, out of love and for help, one after another went in," said Richard Breyer with the county farm extension service in Menominee.

Dorothy Theuerkauf, who lost a husband, two sons, and a grandson in the tragedy said:

"I can't believe something like this could happen. It will probably take me a couple of weeks before it actually sinks in."

On Thursday, investigators said the five men were using a pump to empty a partially covered, 12-foot deep concrete manure pit, and were almost finished when the pump clogged.

Hofer descended into the darkness to clear the block.

"It's unknown which one went in next, but eventually they all went in to save the rest," said Menominee County Sheriffs Deputy Booth Whipp.

County Medical Examiner Dr. Paul Haupt estimates it took about 90 seconds for each of the men to suffocate in the invisible cloud of gas, composed primarily of methane and hydrogen sulfide.

65% of fatalities due to atmospheric hazards

Ref. #	Accident Type	Events	Injuries	Deaths
1	Atmospheric condition in CS	80	72	78
2	Explosion or fire in CS	15	49	15
3	Explosion or fire at point of entry	23	20	32
4	Electrical shock or electrocution	11	2	9
5	Caught in / crushed by machinery	10	3	10
6	Engulfment	16	0	16
7	Struck by falling objects	15	15	0
8	Falls inside Confined Space	27	26	1
9	Ingress / egress	33	30	3
10	Insufficient maneuverability	15	15	0
11	Eye injury	10	10	9
12	Other	21	6	15
	Total	276	234	193

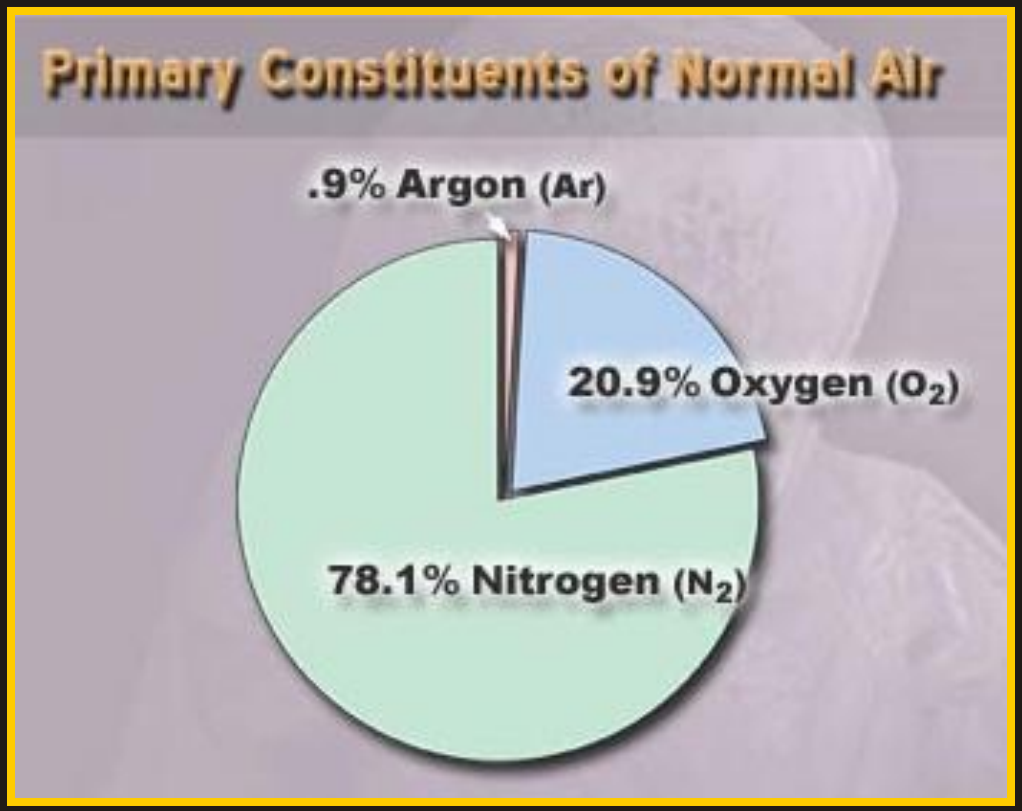
Three basic kinds of atmospheric hazards

- Oxygen (deficiency and enrichment)
- Flammable gases and vapors
- Toxic contaminants

Oxygen Deficiency

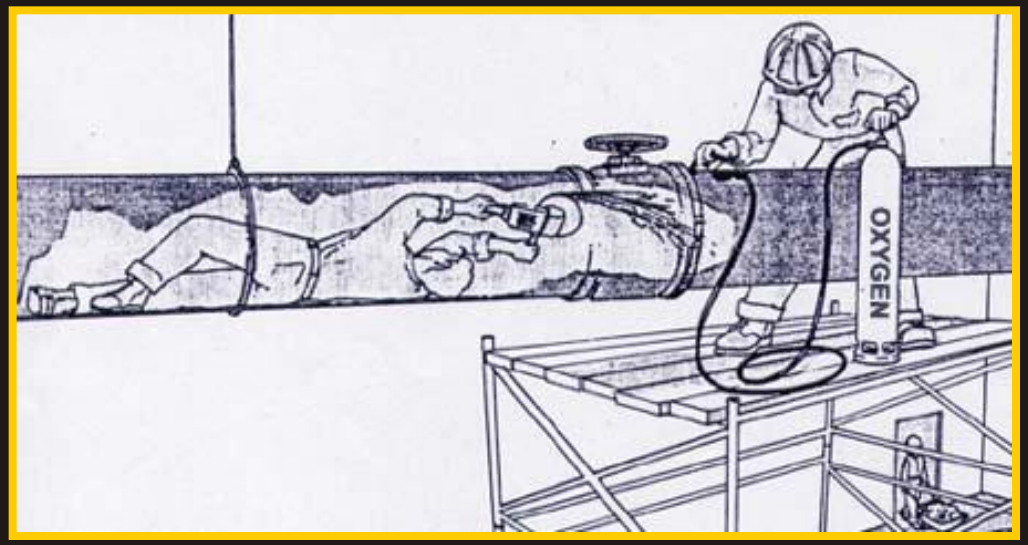
Composition of fresh air

- *78.1 % Nitrogen*
- *20.9 % Oxygen*
- *0.9 % Argon*
- *0.1 % All other gases*
  - *Water vapor*
  - *CO_2*
  - *Other trace gases*



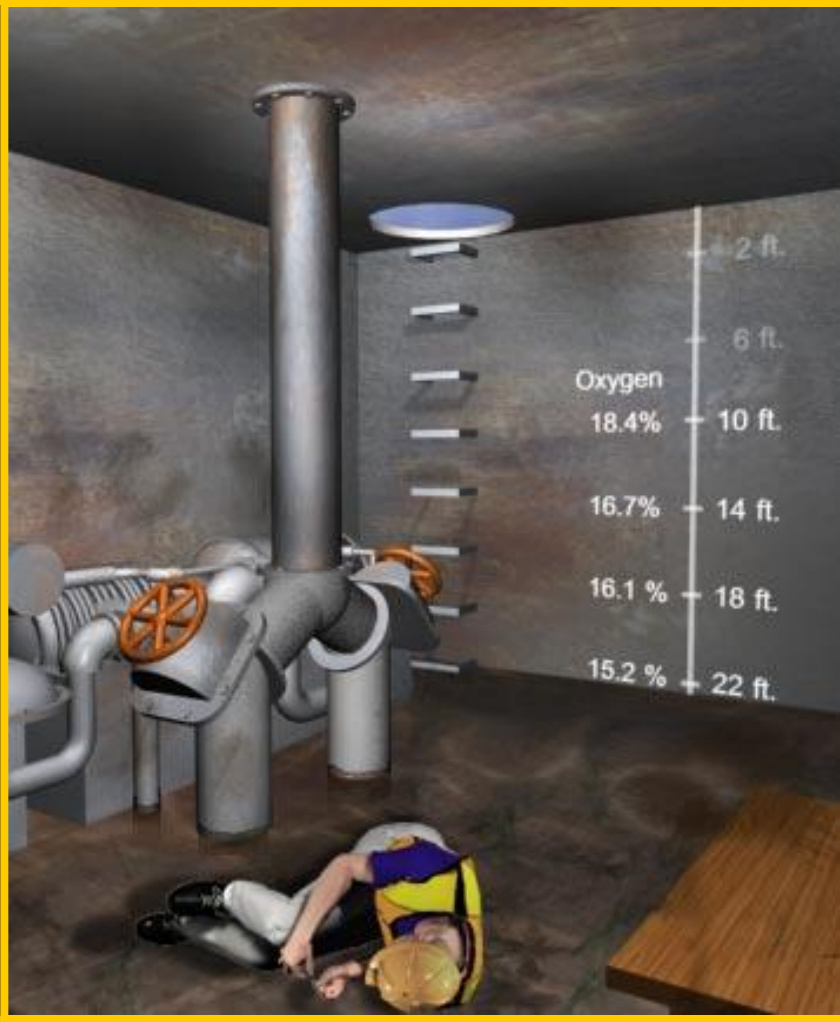
Oxygen Enrichment

- *Proportionally increases the rate of many chemical reactions*
- *Can cause ordinary combustible materials to become flammable or explosive*



Causes of Oxygen Deficiency

- *Displacement*
- *Microbial action*
- *Oxidation*
- *Combustion*
- *Absorption*

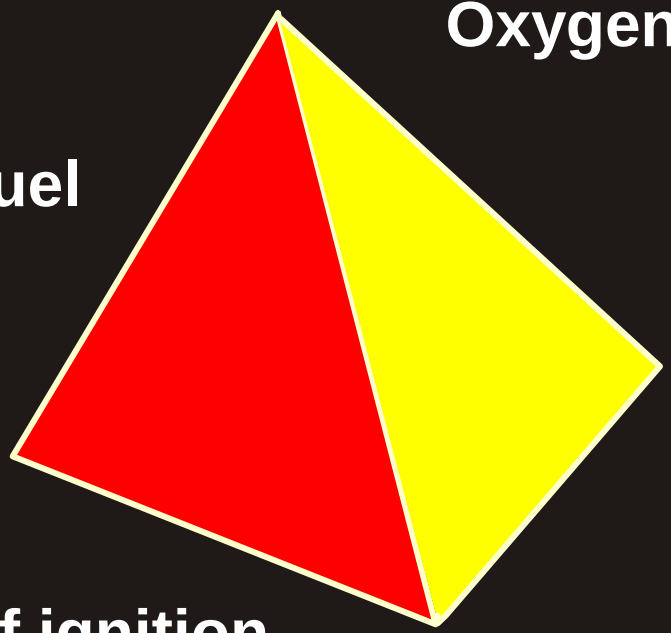


Symptoms of Oxygen Deficiency

20.9 %	Oxygen content in fresh air
19.5 % - 12 %	Impaired judgment, increased pulse and respiration, fatigue, loss of coordination
12 % - 10 %	Disturbed respiration, poor circulation, worsening fatigue and loss of critical faculties, symptoms within seconds to minutes
10 % - 6 %	Nausea, vomiting, inability to move, loss of consciousness, and death
6 % - 0 %	Convulsions, gasping respiration, cessation of breathing, cardiac arrest, symptoms immediate, death within minutes

Explosive or Flammable Atmospheres

Fire Triangle



Lower Explosive Limit (L.E.L.)

- *Minimum concentration of a combustible gas or vapor in air which will ignite if a source of ignition is present*

Flammable Risk

- Gases are ignitable within their flammable range
- Gases are usually measured in percentage of their explosive Limit (%LEL)
- 5% Methane = 100% LEL or 50,000 PPM
- Alarm set points are:
  - 10% LEL 5,000 PPM
  - 20% LEL 10,000 PPM
  - 50% LEL 25,000 PPM

Toxic Gases and Vapors

Toxic atmospheres come from

- *Microbial action on material in CS*
- *Products or chemicals stored in CS*
- *Work being performed in CS*
- *Areas adjacent to Confined Space*

Exposure Limits defined in three ways:

- *Time Weighted Average (TWA)*
- *Instantaneous*
- *Short Term Exposure Limit (STEL)*

TWA is projected value

- When monitoring session less than eight hours, TWA projected for the full eight hour shift.
- When monitoring session more than 8 hours, TWA calculated on an “equivalent” 8 hour shift basis

Short Term Exposure Limit (STEL)

- *Some gases and vapors have an allowable maximum Short Term Exposure Limit which is higher than the 8 hour TWA*
- *STEL values usually calculated as 15 minute, or in some cases, as 5 minute or 10 minute time weighted averages*

Immediately Dangerous to Life and Health

- IDLH
  - IDLH is maximum concentration from which it is possible for an unprotected worker to escape without suffering injury or irreversible health effects during a maximum 30-minute exposure
  - Primarily used to define the level and type of respiratory protection required
  - Unprotected workers may NEVER be deliberately exposed to IDLH or ANY concentrations which exceed the PEL

Your BW Micro & M5 PID detectors use one or more of these sensor technologies:

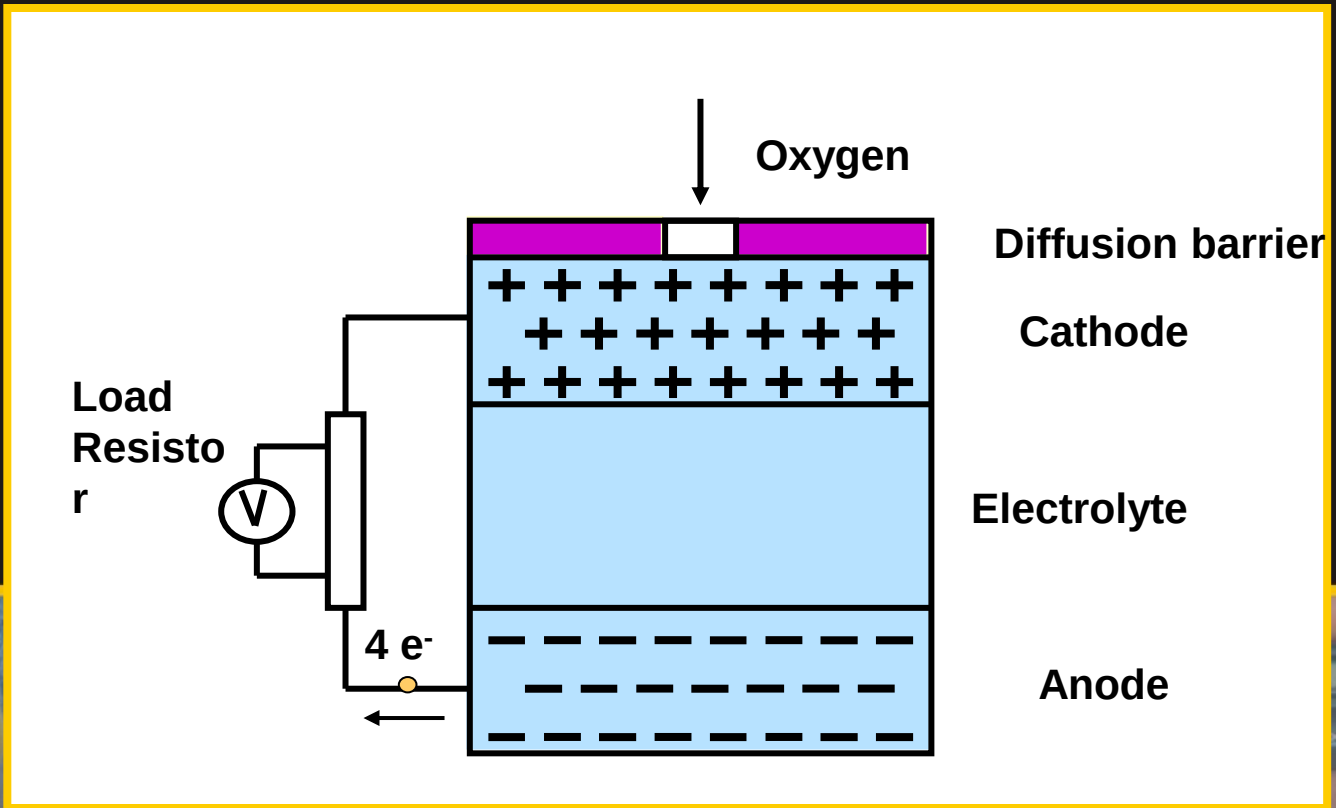
Electrochemical
Catalytic bead
Photoionization

Substance Specific Electrochemical Sensors

- Gas diffusing into sensor reacts at surface of the sensing electrode
- Sensing electrode made to catalyze a specific reaction
- Use of selective external filters further limits cross sensitivity

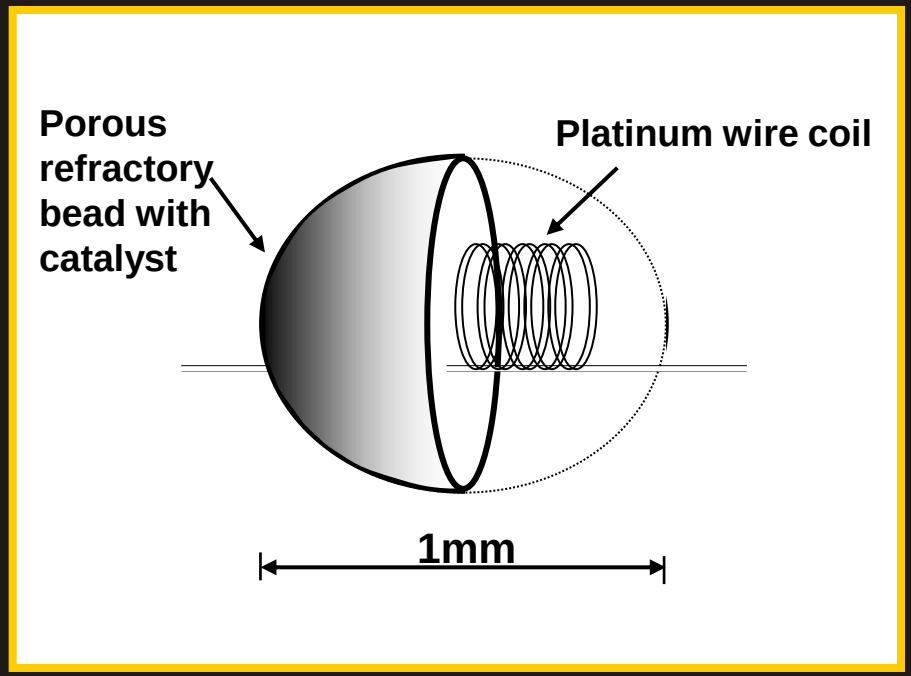
Oxygen sensor detection principle: “Fuel Cell”

- *Sensor generates electrical current proportional to the O_2 concentration*
- *Sensor used up over time (usually last one to two years)*



Catalytic "Hot Bead" Combustible Sensor

- *Detects combustible gas by catalytic oxidation*
- *When exposed to gas oxidation reaction causes bead to heat*
- *Requires oxygen to detect gas!*



Combustible sensor poisons

- Combustible sensor poisons:
  - Silicones
  - Hydrogen sulfide
  - Other sulfur containing compounds
  - Phosphates and phosphorus containing substances
  - Lead containing compounds (especially tetraethyl lead)
  - High concentrations of flammable gas!
- Combustible sensor inhibitors:
  - Halogenated hydrocarbons (Freons®, trichloroethylene, methylene chloride, etc.)

Over-Limit Protection

- *LEL sensor only designed to detect 0-100% LEL concentration of flammable gas*
- *If O2 concentration less than 10% O2, LEL sensor will not read properly*
- *Also, sensor may be damaged by exposure to higher than 100% LEL concentrations*
- *To prevent damage, sensor is switched OFF and instead of the LEL reading OL (Over Limit) is displayed.*

Photoionization Detectors

- *Measuring Solvent, Fuel and VOC vapors in the workplace environment*

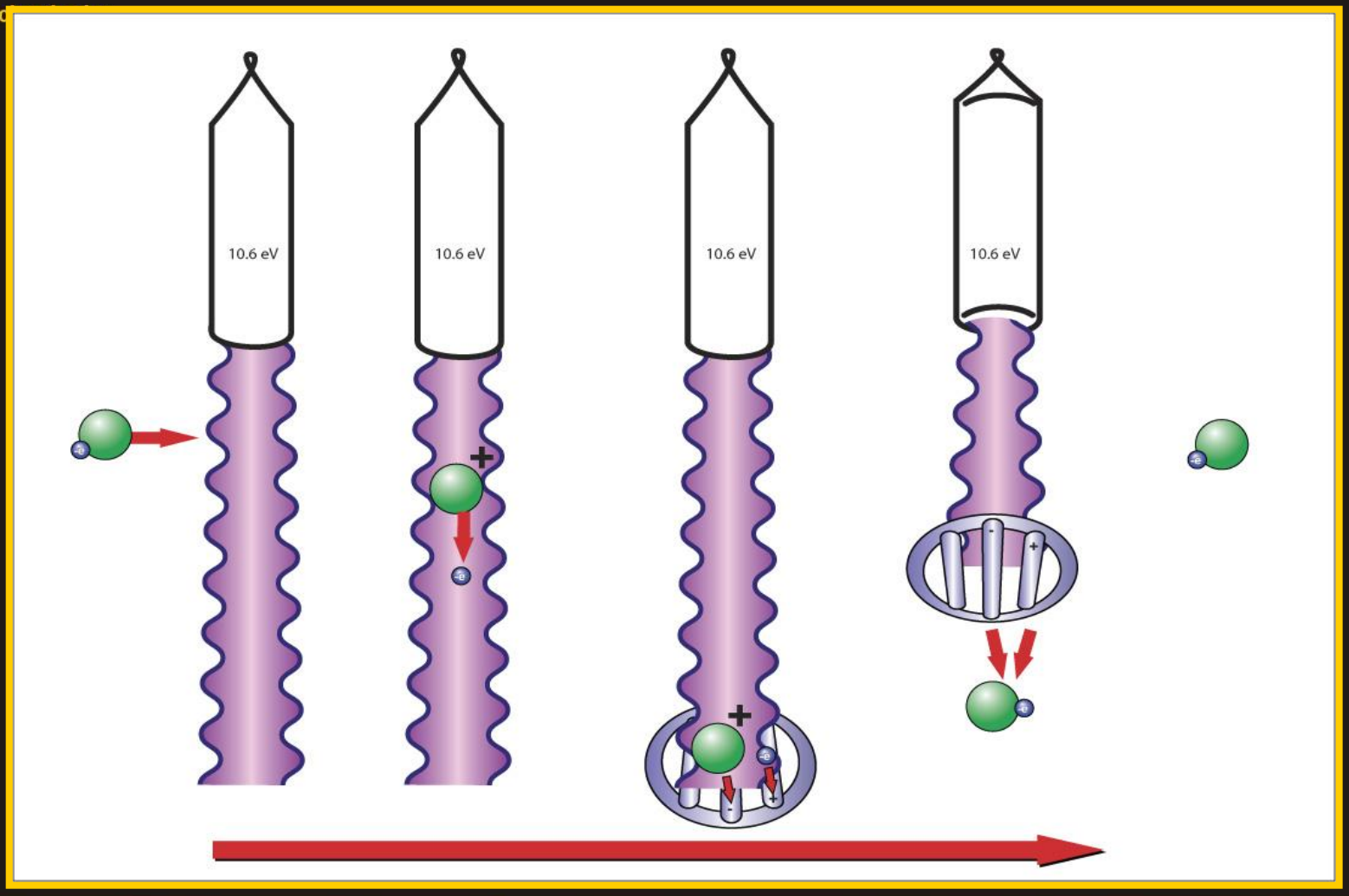
LEL vs. PID Sensors

- *Catalytic hot-bead combustible sensors and photoionization detectors complementary detection techniques*
- *Catalytic hot-bead sensors excellent for measurement of methane, propane, and other common combustible gases that are NOT detectable by PID*
- *PIDs detect large VOC and hydrocarbon molecules that are undetectable by hot-bead sensors*
- *Best approach to VOC measurement is to use a multi-sensor instrument capable of measuring all the atmospheric hazards that may be potentially present*

PID - Operating Principle

- *PIDs use ultraviolet light as source of energy to remove an electron from neutrally charged target molecules creating electrically charged fragments (ions)*
- *This produces a flow of electrical current proportional to the concentration of contaminant*
- *The amount of energy needed to remove an electron from a particular molecule is the ionization energy (or IP)*
- *The energy must be greater than the IP in order for an ionization detector to be able to detect a particular substance*

How does a PID work?



Volatile organic compounds (VOCs)

- VOCs are organic compounds characterized by tendency to evaporate easily at room temperature
- Familiar VOCs include:
  - Solvent
  - Paint thinner
  - Nail polish remover
  - Gasoline
  - Diesel
  - Heating oil
  - Kerosene
  - Jet fuel
  - Benzene
  - Butadiene
  - Hexane
  - Toluene
  - Xylene
  - Many others

VOC Toxicity

- *VOCs present multiple potential threats in the workplace environment*
- *Heavier than air, flammable and toxic*
- *Increased awareness of toxicity is leading to lowered exposure limits*
- *This leads in turn to increased need for direct measurement of VOCs at exposure limit concentrations*

Ionization Potential Values

Substance	Ionization Energy (eV)
carbon monoxide	14.01
carbon dioxide	13.77
methane	12.98
water	12.59
oxygen	12.08
chlorine	11.48
hydrogen sulfide	10.46
n-hexane	10.18
ammonia	10.16
hexane	10.13
acetone	9.69
benzene	9.25
butadiene	9.07
toluene	8.82

Compounds not detectable by PID

Compounds normally present in air: Oxygen, Nitrogen, Carbon dioxide, Argon

Inorganic toxics: Carbon monoxide, Hydrogen cyanide, Ozone (O3)

Hydrocarbons and VOCs with ionization energies higher than 11.7eV: Methane, Natural gas

Acids: Sulfuric acid (H2SO4), Hydrochloric acid (HCl), Nitric acid (HNO3)

Radiation

Aerosol droplets and particulates

Radiation

Characteristics of PID Lamps

- *Sealed borosillicate glass body*
- *Window of specific crystalline material*
- *Filled with specific noble gas or mixture of noble gases*
- *10.6 eV lamp should last 10,000 operating hours or three years or longer*

PID Performance

- **BW PID**
  - *7 Series formatted miniaturized PID*
  - *Fence electrode: electro statically collects charged fragments, prevents from accumulating on window and collector electrodes*
  - *Replaceable electrode stack: very inexpensive consumable component*
  - *Automatic notification when necessary to change*
  - *Replace stack rather than clean lamp*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Hydrogen Sulfide

Colorless gas with a strong odor of rotten eggs. *[Note: Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H_2S. Shipped as a liquefied compressed gas.]*

Hydrogen Sulfide

IDLH 100 ppm

BW Technologies Default Alarm Set points

TWA = 10ppm STEL = 15ppm

LOW = 10ppm HIGH = 15ppm

Hydrogen Sulfide

Exposure Routes: inhalation, skin and/or eye contact

Symptoms: Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite

Target Organs: Eyes, respiratory system, central nervous system

Hydrogen Sulfide Sources & Applications

- ***Typical Sources:***
  - ***Raw sewage***
  - ***Crude oil***
  - ***Marine sediments***
  - ***Tanneries***
  - ***Pulp and paper industry***

Hydrogen Sulfide Markets

- CONFINED SPACE ENTRY MARKET
- Municipalities
- Utilities
- Telecom
- Oil and Gas (up stream)
- Refining and Petrochemical Facilities (down stream)
- Pulp and Paper

Physical Description

Colorless, odorless gas.

Carbon Monoxide

IDLH 1200 ppm

BW Technologies Default Alarm Set points

TWA = 35ppm STEL = 50ppm

LOW = 35ppm HIGH = 200ppm

Carbon Monoxide

Exposure Routes: inhalation, skin and/or eye contact (liquid)

Symptoms: Headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope

Target Organs: cardiovascular system, lungs, blood, central nervous system

Carbon Monoxide Sources & Applications

- ***Produced as a by product of incomplete combustion***
- ***Associated with internal combustion engine exhaust***
  - ***Vehicles***
  - ***Pumps***
  - ***Compressors***

Carbon Monoxide Markets

- CONFINED SPACE ENTRY MARKET- Motorized Sample Draw
- Municipalities
- Utilities
- Refining and Petrochemical Facilities (down stream)
- Fire Rescue
- Steel Mills
- Pulp and Paper
- Construction
- Marine/ Shipping
- Transportation
- Fossil fueled power facilities
- General Industry (Military, Pharmaceuticals, Mining, Chemicals and all Confined Space entry)

Gas Stratification

GAS	DESCRIPTION	STEL	TWA	IDLH	COLOR	MOL WEIGHT
H2	HYDROGEN	NONE	NONE	NONE	NONE	2
N	NITROGEN	NONE	NONE	NONE	NONE	14
CH4	METHANE	NONE	NONE	NONE	NONE	16
NH3	AMMONIA	35 PPM	50 PPM	300 PPM	NONE	17
HCN	HYDROGEN CYANIDE	4.7 PPM	10 PPM	50 PPM	NONE	27
CO	CARBON MONOXIDE	35 PPM	50 PPM	1200 PPM	NONE	28
AIR						29
NO	NITRIC OXIDE	NONE	25 PPM	100 PPM	NONE	30
H2S	HYDROGEN SULFIDE	15 PPM	20 PPM	100 PPM	NONE	35
CO2	CARBON DIOXIDE	30,000 PPM	5,000 PPM	40,000 PPM	NONE	44
NO2	NITROGEN DIOXIDE	1 PPM	5 PPM	20 PPM	RED BROWN	46
SO2	SULFUR DIOXIDE	5 PPM	2 PPM	100 PPM	NONE	64
CL2	CHLORINE	.3 PPM	.1 PPM	5 PPM	GREEN YELLOW	71

Questions?