

**Hydrogen Sulphide
Awareness**

&

Breathing Apparatus

Hydrogen Sulphide (H₂S)

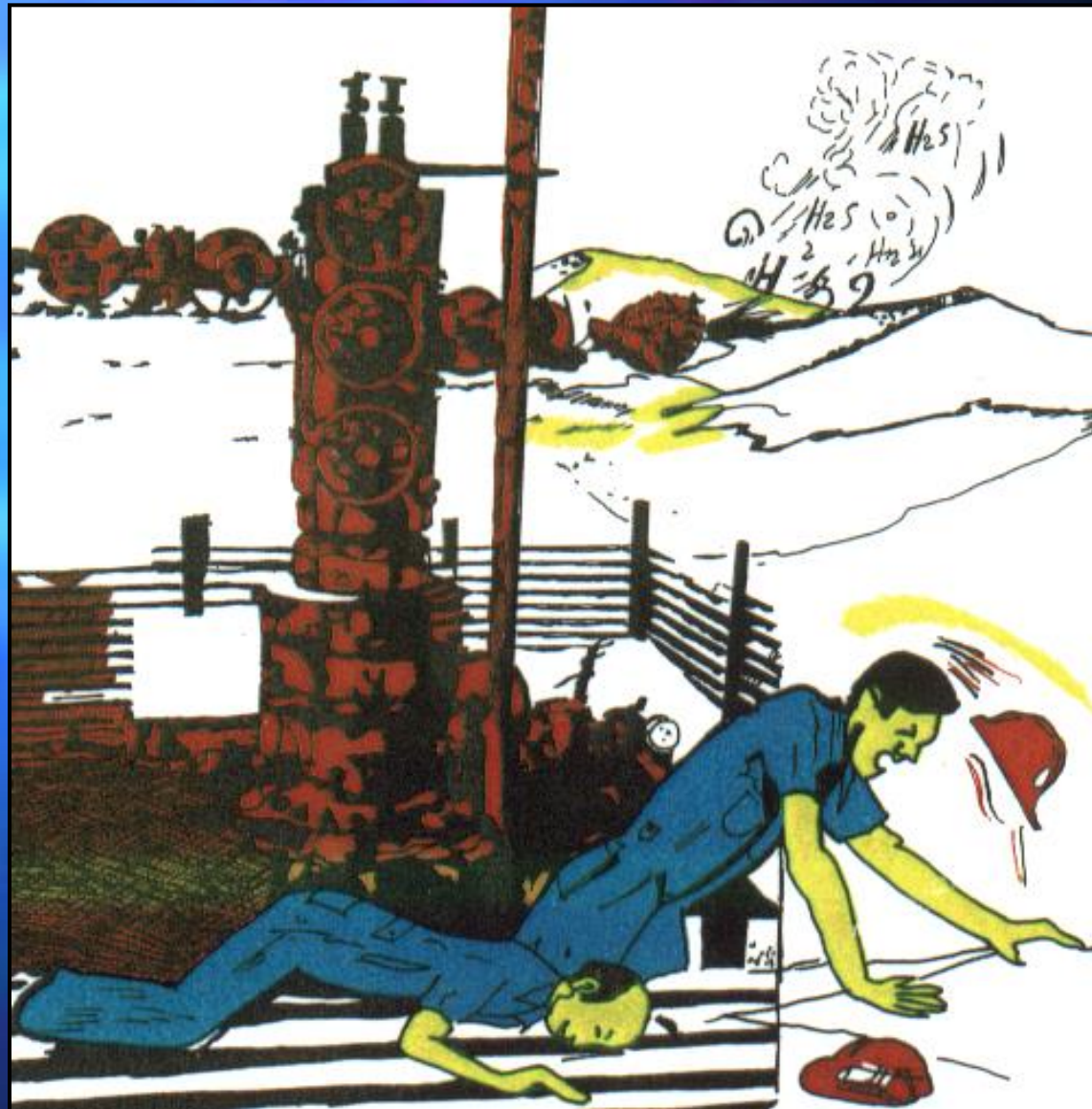
- ❑ No Smoking
- ❑ Emergency Response
- ❑ Toilets
- ❑ Breaks as & when required
- ❑ Switch off mobile phones and pagers please.



Hydrogen Sulphide (H₂S)

- » Let's get to know each other a bit better.
- » Please tell us your:
- » Name
- » Job
- » Experience





Hydrogen Sulphide (H₂S)

- » It is colourless
- » It has the smell of rotten eggs
- » It is heavier than air
- » It is highly inflammable
- » It is water soluble
- » It is extremely toxic



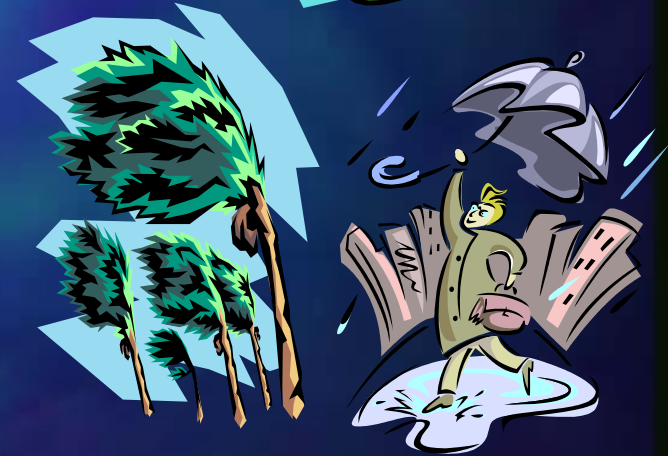
Other names

- H_2S
- Stink Damp
- Sulphurated Hydrogen
- Sour Crude
- Rotten-Egg Gas
- Hydrosulphuric Acid
- Sulphur Hydride

Awareness & Escape

What is H₂S ?

- » One breath is enough to kill
- » At very low concentrations when mixed with air it smells of rotten eggs
- » At slightly higher concentrations when mixed with air it will kill your sense of smell
- » It is one of the most lethal gases known to man



Awareness & Escape

How is H₂S formed ?

- » H₂S is a combination of hydrogen and sulphur atoms
- » The process of combination takes place in several ways by either:
 - » Bacteria
 - » Chemical reactions
 - » The decomposition or decaying process of organic matter-vegetation etc.



Toxicity

The toxicity of the gas was responsible for the deaths of 26 men in Wyoming and West Texas between 1974 & 1976.

In Saudi Arabia 19 people were killed in one incident due to H_2S poisoning in 1980



Awareness & Escape

H₂S: - the name itself gives the message:

- » H - HOW
- » 2 - TO
- » S - SAVE

Your life (first)

The lives of others overcome by H₂S

HYDROGEN SULPHIDE IS A KILLER!!



Awareness & Escape

What is meant by PPM ?

Parts **P**er **M**illion

If a million particles of air by volume (ABV) contains one part of H₂S it is 1PPM

» H₂S

» 1PPM = 0.0001%

» 10 PPM = 0.001% (TLV)

» 100 PPM = 0.01%

» 1000 PPM = 0.1%

» 10,000 PPM = 1%

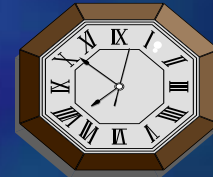
Awareness & Escape

- » One Part Per Million would be one (1) teaspoonful in approximately 25 drums

Or

- » If one second represented One Part Per Million of gas, this would be like comparing one second in 11½ days

Or



- » If one inch represented One Part Per Million of gas, this would be like comparing one inch in 15½ miles in distance

Awareness & Escape

How does H₂S affect individuals?

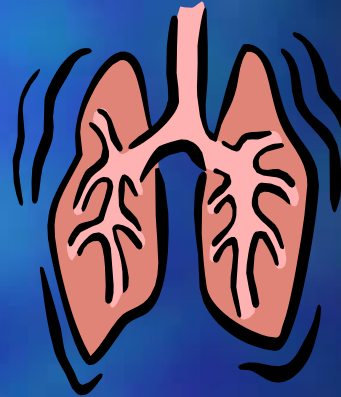
» Breathing cycle:

H₂S goes to the lungs and into the bloodstream & gets dissolved

» Defence System:

The body's defence system operates. It oxidizes/breaks down H₂S as rapidly as possible into a harmless compound

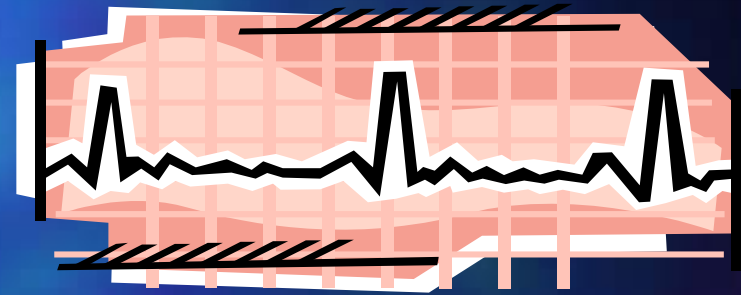
With higher doses of H₂S, the body's defence system will weaken. H₂S settles in the blood and the individual becomes poisoned.



Awareness & Escape

Symptoms of exposure to H₂S

- » Giddiness (dizziness), vomiting sensation (Nausea), severe coughing, irritation in nose & throat, beginnings of loss of consciousness
- » Nerve centre in the brain is paralysed
- » Breathing stops
- » Unconsciousness, Asphyxiation
- DEATH!!



Awareness & Escape

<u>Concentration (PPM)</u>		<u>Effect</u>
below	1 PPM	Detectable by smell
below	10 PPM	Long term exposure limit -8 hour average value
below	15 PPM	Short term exposure limit- 10 minute average
about	30 PPM	Eye and respiratory tract irritation
about	100 PPM	Loss of sense of smell
about	500 PPM	within 15 minutes- dizzy, headache, nausea, abdominal pains
		after 30 - loss of consciousness, possible death
about 1,000 PPM and above		rapid loss of consciousness, death within minutes !!!

Awareness & Escape

Toxicity table

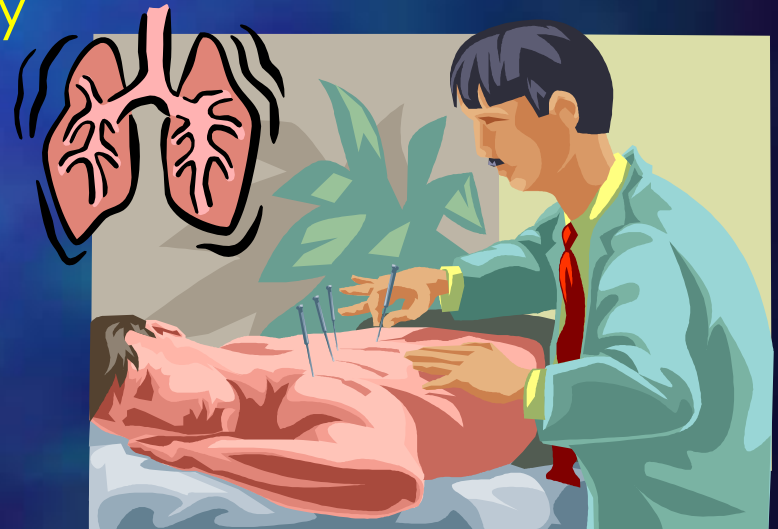
0.13	ppm	Minimal perceptible odour
4.60	ppm	Easily detectable, moderate odour
10	ppm	Beginning eye irritation
27.0	ppm	Strong, unpleasant odour, but not intolerable
100	ppm	Coughing, eye irritation, loss of sense of smell after 2-5 minutes
200-300	ppm	Marked conjunctivitis(eye inflammation) and respiratory tract irritation after one hour of exposure
500-700	ppm	Loss of consciousness and possible death within 30 minutes to one hour
700-1000	ppm	Rapid unconsciousness, cessation (stopping or pausing) of respiration and death
1000-2000	ppm	Unconsciousness immediately with rapid cessation of respiration and death within a few minutes. Death may occur even if the individual is removed to fresh air at once

Awareness & Escape

The effect of H₂S depends on 4 factors:

Duration
Frequency
Intensity
Individual susceptibility

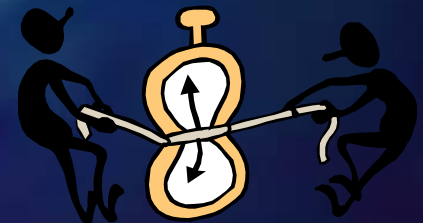
Example:
Bronchial Asthma



Awareness & Escape

TLV - Time Weighted Average

- » This value is the maximum concentration of toxic gas that a worker can be exposed to day after day without suffering health problems
- » This TLV is an average taken over an 8 hour day or a 40 hour week
- » TLV - Threshold Limit Value
- » TWA - Time Weighted Average
- » Threshold Limit Value-Time Weighted Average is normally abbreviated as TLV-TWA
- » H₂S has a TLV of 10 PPM



Awareness & Escape

Threshold Limit Value Short

Term Exposure Limit (TLV-STEL)

- This is a higher TLV which defines the maximum concentration that a person may be exposed to for a maximum of 10 minutes
- There should be no more than four such exposures per day, with at least 1 hour between exposures

Awareness & Escape

Threshold Limit Ceiling (TLV-C)

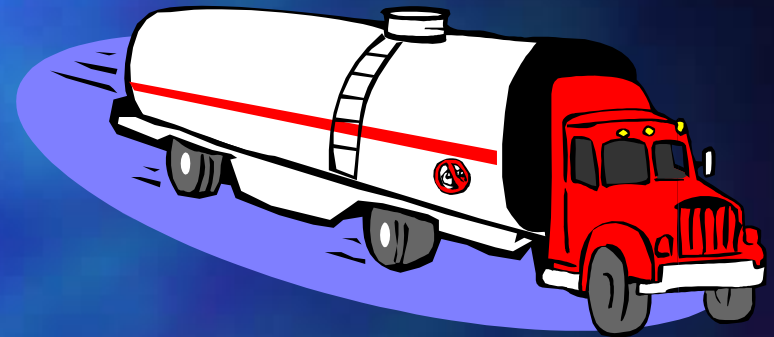
This is the concentration level beyond which workers must never be exposed- **even for an instant !**

Remember: H₂S is a killer !!!



Awareness & Escape

- On Tankers: in vents, tank hatches & pump rooms
- In storage tanks: in vents & gauge/sample hatches
- In pumps & compressors: in vents & drains
- In drains & sumps, in sewers & ditches



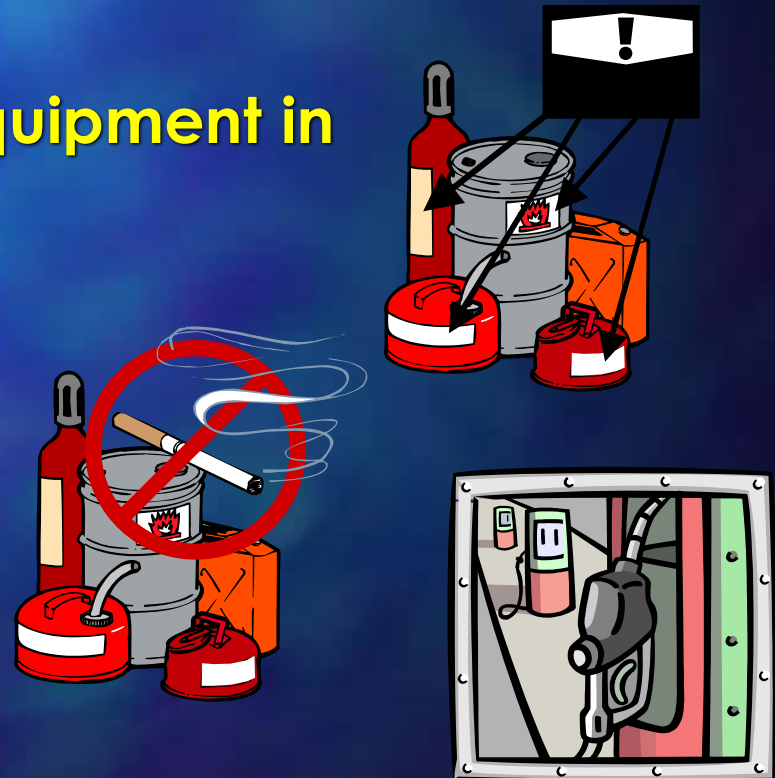
Awareness & Escape

Other areas where you find H₂S:

Liquids & Gaseous Hydrocarbons may contain H₂S in sufficient quantities to present a potential hazard to:

Personnel, Environment & Equipment in

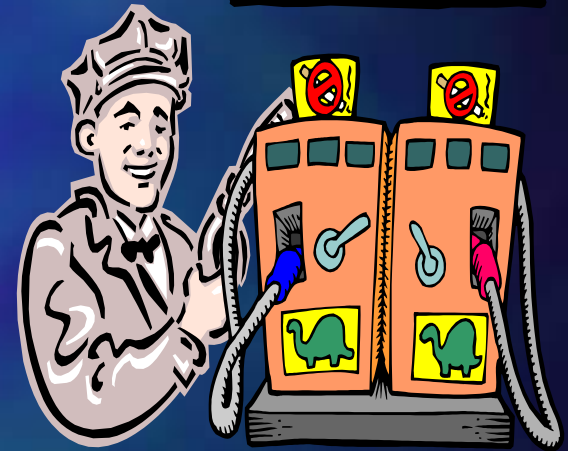
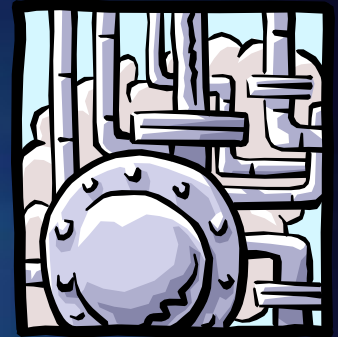
- » Processing Stations
- » Storage Facilities
- » Refineries
- » Sewage Treatment Plants



Awareness & Escape

Potential exposure to H₂S in the Petroleum Industry:

- Drilling operations
- Field maintenance of wells
- Entry into confined spaces
- Leaks in pumps/valves/lines/flanges
- Gas injection



Awareness & Escape

Properties of H₂S

- It is as deadly as Hydrogen Cyanide
- More deadly than Carbon Monoxide - 5 or 6 times!
- In high concentrations it can kill instantly
- It is a deadly and extremely toxic gas !!!



Awareness & Escape

Remedy

- Safety awareness programme
- Eliminate FEAR of H₂S but not RESPECT for it



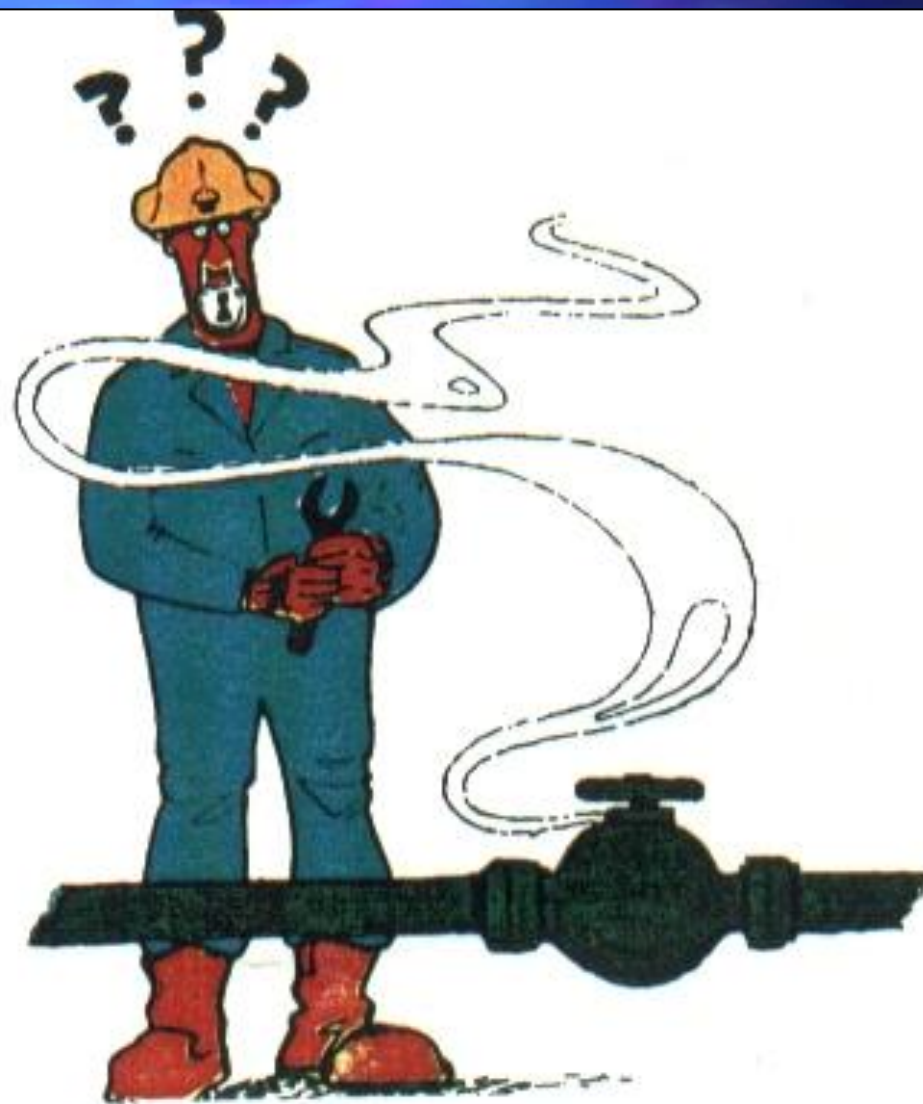
Awareness & Escape

Detections:

- H_2S is colourless
- H_2S deadens the sense of smell
- At low concentrations it gives off the smell of rotten eggs
- At higher concentrations the sense of smell is lost immediately
- Never depend on your nose to detect H_2S . Always use a detector **or you might not live to regret it!!!**





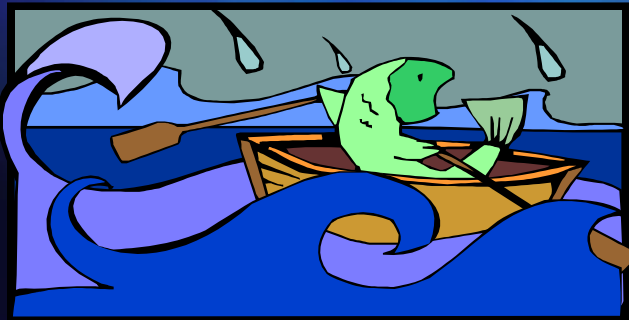
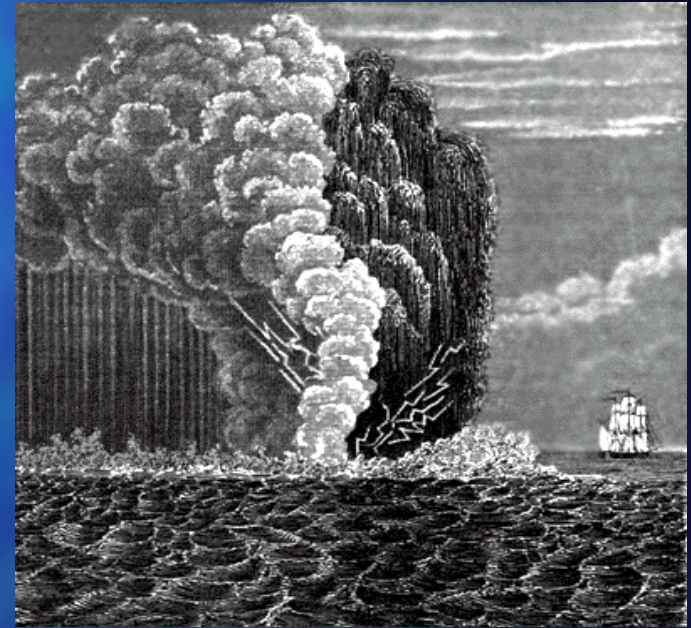


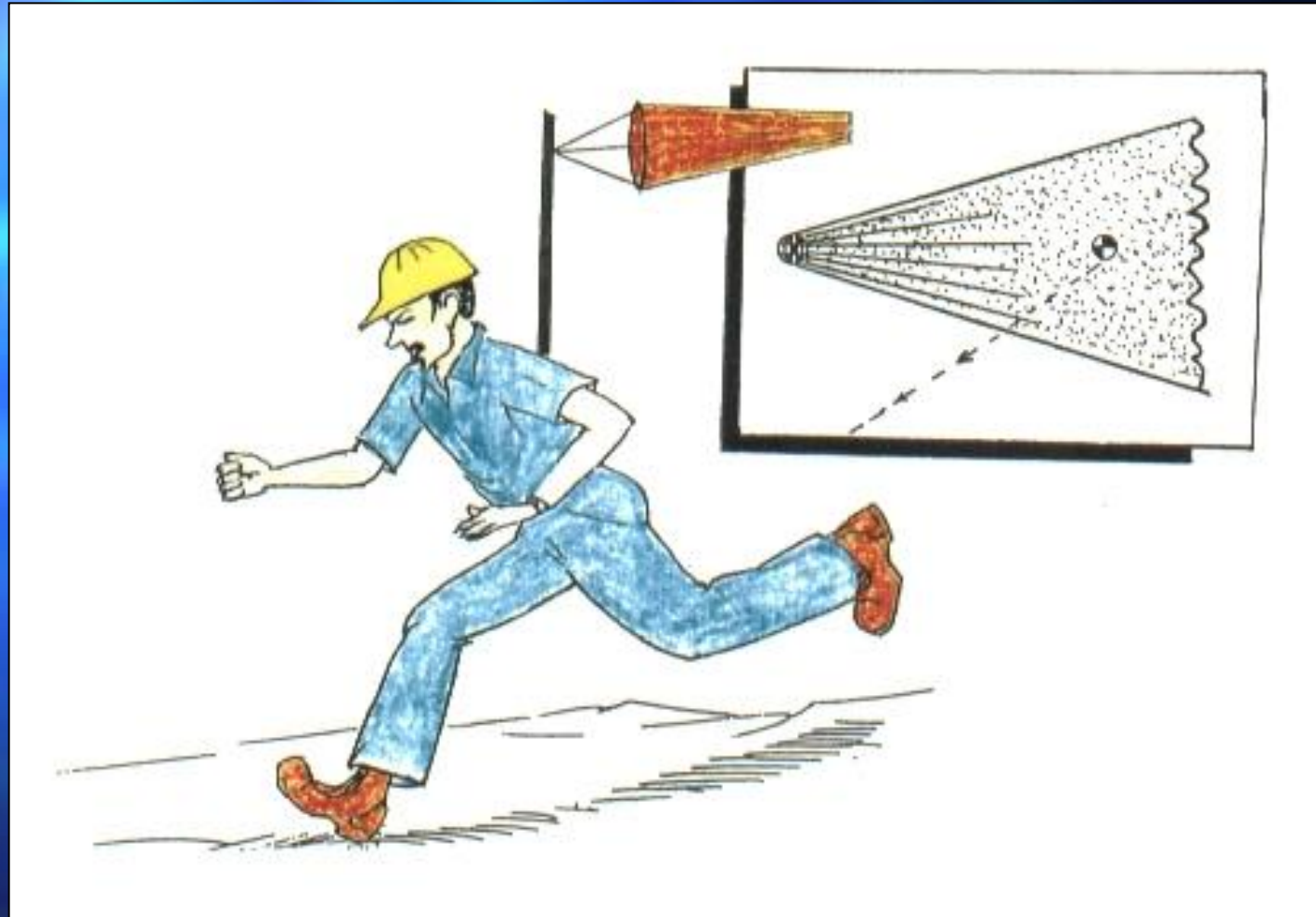
١٠٠ جزء في المليون 100 ppm

Awareness & Escape

Wind

- H₂S is readily dispersed by the wind or air currents
- It is vital, for your safety, to observe the wind socks or streamers
- Always move upwind or crosswind to escape from H₂S





Awareness & Escape

H₂S is soluble in liquids/water.

When dissolved in water it creates a weak acid

- **Symptoms:**

- burning eyes/eye inflammation
- respiratory tract irritation
- sore throat
- irritation/burning around the neck
- rinse eyes out with copious quantities of fresh water
- remove clothing as required



Awareness & Escape

H₂S is heavier than air:

- H₂S is heavier than air. Its vapour density is 1.19. Air is 1.00.
- It gathers in low lying areas:
well cellars, sumps, wadis,
trenches and excavations,
confined spaces (tank bottoms)



Awareness & Escape

H₂S is highly inflammable

- It is **highly explosive** by nature when mixed with air between 4.3% to 46% by volume.
- LEL is 4.3% = lower explosive limit
- UEL is 46% = upper explosive limit
- Burns with a blue flame and forms SO₂ (Sulphur Dioxide) which is also a toxic gas

Awareness & Escape

H₂S is highly corrosive

- H₂S is highly corrosive by nature
- It reacts with metals resulting in:
- Hydrogen embrittlement
- Sulphide stress cracking (SSC)
- Hydrogen induced cracking (HIC)
- Forms an acid in water which causes pitting on steel

Awareness & Escape

Pyrophoric Iron Sulphide (PIS)

- In presence of H_2S , carbon steel equipment will develop PIS- a black powdery rust
- PIS is highly explosive in presence of Oxygen (O_2) + Hydrocarbons- spontaneous combustion
- Can cause FIRE even in absence of hydrocarbons
- Can cause fire/explosion in presence of hydrocarbon vapours
- Where is it found?
- Wireline lubrication, filters, vessels,
- pipelines, valves, pigging tools, flare line systems
- **Remedy:- wetting, water filling and N_2 purging**

Awareness & Escape

Technical information on H₂S

- Auto ignition temperature: 500 F/260 C
- Flammable limit: LEL 4.3%
- _____ UEL 46%
- Vapour density: 1.19 (air = 1)
- Solubility: at 30 C = 2950 PPM
_____ at 50 C = 1850 PPM

Awareness & Escape

Emergency situation without escape set:

- do NOT panic !!!
- hold your breath
- check the wind direction
- escape upwind or crosswind
- call for help
- don't rush in to help a colleague-recipe for disaster!



Awareness & Escape

Emergency situation with escape sets

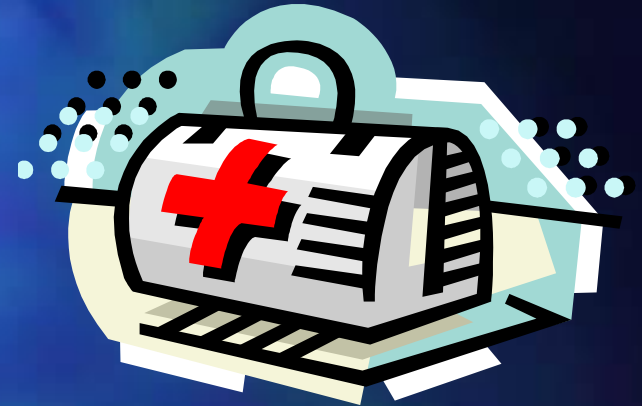
- Do NOT panic !!!
- Hold your breath
- Don the escape set
- Check the wind direction
- Escape upwind or crosswind to the nearest muster point or exit
- Watch out for your buddy, but do not attempt a rescue
- Report to the facility operator or control room immediately



Awareness & Escape

First Aid

- If possible remove victim overcome by H₂S to a position of safety in fresh air
- If victim is not breathing give Artificial Respiration immediately or use oxygen resuscitator if breathing difficulty.
- Flush exposed skin and eyes with running water for at least 15 minutes
- Remove contaminated clothing
- Keep victim warm, comfortable and quiet
- Reassure the victim that he's going to be OK



Awareness & Escape



DO's for working in H2S areas:

- training programmes
- knowledge of hazards of H2S and SO2
- knowledge of H2S detectors and personal monitors
- note wind direction
- know how to wear & operate your BA set-keep clean shaven(ADCO facial hair policy-HSE Manual 10- part 8)
- familiarisation of briefing areas, muster points, exit gates and warning system
- first aid knowledge
- evacuation procedure
- correct use of ventilation equipment (confined spaces entry)
- REGULAR escape drills are a MUST !!!



Procedures Manual

Know your company policies & procedures!

Part 8 of Procedure
Manual 10 covers
the procedures when
working in areas
where there is H₂S
present. Familiarise
yourselves with it.



Awareness & Escape



DON'T's:



- be overconfident
- neglect H₂S safety procedures
- work alone
- get lazy in checking personal monitor
- enter confined spaces without proper gas testing and
- wearing proper RPE
- panic
- make attempts to rescue without RPE
- carry on work if you suspect any danger



ADCO Fields

(Abu Dhabi Company for Onshore Oil Operations)

- | | | |
|-----------|-------|------------|
| • Bab | up to | 270,000ppm |
| • Bu Hasa | up to | 9,000ppm |
| • Shah | up to | 3,000ppm |
| • Sahil | up to | 500ppm |
| • Asab | up to | 100ppm |

Awareness & Escape

Summary:

- Know your enemy = **H2S**
- Be alert at all times
- Know the procedures for your safekeeping
- Never panic:- panic increases your breathing rate and will only make matters worse
- Always assume the worst:- avoid complacency.
Complacency KILLS !!!

Finally,

- Remember- don't take chances with H₂S
- You won't get a second chance
- Work safely & have a nice day!