

# TRAINING PROGRAMME FOR ETP OPERATORS IN TEXTILE INDUSTRY

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC

# Managing H2S and work in confined space

GIZ FABRIC – ETP Operator Course



# Contents

- Safety issues with Hydrogen Sulphide gas
- Precautions for working in confined space
- Precautions for dealing with Hydrogen Sulphide gas

# Safety issues with Hydrogen Sulphide gas

# Safety issues with Hydrogen Sulphide gas

- Generation and release of Hydrogen Sulphide ( $H_2S$ ) gas key risks in ETP
  - **highly toxic**, colorless gas, **heavier than air**, invisible, strong **unpleasant odor** (in low concentrations)
  - causing drowsiness, nervous problems, loss of consciousness, death (in high concentration)
- Detection of  $H_2S$  critical:
  - **strong odor in very low concentration** not having adverse effects on health
  - **Severe health effects in higher concentrations**, when not detectable by humans by smell
    - ▶ Often wrong assumption about no  $H_2S$  being present (!)



# Safety issues with Hydrogen Sulphide gas

## Impact of H<sub>2</sub>S gas on humans

Exposure in ppm	Time	Effect on unprotected person
0.03	No limit	No effect
0.03-2		Odour threshold
10	Up to 8 hrs	No effect
10-20		Threshold for eye irritation
20-200		Headache, nausea, general weakness, pain in legs
200-500	1 min.	Irritation of nose & throat, vertigo, blurring of vision, temporary loss of consciousness
500-900	1 min.	Profound coma, muscular spasm- twitching convulsions, disorientation after recovery
900 and above	1 min.	Instant coma and death

# Safety issues with Hydrogen Sulphide gas

## ETP locations with Hydrogen Sulphide gas risk

- Raw effluent channel
- Manholes
- Pumping stations and receiving sump at ETP
- Valve and pump pits
- Equalization tank, effluent transfer pump sump and valve pits
- Unutilized pits and tanks
- Primary sludge pumping room and tanks
- Sludge thickener
- Sludge dewatering equipment feed tank



# Safety issues with Hydrogen Sulphide gas

## ETP locations with Hydrogen Sulphide gas risk



Effluent channels



Sludge collection tanks



Deep pits



# Precautions for working in confined space

## Precautions for working in confined space

# Precautions for working in confined space

## Special focus – Confined spaces

- Defined as location just large enough for one person to enter and perform assigned work
  - **limited or restricted** means for **entry or exit**
  - not designed for continuous worker occupancy
- Typical areas in ETPs:
  - sewers
  - tanks
  - pits
  - any location with cramped space and narrow openings.



# Precautions for working in confined space

## Special focus – Confined spaces

Serious hazards associated:

- **difficult access**
- **inadequate ventilation**
- noxious and **poor air quality**

### Important

- Two-thirds of deaths in confined space when people trying to rescue someone else
- **Challenging rescue situation**, particularly poorly planned and lack of adequate emergency provisions



# Precautions for working in confined space

## Safe work practices

**Before entry** or work in confined space

- Careful planning using **standard operating procedure**
- **Never alone**, always team involved (worker and stand-by team)
- **Training and briefing** on
  - work procedures
  - rescue procedures
- Availability of necessary gear and protective equipment



# Precautions for working in confined space

## Safe work practices

### Necessary gear and protective equipment

- Tripod
- Full Body Harness
- Work winch to raise and lower materials only.
- Man-rated winch
- Personal protective equipment
- H<sub>2</sub>S detector or at least lead acetate paper.
- Self-contained breathing apparatus (SCBA)

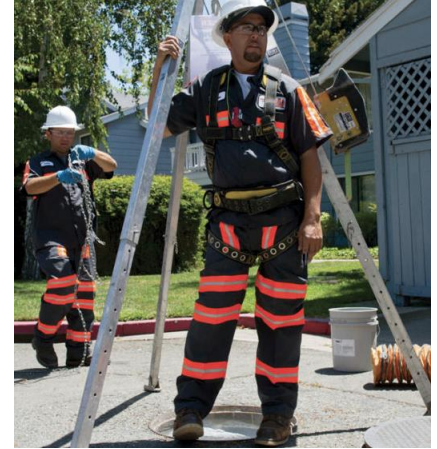


# Precautions for working in confined space

## Safe work practices

### Personal protective equipment (PPE)

- **Helmet**
- **Boots**
- Elbow length **gloves**
- **Full body suit** (PVC or similar material) suitable for maintenance work in manholes, pits and tanks
- **Full body type harness**
  - light weight
  - made of washable canvas
  - straps for shoulder, waist and legs



# Precautions for working in confined space

## Safe work practices

### Entry procedures

1. Brief all persons involved
2. Ventilate confined space well (natural, mechanical)
3. Use detector to assess air quality before work
4. Lower worker attached to independent lifeline for adequate fall protection and retrieval
  - Worker to stay connected to lifeline all time
5. Monitor air quality during work
6. Stand-by team to maintain contact with worker all time



# Precautions for dealing with Hydrogen Sulphide gas



# Precautions for dealing with Hydrogen Sulphide gas

## Detection and measurement of H<sub>2</sub>S

### H<sub>2</sub>S meters commonly used

- **On-line meters** installed in fixed location
  - in raw effluent and sludge handling areas
  - to alert operators with alarm at set concentrations (e.g. 10 to 15 ppm)
- **Portable meters** for real-time accurate reading
  - For testing confined spaces and general work areas to verify presence or elevated levels of H<sub>2</sub>S
- **Personal detectors** worn by workers
  - to alarm workers at set concentrations (e.g. 10 to 15 ppm)



# Precautions for dealing with Hydrogen Sulphide gas

## Detection and measurement of H<sub>2</sub>S



Portable meters



On-line meters

# Precautions for dealing with Hydrogen Sulphide gas

## Detection and measurement of H<sub>2</sub>S

### Alternative methods without meters

- using **lead acetate paper** as emergency measure
- Similar to pH papers and handy.
  - paper strips extended into tank or areas for few minutes,
  - coloration indicate gas presence, but not very reliable compared to H<sub>2</sub>S meter
- Moist lead acetate paper turning black due to formation of lead sulphide when reacting with gas.



# Precautions for dealing with Hydrogen Sulphide gas

## Protecting against H<sub>2</sub>S

Need for external supply of clean air (oxygen)

- Self contained breathing apparatus (SCBA)
- Air line supply system



# Precautions for dealing with Hydrogen Sulphide gas

## Protecting against H<sub>2</sub>S

### Using air line supply system to work in deep tanks

- **Compressed air cylinders** supply for one or two wearers
  - 1.5 hours for two persons or 3 hours for one person
  - depending on workload, ambient temperature, wearer`s stress level.
  - **air supply** to be constantly **monitored**
- **Wire embedded rubber air hose** with adjustable couplings of at least **at least 15 meters**.
  - protected against contact with sharp edges
  - regularly tested for wear, tears and leaks.



# Precautions for dealing with Hydrogen Sulphide gas

## Protecting against H<sub>2</sub>S

### Using air line supply system to work in deep tanks

- **full vision face mask** with
  - inhalation and exhalation valves
  - double sealing frame
  - speech diaphragm
  - self demisting.

### Important

- Check **proper sealing of mask**
  - wearers with large beards (!)

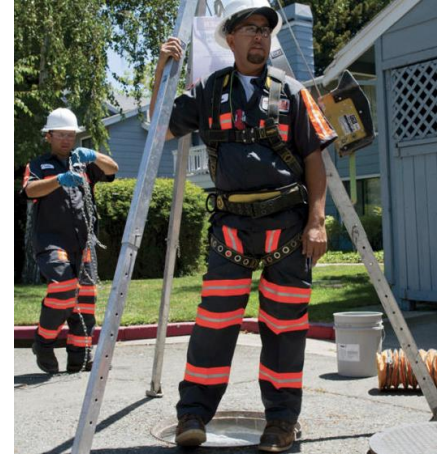


# Precautions for dealing with Hydrogen Sulphide gas

## Work procedure for areas with H<sub>2</sub>S

Similar to confined space

- Use mechanical equipment to avoid manual entry
- Agitate tank or areas manually or mechanically
- Induce temporary air circulation using blowers
- Check H<sub>2</sub>S gas with gas meter (or lead acetate paper)
- Enter with safety harness, air supply unit, gloves and boots
- Person outside maintains clear and constant communication with worker inside
- Compressor to be placed at distance to draw fresh air
- Compressed air to be free of moisture, oil and carbon monoxide





# Precautions for dealing with Hydrogen Sulphide gas

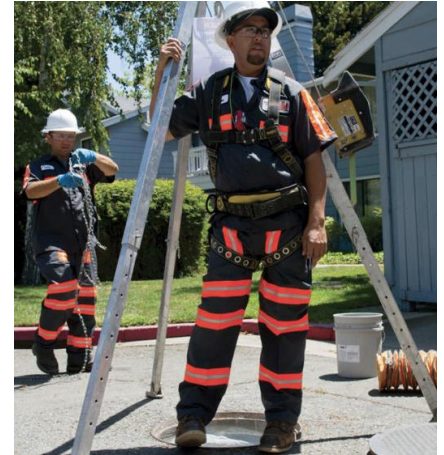




# Precautions for dealing with Hydrogen Sulphide gas

## Being prepared for emergencies

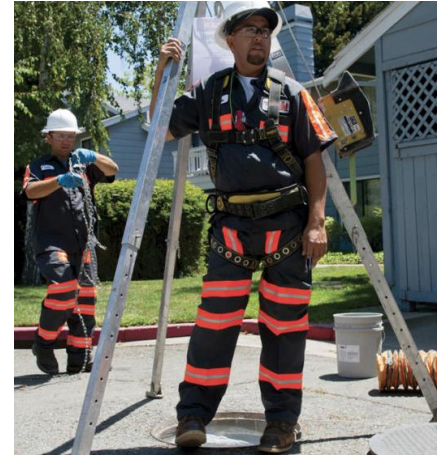
- **Exclusive emergency** and safety **equipment**
  - ready in properly **marked location**
  - **clean** and in **good order**
- First aiders and yourself **trained on required measures**
- **Rescue drills** for all risk locations in your ETP
  - in particular from tanks, pits, manholes



# Precautions for dealing with Hydrogen Sulphide gas

## Being prepared for emergencies

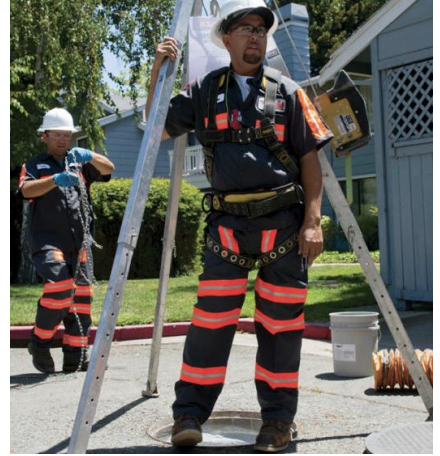
- **Contact numbers** of fire brigade and hospital on display.
  - Close liaising with nearest **fire brigade** for immediate assistance
  - Close liaising with **company doctor** and nearest **hospital** to assure their emergency preparedness
- ▶ **On-site emergency provisions to match response time of emergency services!**



# Precautions for dealing with Hydrogen Sulphide gas

## Responding to emergencies

- Protect yourself before rescuing victim using appropriate safety equipment
  - **Do not enter area if not adequately protected!**
- Immediately remove victim from accident area
- Alert emergency service
- Start providing first aid (see next slide)
- Arrange for transport to nearest doctor or hospital

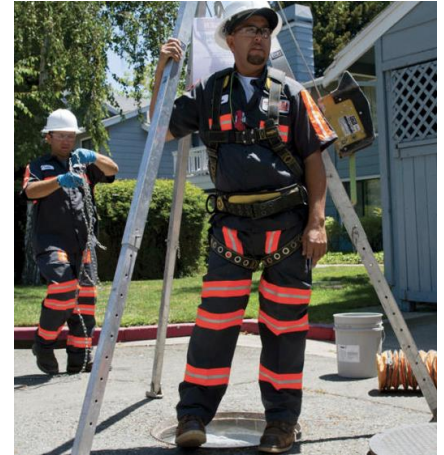


# Precautions for dealing with Hydrogen Sulphide gas

## Responding to emergencies

### First aid measures

- Artificial respiration if victim not breathing
- If breathing and unconscious, place victim on side with face down
- Attend to wounds and stop bleeding
- Treat for shock.
  - Place victim on side and
  - Cover with blanket to keep warm.



# Precautions for dealing with Hydrogen Sulphide gas

## Responding to emergencies

### First aid measures

H <sub>2</sub> S exposure	Symptoms	Preventive measures	First Aid measures
Inhalation	Cough, dizziness, headache, sore throat, lung edema, unconsciousness	General ventilation Local exhaust ventilation Respiratory protection	Fresh air and rest Artificial respiration Medical attention including oxygen supply
Eye contact	Redness, eye pain	Safety goggles Eye protection combined with respiratory protection	Washing eye with fresh water Rest

# To remember

- Priority to **avoid need for entry** into confined and H<sub>2</sub>S risk areas
  - Example:
    - Use of mechanical equipment for manhole and UG tank cleaning
- Develop and use **standard operating procedure**
- Keep ready and use necessary **safety and emergency equipment**



Mechanical cleaning at VANITEC CETP

# For further reading and reference

- UNIDO Pocketbook “How to deal with H<sub>2</sub>S gas in ETPs”
  - <https://open.unido.org/api/documents/4670868/download/How%20to%20deal%20with%20hydrogen%20sulphide%20gas%20in%20tanneries%20and%20effluent%20treatment%20plants>
- UNIDO Safety Video
  - [www.youtube.com/watch?v=xQkXMyetLfM&t=157s](http://www.youtube.com/watch?v=xQkXMyetLfM&t=157s)
- UNIDO e-learning
  - <https://leatherpanel.org/content/unido-line-course-how-deal-hydrogen-sulphide-gas>

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