Chlorine Safe Handling Training
INTRODUCTIONS
AGENDA

This training will review the following information:

• Chlorine packaging process overview
• Chlorine’s physical and chemical properties
• Chlorine’s health effects
• PPE
• Safe chlorine handling practices
• Emergency response
• Regulatory requirements

Question & Answer session
Water & Wastewater Video
Chlorine Packaging

Process Overview
Chlorine Process Overview

Chlorine Process Block Flow Diagram

Air Compressor

Air Dryer

Unipro R/C Safety

Tank Car Safety System

Chlorine Railcar

Bleach Production

Container Filling

Blow Down

Vacuum

Barometric Loop

Eductor & Pump

Scrubber Tank

Container Storage

Gas Detection System

Date: 10-16-13
Chlorine Packaging - Evacuation

• All cylinders and tons are completely evacuated upon return.
  • Required to perform tare weight check.
  • Detect presence of water
  • Detect excessive corrosion
  • Necessary to perform internal inspection
Chlorine Packaging - Inspections

• Cylinders internal inspections:
  • Rust or debris
  • Moisture
  • Completed before every refill

• Ton containers internal inspections:
  • Rust and debris
  • Excessive pitting
  • Moisture
  • Completed prior to every fourth refill

• External inspections:
  • Gouges, dents and pitting
  • Test date
  • Fuse plugs
  • Threads of openings
Chlorine Packaging – Preparation for Filling

• Valve installation:
  • Cylinders valves replaced with rebuilt valves every refill
  • Ton container valves inspected and refurbished as needed.
  • Packings replaced every refill
• Cylinders & ton containers are painted as needed
  • Footring/bottom inspection every refill
• Required markings verified
Chlorine Packaging - Filling

- Cylinders and ton containers filled on scales
  - Tare weight checks
    - 5% loss in tare and cylinder/ton container require retest
    - 10% loss in tare cylinder/ton container condemned
  - Valve operation confirmed
  - Packing nut torque confirmed
  - Valve stem closed to 20 to 50 ft-lbs.
  - Outlet cap applied
  - Protective bonnets replaced
  - Labels applied
  - Extra lead washers attached.
Chlorine Packaging – Storage and Shipping

- Cylinders/ton containers stored for 24 hours before shipping
  - Confirm no leaks
- Cylinders stored in cages for safe movement and securement
- Tons stored off the ground and with adequate spacing for inspection
- Cylinders typically shipped in cages
- Ton containers shipped on specially designed flatbeds
Physical & Chemical Properties
Vapor Pressure

Definition - The amount of pressure exerted by the vapor against the walls of its container at a given temperature.

Temperature F | PSIG
---|---
-29 | 0
60 | 69
85 | 111
158 | 302

Note: Pressure increases at a greater rate as temperature increases.
Liquid Volume of Filled Containers

- Containers are only filled to 1.25 times its water capacity or approx. 82.5% at 0 F.
- At 156 F the container is completely liquid full.
- Liquids compress very little, generating high pressures when confined and temperature increases.
- Fuse plugs melt at 156 F, preventing a hydrostatic pressure from rupturing the container.
Liquid Filled Container
Physical & Chemical Properties

• Chlorine & water
  • Low solubility, < 0.7% at 20 °C
  • Liquid chlorine is approximately 1.4 time heavier than water
  • \( \text{Cl}_2 + \text{H}_2\text{O} = \text{HOCl} \) and \( \text{HCL} \)
Physical & Chemical Properties

Vapor Expansion

• Definition – The amount of vapor that is produced when the liquid evaporates
• Vapor expansion of liquid chlorine is approximately 460 to 1

150 pound cylinder if released will:
• Fill a room 10’ x 10’ x 8’ with 100% chlorine gas.
• If allowed to disperse to the IDLH (10 ppm) it would cover an area of 229 acres by eight foot high.
Health Effects
## Health Effects

<table>
<thead>
<tr>
<th>TYPES OF HAZARD/EXPOSURE</th>
<th>ACUTE HAZARDS/SYMPTOMS</th>
<th>PREVENTION</th>
<th>FIRST AID/ FIRE FIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>EYES</td>
<td>Corrosive. Pain. Blurred vision. Severe deep burns.</td>
<td>Full Face Respirator or Safety goggles in combination with respirator recommended for container change outs.</td>
<td>First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then seek medical attention.</td>
</tr>
<tr>
<td>INGESTION</td>
<td>Unlikely – Changes to a gas upon loss of containment.</td>
<td></td>
<td>Refer for medical attention.</td>
</tr>
<tr>
<td>Exposure Level (ppm)</td>
<td>Effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2 - 0.4</td>
<td>Odor threshold (decrease in odor perception occurs over time)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 0.5</td>
<td>No known acute or chronic effect.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>TLV-TWA, REL-Ceiling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PEL-Ceiling, TLV-STEI, ERPG-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3</td>
<td>Mild, mucous membrane irritation, tolerated up to 1 hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 – 15</td>
<td>Moderate irritation of the respiratory tract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ERPG-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>IDLH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>ERPG-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Becomes visible – estimated, humidity dependent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Immediate chest pain, vomiting, dyspnea, cough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 - 60</td>
<td>Toxic pneumonitis and pulmonary edema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>430</td>
<td>Lethal over 30 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>Fatal within a few minutes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 CI Pamphlet 63
PPE
PPE

• For areas where chlorine is stored or used:
  • Escape Respirator available
  • Normal work clothing
  • Compliance with facility’s PPE requirements

• For initial line breaks:
  • Chlorine gas – Full face respirator
  • Chlorine liquid – Full face respirator and protective gloves

• PPE recommendations above based on facility:
  • Has performed industrial hygiene sampling
  • Employees have been trained
  • Has system for purging and evacuating piping before line break
Limitations for respirators:

- **Escape respirators**
  - Only for evacuating contaminated area *immediately*
  - Must have sufficient oxygen level

- **Full face respirators**
  - Must be medically approved
  - Fit testing required annually
  - Must know concentration of chlorine and it be within respirator’s limitations
    - If level not known, then SCBA required
  - Must have sufficient oxygen level
Transportation on public roads of any amount:

- Requires a CDL with hazmat endorsement
- Hazmat permit for facility
- Transportation security plan
- Driver training
- Placarding
- Shipping papers

Transportation of empty containers have the same requirements as full
Transportation, Storage & Handling

Storage concerns:
• Store in dry areas, away from direct sunlight if possible
• Away from heat sources
  • Aware of two instances where heaters in small storage rooms melted the fuse plugs resulting in a release.
• Gas detection equipment in storage areas
  • Location of probes
  • Calibration
• Access to cylinders or ton containers for emergency response
• Fire protection
Connecting, Use & Disconnecting
Containers - Ton

Ton Container Design

• Each Valve opening has an eduction tube.
  • When valves are vertically aligned top feeds gas and bottom feeds liquid.

• Each end of container has three fuse plugs.

• Valves and fuse plug openings may be ¾ inch or one inch.

• The ton container has its tare weight(s) and test date(s) marked on the chime area.
  • Typically is also marked on container near the valves
Containers - Cylinders

• Cylinder Design:
  • Foot Ring
  • Bump bottom (Heavy)

• Cylinder’s test date and tare weight marked on shoulder area.
  • Hydrostatic test is valid for 5 years.
  • Tare weight – It may more than one tare weight marked indicating it has been requalified since its original manufactured date.

• DOT markings – One inch
  • “Poison - Inhalation Hazard”
  • “Chlorine”
Chlorine Valves

Valve Design
• Body made of a brass alloy.
• Stem is monel.
• Packings may be garlock or teflon.
• One full turn allows maximum flow.
• Always check packing nut before opening.
Chlorine Valves

Cylinder Valves
• Fuse plug is part of valve.
• Only ¾ inch NGT inlet threads.
• Four oversize versions available.

Ton Container Valves
• No fuse plug.
• May be ¾ inch or 1 inch NGT inlet threads.
• Valve seat opening may be larger than cylinder valve’s.
• Four oversize versions available.
Chlorine Valves

• Connections to cylinder and ton container valves always use a yoke.
  • Lead washer, replace after each use.
    • Used lead washers must be disposed of properly.
  • Check valve’s outlet face for imperfections that may prevent gasket from sealing.
  • Some Chlorinators may not require a yoke to mount.

• CGA Connection 660 is not recommended

• Valve outlet threads are not standard tapered pipe threads – do not use standard pipe fittings
Connecting

The suggested steps for connecting a cylinder or ton container are:
• Check packing nut that it is hand tight at minimum
• Verify valve stem is closed
• Remove outlet cap
• Check that valve face is clean and smooth
• Using a new gasket, connect yoke and adaptor
• Tighten yoke to make seal, but do not over tighten
**Disconnecting**

The suggested steps for disconnecting a cylinder or ton container are:

- Wear PPE
- Close valve using torque wrench to 25 ft-lbs.
- Check for pressure drop to 0 psig
- If leak exists (as indicated by pressure increase), increase torque to 40 ft-lbs.
- If valve still leaks, increase torque to 50 ft-lbs. Recheck for leak.
  - If leak still exists, contact supplier.
- If pressure remains constant at or below 0 psig, remove connection.
- Verify outlet cap has gasket and replace valve outlet cap.
- Replace valve hood or bonnet.
Valve Torque

- Excess torque does not usually help the situation.
- If valve is difficult to open, a sharp blow to the wrench versus a slow increase in pressure on the wrench may open valve.
- Alternative is to return the cylinder to your supplier.
- Please mark any valves that are problematic so your supplier can be sure to address them.
Minor Leaks

Valve leaks:

- If at packing nut, tighten nut ½ turn past hand tight. If this does not stop the leak when valve is in use contact supplier
- If through fusible plug (cylinders), apply A kit. Contact supplier.
- If through threads at cylinder or ton opening, apply A kit for cylinders and B kit for ton containers and contact supplier
- If at outlet cap threads, verify valve is closed and tighten outlet cap. Contact supplier

If valve will not completely shut off, try opening and closing the valve a few times while it is still connected to the system. If this does not stop the leak, contact supplier

If fuse plug on ton container leaks, apply B kit and contact supplier. Do not attempt to tighten the fuse plug unless your certain there is no corrosion of the threads or plug.
Minor leaks

• Remember – leaks only get worse, take action when leaks are noticed.
• Please label or tag any bad valves so supplier can follow up with the issue
• Ensure the leak detector solution is of adequate strength
Information, Training & Security
Regulatory Issues

Security
• May be required to have a Security Plan. Be aware of your responsibilities.

EPA – Pesticide
• Chlorine is a registered pesticide.

Risk Management Plans
• A plan to protect the community from hazards

Process Safety Management
• A plan to protect employees from hazards
Information, Training & Security

Sources for additional information:

- The Chlorine Institute (chlorineinstitute.org)
- Most safe handling pamphlets are available for free downloads.
- Safety Videos on safe handling
- Safety Postures
- Your supplier
- Univar provides safe handling seminars
- Other Sources (WEF, AWWA, NWRA, etc)
- Safety Data Sheets
- Available on line from Univar USA Inc. or by request
Emergency Response
Chlorep

What is CHLOREP?
CHLOREP, CHLORine Emergency Plan administered and coordinated by The Chlorine Institute, is a program to provide an organized and effective system for responding to chlorine emergencies in the United States and Canada. It operates on a 24-hour, 7-day-a-week basis with established phone contacts.

How is the CHLOREP Team notified of an emergency?
CHEMTREC (Chemical Transportation Emergency Center), operated by the American Chemistry Council and CANUTEC (The Canadian Transport Emergency Centre in Ottawa) are the Emergency Dispatch Agencies. The dispatcher telephones the designated CHLOREP Emergency Contact who notifies the CHLOREP Team Leader.
# Emergency Response Training

**Summary of HAZMAT Responders Training Requirements** *(29 CFR 1910.120)*

<table>
<thead>
<tr>
<th>Response Level</th>
<th>Minimum Training Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness level</td>
<td>Understanding of hazardous materials, including their risks, and of how to secure the site and notify others in case of an emergency</td>
</tr>
<tr>
<td>First responder, operations level</td>
<td>8 hours of training, including awareness-level topics</td>
</tr>
<tr>
<td>Hazardous materials technician</td>
<td>24 hours of training, including operations-level topics</td>
</tr>
<tr>
<td>Hazardous materials specialist</td>
<td>24 hours of training equal to technician-level competency</td>
</tr>
<tr>
<td>On-scene incident commander</td>
<td>24 hours of training equal to operational level plus competency in commanding incidents and implementing emergency response plans</td>
</tr>
<tr>
<td>Skilled support personnel</td>
<td>Initial pre-entry briefing</td>
</tr>
<tr>
<td>Specialist employees</td>
<td>Annual training and competency in area of specialization</td>
</tr>
</tbody>
</table>
Emergency Response - Planning

The facility’s emergency response plan should be coordinated with the Local Emergency Planning Committee (LEPC).
- Evacuation versus Shelter in Place
- Response capabilities of the facility
- Response capabilities of outside agencies and contractors

Additional information on emergency planning is available:
- Chlorine Institute Pamphlet 64
- Chlorine Institute Video “Chlorine Emergencies”
- LEPC
- Local Fire department
Wrap Up
QUESTIONS