Accidental Mixing: Dangers, Incidents, and Prevention
Definition

Accidental Mixing: the unintended combination of two or more chemicals
Sodium Hypochlorite Reactions

- **Acids/ Acidic Compounds**: Chlorine Gas
  - + Sodium Hypochlorite

- **Ammonia**: Chlorine Gas + Explosive Compounds
  - + Sodium Hypochlorite

- **Organics (Fuel)**: Chlorine Gas + Explosive Compounds + Chlorinated Organics
  - + Sodium Hypochlorite

Source: CI Sodium Hypochlorite Incompatibility Chart
Unintended Consequences

Chlorine Gas is considered a toxic inhalation hazard (TIH) chemical

<table>
<thead>
<tr>
<th>Chlorine Exposure Thresholds in ppm</th>
<th>Description</th>
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<tbody>
<tr>
<td>0.2 – 0.4 ppm</td>
<td>Odor threshold (decrease in odor perception occurs over time)</td>
</tr>
<tr>
<td>1 – 3 ppm</td>
<td>Mild mucous membrane irritation, tolerated up to 1 hour</td>
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<tr>
<td>5 – 15 ppm</td>
<td>Moderate irritation of the respiratory tract. The gas is very irritating, and it is unlikely that any person would remain in such an exposure for more than a very brief time unless the person is trapped or unconscious</td>
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<tr>
<td>30 ppm</td>
<td>Immediate chest pain, vomiting, dyspnea (labored breathing), cough</td>
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<tr>
<td>40 – 60 ppm</td>
<td>Toxic pneumonitis and pulmonary edema</td>
</tr>
<tr>
<td>430 ppm</td>
<td>Lethal over 30 minutes</td>
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<tr>
<td>1000 ppm</td>
<td>Fatal within a few minutes.</td>
</tr>
</tbody>
</table>

Source: CI Pamphlet 1: Chlorine Basics
Sodium Hypochlorite Reactions

Metals
(Steel, aluminum, bronze, brass, Inconel®, Monel®, etc.)

Non-violent release of oxygen gas, could cause overpressurization of closed vessels or systems
Sodium Hypochlorite Reactions

**Hydrogen Peroxide** + Sodium Hypochlorite → Violent release of oxygen gas
Sodium Hypochlorite Resources

• Pamphlet 96) The Sodium Hypochlorite Manual
• HYPO-DVD) Handling Sodium Hypochlorite Safely
• Sodium Hypochlorite Incompatibility Chart
• Customer Checklist

All materials listed here are available from the Chlorine Institute: www.chlorineinstitute.org
Hydrochloric Acid Reactions

Caustic Soda/Alkalies + HCl → Heat, splashing of solution

Hot, uncontrolled, splattering liquids pose a threat to the chemical handler

Video – Caustic + HCL
Hydrochloric Acid Reactions

Metals + HCl → Hydrogen Gas (H₂)

- Concentrated H₂ is flammable between 4% and 75%
- A hydrogen gas-rich atmosphere can become an explosion hazard

Video – Aluminum Foil + HCL
Hydrochloric Acid Resources

• Pamphlet 98) Recommended Practices for Handling Hydrochloric Acid in Tank Cars
• HCL-DVD) Safe Handling of Hydrochloric Acid
• Pamphlet 163) Hydrochloric Acid Storage and Piping Systems

All materials listed here are available from the Chlorine Institute: www.chlorineinstitute.org
Caustic Reactivity

- Caustic reacts with pure metals or alloys of aluminum, zinc, and tin and may generate flammable hydrogen gas. The reaction of caustic with aluminum is particularly vigorous.

- Caustic will also rapidly attack and destroy leather and wool.
Caustic Resources

• Pamphlet 87) Recommended Practices for Handling Sodium Hydroxide Solution and Potassium Hydroxide Solution (Caustic) in Cargo Tank Cars

• Pamphlet 164) Reactivity and Compatibility of Chlorine and Sodium Hydroxide with Various Materials

• Pamphlet 65) Personal Protective Equipment for Chlor-Alkali Chemicals
Caustic Trailer Accidental Mixing Video
Case Study:
Sodium Hypochlorite + Ammonium Sulfate

Series of Events:

• April 2, 2014, a driver was scheduled to deliver ammonium sulfate to an unstaffed water treatment facility in Kitchener, Ontario
• The ammonium sulfate is accidentally delivered into a sodium hypochlorite tank
• The reaction is so violent, there is damage to the roof of the multi-story building
Case Study: Sodium Hypochlorite + Ammonium Sulfate

The Aftermath:

• There were concerns that nitrogen trichloride, a reactive byproduct was still present, days after the explosion occurred.

• There were three organizations involved:
  – Subcontracted delivery company
  – Chemical supply company
  – Facility owners

Damage to the roof of the Greenbrook Pumping Station can be seen Thursday, the day after an explosion there.
Case Study:
Sodium Hypochlorite + Ammonium Sulfate

• The incident receives multi-day news coverage
• 12 days after the incident, there is speculation that the building will need to be demolished due to structural issues
Safeguards - Drivers

- Empower drivers to refuse deliveries in unsafe conditions with upper management support
- Checklists
- Understand the nature/reactivity of the chemical
- Ask questions; double-check
All bulk tanks and the unloading connection point, must be clearly & correctly labeled according to their contents. Bulk delivery drivers are not allowed to transfer product into unlabeled tanks or lines.
Safeguards - Customers

- Label all hose connections and storage tanks
- Lock out unloading valves
- Double sign off that the connection has been properly made (by both driver and customer)
Safeguards - Suppliers

• Offer training
• Periodically inspect your customer’s facility
• Encourage drivers to raise safety concerns and questions; follow-up appropriately
• Incorporate safety policies regarding bulk deliveries that empower drivers by providing strong management support and buy-in
The Chlorine Institute Mission is Safety

Thank you for your attention!!!

CI exists to promote safety

Visit us online:  http://chlorineinstitute.org

Email questions:  techsvc@CL2.com