How major incidents can drive safety, sustainability and profitability: Lessons from the U.S. Chemical Safety Board

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Significant Historical Process Safety Events

Union Carbide, Bhopal (1984)
Thousands dead; tens of thousands injured

Arco Chemical (1990)
17 Dead; 5 Injured;
$36 MM in damage

23 Dead; 314 Injured;
$716 MM in damage

AP Photo/Sondeep Shankar
www.healthandsafetyatwork.com
www.gendisasters.com
Clean Air Act Amendments (1990)

- Created the Chemical Safety Board
- Risk Management Plan rule (RMP)
- Process Safety Management standard (PSM)
Vision:

A nation safe from chemical disasters.

Mission:

Drive chemical safety change through independent investigations to protect people and the environment.
About the CSB

• Independent, non-regulatory U.S. Federal agency
• Root cause investigations of chemical incidents
• Primary policy levers are outreach and safety recommendations.
Types of Incidents That We Investigate

Jurisdiction: Release of hazardous substance into the ambient air from a fixed facility

Deepwater Horizon
Gulf of Mexico
April 20, 2010

BP America Refinery / Texas City, TX
March 23, 2005

Freedom Industries / Charleston, WV
January 9, 2014

Provided to the New York Times

Jurisdiction: Release of hazardous substance into the ambient air from a fixed facility
Intercontinental Terminal Company
Deer Park, TX
March 17, 2019
Case Study: MGP Ingredients

MGPI Processing Plant

- October 21, 2016 / Atchison, KS
- 140 people sought medical attention
- Shelter-in-place, evacuation of thousands of residents
Overview of MGPI Toxic Release

See video

*Mixed Connection, Toxic Result*

https://www.youtube.com/watch?v=Tflm9mttAAI
Key Lessons from Incident

- **Design**
- **Human Factors**
- **Pipe Markings**
- **Procedures**
Fill line proximity
Pipe markings
Identical connections and locks
• Alarms and interlocks on process control system
• Automated shutdown procedures
• Building design and ventilation system
- Practices aligned with procedures
- Access to respirators
- Defined responsibilities during an emergency
Recommendations Issued to MGPI

• Commission an independent engineering evaluation of its building and ventilation system, and implement design changes and controls to protect occupants from a chemical release.

• Conduct an evaluation of the chemical transfer equipment and install appropriate engineering safeguards to prevent and mitigate an unintended reaction, chemical release, or spill during bulk unloading.
Post-Incident Changes

- Labeling of fill lines
- Chemical unloading procedures
- New couplings on sulfuric acid fill line
- Secure cages with card-reader access control
- Engineering system interlocks
- Design changes to control room
- Greater accessibility of respirators
Post-Incident Changes (cont.)

• Dedicated locks with separate keys
• New key fob lockout system
• Color-coded tags
• New shutoff valves
Top-to-bottom Review of Operation

Established local requirements for inspection, testing and standards for pressure vessels, piping, storage tanks, pressure-relief devices, pumps and control systems.
Process Hazard Analyses → Enhanced Safety

PHAs done on other chemicals at the transfer station:

- **Propylene oxide**
  (extremely flammable, probable carcinogen, RMP)

- **Phosphorous oxychloride**
  (water-reactive, PSM, RMP)

- **Acetic anhydride**
  (Class II combustible, irritant, water-reactive)

Identified potentially hazardous process deviations such as misdirected flow, high or low temperature, high or low-level indication, high or low pressure, and outside external elements.

The propylene oxide day tank and all instruments and conduit in the propylene oxide containment were replaced.
Bulk Flammable Chemical Removed

Process involving acetic anhydride was removed entirely and the tank decommissioned.

Number of liquid bulk chemicals: 5 → 4
Number of bulk flammable chemicals: 2 → 1
Additional Facts

Hired a full-time process safety engineer.

Achieved cost savings from streamlined, safer, more sustainable processes.
CSB SAFETY SPOTLIGHT: INNOVATION, A ‘KEY’ FACTOR IN DRIVING CHEMICAL SAFETY

The U.S. Chemical Safety and Hazard Investigation Board (CSB) spotlights the actions of a single plant for its response to our investigation. The MGPI Processing, Inc. (MGPI) facility’s thorough, thoughtful, innovative thinking and immediate implementation of safety improvements serve as an example of how companies can drive chemical safety change following an incident.

Summary of Incident and Key Findings
On October 21, 2016, a chemical release occurred at the MGPI facility when the driver of a chemical company’s delivery vehicle (owned and operated by another company) inadvertently connected its sulfuric acid hose to a tank containing sodium hypochlorite, better known in its less concentrated form as bleach. This mixture of two incompatible chemicals formed a solution, and the uncontrolled chemical reaction quickly formed a toxic vapor cloud. There was no way to stop the continued mixing of the chemicals other than closing manual valves or triggering one of the truck’s emergency shut-offs, neither of which could be accomplished due to the vapor cloud. The CSB found that the close proximity of the sulfuric acid and sodium hypochlorite fill lines increased the likelihood that workers would make an incorrect connection during chemical unloading. The two fill lines looked and functioned identically, and used the same type of connections, which were not clearly labeled or properly secured.

Thoughtful, Safety-Minded Planning
As the CSB conducted its investigation, MGPI facility managers were also examining their own processes and equipment to identify opportunities to reduce risk and prevent recurrences. Prior to the discussion of potential recommendations, the company presented the CSB with a list of processes and equipment that they were looking to modify.

As a result of MGPI’s initiative to address potential safety issues, the CSB only issued two recommendations to the facility. The first required MGPI to commission an independent...