
Understanding & addressing different types of hazards: CHEMICALS

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Introduction

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Outline

- Industrial Chemical Accidents & Disasters
- Lessons Learned
- Chemical Safety vs Security
- Mitigation Strategies
- Industrial Chemical Safety & Security
- Industrial Chemical Management
- Key Points
Industrial Chemical Disasters

1. Piper Alpha
2. Bhopal
3. Deepwater Horizon, Gulf Mexico
4. Visakhapatnam gas leak, India (2020) - styrene
Industrial Chemical Accidents

1. Tianjin Explosion, China, 12 August 2015, killed 173 people, injured hundreds of others at a Chemical storage station at the Port of Tianjin 800 tonnes of ammonium nitrate (approx. 256 tonnes TNT equivalent)

2. Beirut Explosion, Lebanon, 4 August 2020, a large amount of ammonium nitrate stored at the Port of the city of Beirut, exploded, causing at least 200 deaths, 3 people missing, and 6,500 injuries, US$10–15 billion in property damage, and leaving an estimated 300,000 people homeless. Around 2,750 tonnes of the substance (equivalent to around 1.1 kilotons of TNT) had been stored in a warehouse without proper safety measures for the previous six years
Industrial Chemical Accidents

1. Fire due to Chemical Theft (Oil & Gas, 2009): 1 deaths, USD7,000,000 – Chemical Security
2. Explosions in Fireworks Factory: 49 deaths – Poor understanding of chemical hazards (2017)
3. Illegal Oil Pipeline Tapping (2014) – 4 deaths, Chemical Security
4. Illegal Oil Drilling (2017) – 2 deaths, 20 severe burns, Chemical Security
Lessons Learned

- Inadequate **hazard identification or risk assessment**
- **Lack of understanding** in addressing chemical hazards & threats
- **Low awareness** on Chemical Safety & security
- Inadequate **work standards/procedures**
- Inadequate **supervision**
- Improper decision making or **lack of judgement**
- Inadequate **training/competence**
- Violation unintentional (by individual or group)
Chemical Safety
- Hazard assessment
- Consequence assessment
- Control measures assessment
- Safety incidents: accidental

Chemical Security
- Threat assessment
- Consequence assessment
- Protective Barriers assessment
- Security incidents: intentional

“Swiss cheese model”

Industrial Chemical Safety & Security

Industrial Chemical Safety

• Chemical Safety Risk is a measure of human injury, environmental damage, or economic loss in terms of both the incident likelihood and the magnitude of the loss or injury
• Protection of workers from chemical hazards
• Chemical accidents prevention
• Unintentional

Industrial Chemical Security

• Security Risk is an expression of the likelihood that a defined threat will exploit a specific vulnerability of a particular attractive target or combination of targets to cause a given set of consequences
• Protection of chemicals from misuse
• Chemical security incidents prevention
• Intentional

Mitigation Strategies

**Industrial Chemical Safety**
- Process Safety Management
- Major Hazards Control

**Industrial Chemical Security**
- Security Vulnerability Assessment
- Identify Critical Target
- Assess Threats & Consequences
- Evaluation of Safeguards
Mitigation Strategies
Industrial Chemical Management

PDCA Cycle

Chemical Order & Purchasing
Receiving
Storage
Transportation
Handling
Waste
Disposal
Mitigation Strategies
Industrial Chemical Safety

Process Safety Management – 20 element

1. Process Safety Culture
2. Standards, Codes, Regulations, & Laws
3. Process Safety Competency
4. Workforce Involvement
5. Stakeholder Outreach
6. Process Knowledge Management
7. Hazard Identification and Risk Analysis
8. Operating Procedures
9. Safe Work Practices
10. Asset Integrity and Reliability
11. Contractor Management
12. Training and Performance Assurance
13. Management of Change
14. Operational Readiness
15. Conduct of Operations
16. Emergency Management
17. Incident Investigation
18. Measurement and Metrics
19. Auditing
20. Management Review & Continuous Improvement

Major Hazards Control

1. Identification of major hazard installations
2. The role of management
3. The role of authorities
4. The role of workers & workers’ organisations
5. Emergency planning
6. Implementation of major hazard control systems
7. Prerequisites for a major control system

ILO, Major Hazards Control, 1993
Implementation of Industrial Chemical Security

• Security Vulnerability Assessment
  – Identify Target & Critical assets
  – Assess Threats
  – Assess Consequences

• Industrial Chemical Security Risk Reduction

• Evaluation of Safeguards
Target & Critical Assets
Industrial Chemical Security

Identify Critical Assets from your Facility

- People
- Equipment
- Systems
- Chemicals
- Products
- Information

What other possible Target & Critical Assets in your facilities?
Assess Threats

- Pirates
- Theft
- Public Demonstration
- Adversaries
- What other possible threats?
Assess Consequences

- Fire
- Explosion
- Pollution
- Injury
- Acute Toxicity
- Assets damages/loss

Is your organization ready for this?

Sources: Google image
Chemical Security Risk Reduction

- Deter, Detect & Delay Principles
- Physical or Cyber Protection
- Procedures & Administrative Controls
- Inherently Safer Systems
Types of Countermeasures

- Physical security & Barriers
- Detection equipment & Access Control
- Loss prevention, material control & inventory management
- Control Room Security
- Crisis Management & Emergency Response
- Policies & Procedures
- Information/cyber security
- Intelligence
Physical Security & Barriers

- Detection equipment
- Assessment / response
- Communication
- Access Control
- Material control, accountability & movement control

- Barriers
- Perimeter Protection
- Fencing
- Walls
- Landscaping
Detection Equipment & Access Control

Detection Equipment
Provides warning of unauthorized entry to areas within facilities
- Intrusion detection sensors & systems
- CCTV / video surveillance
- Alarm monitoring consoles

Access Control
- The objective: to establish positive control over whom & what is permitted entry to or exit from the site or critical areas of the site.
- Control over personnel, property & a vehicle passing through the site’s perimeter
- Access control:
  - Equipment
  - Building
  - Grounds design
  - Security practices
Evaluation of safeguards

*PIDAS:*
Perimeter Intrusion Detection and Assessment System

- Professional response force
- On-site guards
  - Sensors - cameras
  - Fences - access control
- Staff security awareness
- Threat understanding

Technology and/or Cost

Key Points

1. Understanding the chemical hazards & threats are very important

2. The urgency need to address chemical safety & security

3. Several mitigation strategies could be implemented to address chemical risks

4. Implementation of holistic approach to chemical safety, security and management
References

- Picturesources: Google image
Thank You

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