

CE 400 / CE 500

Process Safety Management

Lecture 01 Course Introduction

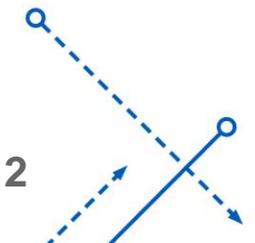
Instructor: David Courtemanche



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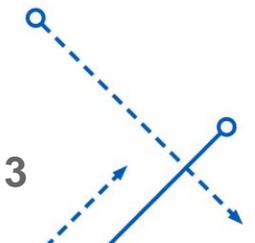
“If you think safety is expensive, try an accident”

- Trevor Kletz, 1922-2013, Father of Industrial Process Safety



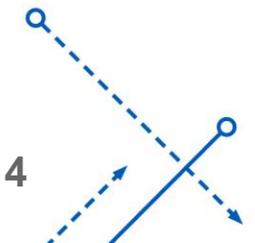
Chemical Engineering leads to many benefits to society

- Instrumental to world energy supply
- Mass production of many, many essential materials
- Food Supply
- Production of crucial medicines
- Introduction of new products



Unfortunately the benefits also lead to Hazards

- Toxic Chemicals
- Flammable Chemicals
- Exothermic Reactions
 - Leads to increases in temperature and pressure
 - Can cause rupture or explosion of process vessels
 - Pressure waves and projectiles
 - Release of flammable materials – Fire
 - Release of toxic materials



Personal Safety versus Process Safety

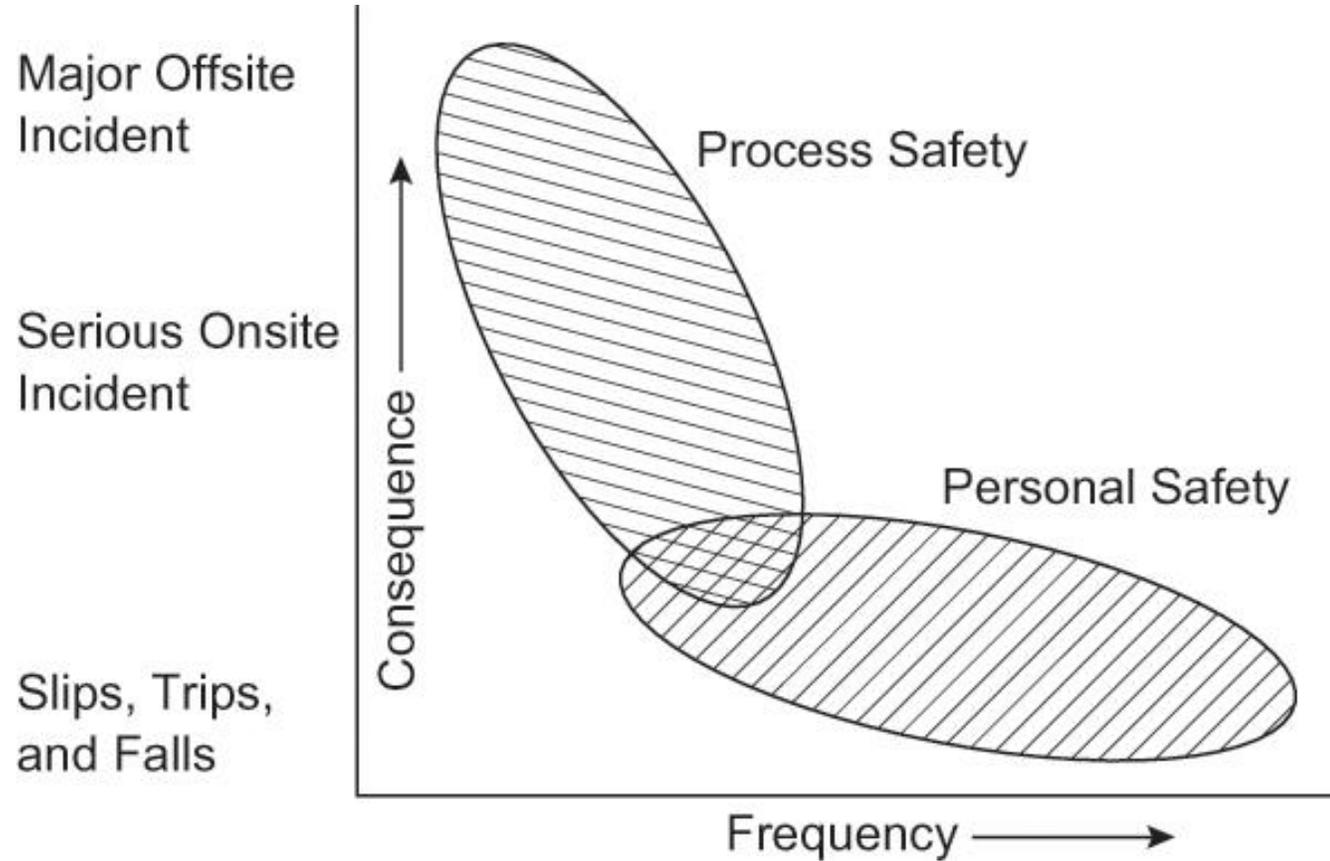
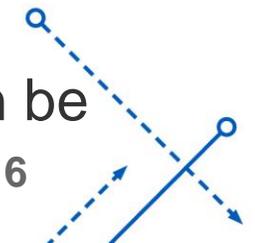


Figure 1-1 Personal safety versus process safety. Personal safety consists of more frequent, but lower consequence incidents. (Source: Dow Chemical Faculty Workshop, June 2017, AIChE.)

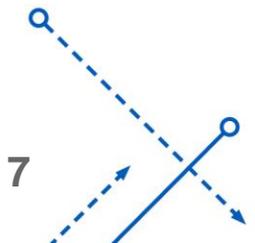
What Do We Mean by “Process Hazards”

- There are a variety of safety concerns at a manufacturing site
- Most of them are not “Process Safety” concerns
- Process Safety refers to hazards directly caused by process itself
 - They are unique to the specific process in question – therefore codes don’t suffice
- “**Hard Hat Safety**” – refers to generic safety considerations that apply to any manufacturing site and are mandated by other OSHA standards. For example:
 - Work platforms above a certain height off of the ground require safety rails to prevent
 - Wearing steel toed shoes and gloves in production area
 - Hearing Protection Programs
- These are regulations that are fairly straightforward to interpret and to comply with – they do not require a lot of in-depth analysis
 - Although one does need to be knowledgeable about the standards, they can be confusing



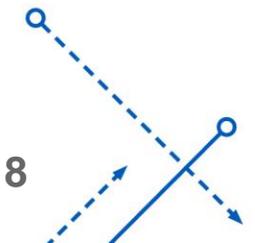
Fire Safety

- This is a specific set of standards by the NFPA (National Fire Protection Association)
- You might think that this would be a “Process Hazards” category but it is not
 - The codes will dictate things based on the flammability, quantity, and category of use (warehouse vs production, etc)
- Examples of code requirements:
 - Sprinkler Density
 - Allowable quantities
 - Allowable height of stacking of containers



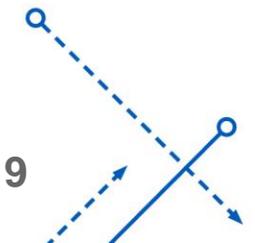
Machine Safety

- Machine Safety is a set of standards covering generic hazards associated with machinery that are not unique to the specific process in question:
 - Machine guards to prevent putting your hands in pinch points
 - Machine guard interlocks which shut off machinery if doors on the guard are opened
 - Emergency Stop buttons
 - Example: Presses usually require two buttons to be pushed simultaneously
 - Makes sure you don't absent mindedly have a hand in the line of fire



What Do We Mean by “Process Hazards”

- True Process Hazards are a result of both the materials and the process that we put them through
 - It is not enough to look at the properties of the materials by themselves at standard conditions
 - You must analyze them with respect to:
 - The properties of the individual chemicals as stored
 - The chemical interactions between the chemicals
 - The properties of the chemicals at the conditions of the process (normal and abnormal conditions!):
 - Temperature
 - Pressure
 - Chemical Interactions/Reactions
 - Catalytic Effects



Toxic Hazards

- The chemical itself will cause harm to people exposed
 - May be fatal
 - May cause permanent health effects
 - May just be an irritant
- Chronic
 - Need to be exposed over a long period of time for effects to manifest
- Acute
 - Single exposure is enough
- More on all of this in the next lecture...

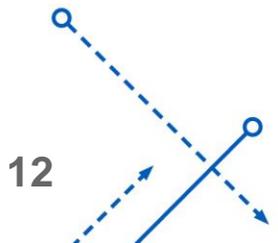


Fire and Explosion

- Need to assess the chemicals at all possible conditions your process may reach
 - Non-combustible, combustible, flammable
- Need to consider unexpected conditions as well as design conditions
 - Process upsets are when most incidents occur
- Hazards are both thermal (from fire itself) and pressure/projectiles from Vapor Cloud Explosions (VCE)
- Consider ignition sources and Loss of Containment (LOC)
- More on all of this in a later lecture...

Chemical Reactivity

- Two major concerns
 - Release of energy (exothermic reaction)
 - Temperature Rise
 - Pressure build up
 - Toxic Products
 - Both planned reactions and unplanned reactions from process upsets
- Need to consider other possibilities
 - Unplanned reaction leads plugged lines which leads to overpressure which leads to LOC



Electrical Hazards

- Normally electrical concerns are covered by electrical codes
 - National Electrical Code (NEC)
 - Various NFPA codes
- If the process itself has unique electrical hazards they may show up as Process Hazards considerations
- DuPont Sodium at old Niagara Falls Plant
 - Very large current put through molten salt to generate sodium metal via electrochemical reaction
 - The electrical hazards fell outside of normal electrical code considerations

- Course is accessed via website:
<http://wwwcourses.sens.buffalo.edu/ce400/index.html>
User Name: ce4500
Password: safety1st
- UBLearns will be used for submitting homework and remote exams

- 1st Tab – Syllabus
 - Typical Syllabus Information
 - Table of Lecture Topics by Date
 - Link to Panopto voiceover video
 - Textbook references
 - Link to PDF of Lecture Notes
 - Link to relevant homework assignment
- 2nd Tab – Homework
 - Links to Homework Assignment and Solution
 - Due date
 - List of relevant lectures
- 3rd Tab – Exams
 - Exam dates
 - List of relevant homework assignments and Lectures

