What should every graduating chemical engineer know about process safety and how can we make sure that they do?

W. David Harding – University of New Haven

Brian Harding – Mary Kay O'Connor Process Safety Center Texas A&M University

Peter Montagna – Henkel Corporation

Presented at 122nd ASEE Annual Conference June 16, 2015
Based on paper #11636

University of New Haven

TAGLIATELA COLLEGE OF ENGINEERING

Motivation

http://www.csb.gov/assets/1/14/GalleryMainDimensionId/Williams2.png

http://www.csb.gov/assets/1/14/GalleryMainDimensionId/Williams1.png

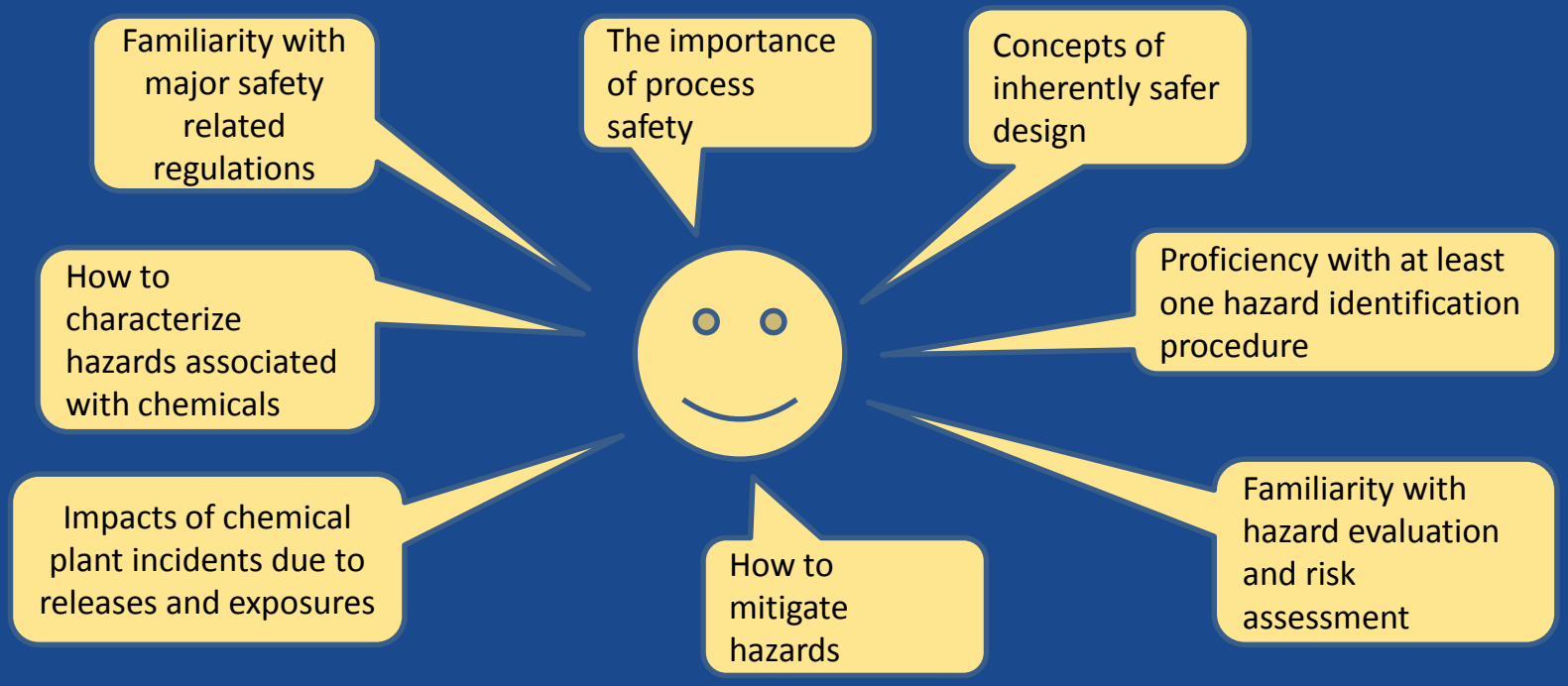
Motivation Part Two

- What are our responsibilities as ChE educators?
- Are current approaches reasonable?
- What chemical process safety topics are critical?
- What are good approaches to teaching these critical topics?
- What resources are available to support teaching of these topics?

Manuscript Includes

- Discussion of the new program specific requirements
- Review of recommended chemical process safety topics
- Suggested strategies for implementing process safety into the undergraduate chemical engineering curriculum
- Review of information sources to:
  - Help chemical engineering programs choose appropriate content
  - Support instruction in process safety
- Suggestions for assessing the effectiveness of instruction

What to teach?



Recommendations from SACHE, February 2010

Challenges

- How and where to incorporate into the curriculum
- Who will lead the effort
  - Adjunct with significant industry experience
  - Faculty specializing in chemical process safety
  - Faculty with specialized training
  - Faculty with a general interest

Primary Sources

- Text books to support chemical engineering instruction
  - General design related text
  - Texts that specialize in process safety
- Products produced by SACHE
- Products produced by CCPS
- E-learning products available through AICHE Academy
- Faculty expertise

Possible Strategies

- Core Course
- Elective Course
- Core course with reinforcement throughout curriculum
- Integration throughout the curriculum

University of New Haven Approach

- Develop a safety culture
- Disperse chemical process safety instruction throughout curriculum
- Focus on process safety in the unit operations laboratory
- Offer an elective course in chemical process safety

Incorporation of SACHE Modules

Mapping of SAChE Modules to Required Chemical Engineering Courses at University of New Haven		
Semester	Course	SAChE Module
4	Process Analysis	Process Safety 101
5	Transport Operations I	Process Safety Lessons Taught from Experience
5	Chemical Kinetics and Reactor Design	Runaway Reactions
6	Transport Operations II	Safety in the Process Industries
7	Chemical Engineering Laboratory	Risk Assessment
7	Chemical Engineering Design I	Chemical Reactivity Hazards
8	Mass Transfer Operations	Dust Explosion Control
8	Chemical Engineering Design II	Inherently Safer Design

University of New Haven Process Safety Course

- Overview of pertinent environmental and occupational safety & health regulations in the United States;
- Fundamentals of toxicology and controls (engineering/administrative/PPE);
- Modeling chemical releases;
- Reactive chemicals and processes;
- Fires/explosions (flammable liquids, combustible dusts) and their prevention;
- Pressure relief sizing and sizing bases;
- Risk assessment, including Hazard and Operability Study;
- Accident/incident investigation;
- Safety Instrumented Systems and Inherently Safer Technologies.

Current text: Crowl & Louvar, Chemical Process Safety: Fundamentals with Applications, 3rd Ed.

Assessing Student Learning

Suggested Performance Indicators Related to Process Safety	
Suggested Performance Indictor	Related Course
Students can identify potential hazards from a process flowsheet (analyze process flowsheet)	Design
Students can describe the steps in a Hazards and Operability Review	Design
Students can propose layers of protection to mitigate process hazards	Design
Students can describe conditions that are likely to lead to a runaway reaction	Chemical kinetics and reactor design
Students can analyze a chemical reaction scenario to determine potential for runaway reaction.	Chemical kinetics and reactor design
Students can determine the hazards associated with operation of laboratory equipment and propose measures to mitigate (or manage) hazards.	Unit operations laboratory

T2 Laboratories

http://www.csb.gov/assets/1/14/GalleryMainDimensionId/Photos_from_T2035.JPG

Wrap Up

As chemical engineering programs undergo reaccreditation they will need to demonstrate that they are integrating the program specific requirement relating to the hazards associated with chemical processes.

We authors hope that the information presented in the manuscript will serve as a resource to assist chemical engineering programs with development of an approach that fits their needs.