

My Unexpected Journey into Process Safety

Daniel A. Crowl

Herbert H. Dow Professor for
Chemical Process Safety

Department of Chemical Engineering

Michigan Tech University

Houghton, MI

MichiganTech.



Two Process Safety Opportunities

AICHE Annual Meeting, Monday, November 4

- **Workshop: Chemical Process Safety, Bridging Theory with Industrial Practice**

12:30 – 3:00 pm, Hilton, Union Square 24

- **Undergraduate Process Safety**

3:15 – 5:45 pm, Hilton, Union Square 24

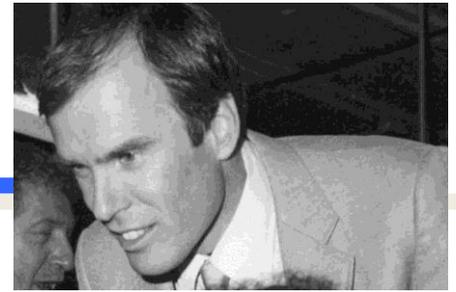
Both co-chair by Dan Crowl and Chip Howat

History – Dan Crowl

- 1971: BS, Fuel Science, Penn State**
- 1973: MS, Chemical Engineering, University of Illinois**
- 1975: PhD, Chemical Engineering, University of Illinois**
Thesis: “An Investigation of the Dynamics and Control of a Well-Stirred Combustor”
- 1975: St. Regis Paper Company, West Nyack, NY**
Senior Process Control Engineer
- 1977: Assistant Professor, Chemical Engineering, Wayne State University.**
Funding on modeling energy extraction from Michigan Oil Shale
- 1978(?): Joe Louvar walks in to my office.**
- 1983: Joe Louvar PhD: “True In-Situ Oil Shale Retort: The Role of Intrashale Transport and Char Gasification”**

No process safety up to this point!

History



- 1984: December: Bhopal accident
- 1985: February: AIChE forms Center for Chemical Process Safety (CCPS) and also Undergraduate Education Committee
- 1985: Summer: First summer **without any identifiable summer support**. Louvar offered Crowl summer job at BASF. **Crowl has epiphany.**
- 1986: Summer: Awarded grant from NSF: “Safety in the Chemical Process Industries”
Course module preparation
5 satellite broadcasts from BASF Process Development facility in Wyandotte, MI
- 1986: Louvar and Crowl decide to offer elective course on process safety at Wayne State.
- 1987: Louvar and Crowl are unable to find a suitable text for course, decide to write own textbook **(Hah!)**

History

- 1987: Crowl and Louvar join CCPS Undergraduate Education Committee**
- 1987: Fall Semester, CHE 657: Safety in the Chemical Process Industries elective course offered at Wayne State with 4 students!**
5 live video broadcasts from BASF to Wayne State and Michigan Tech classrooms.
- 1988: Submit textbook proposals to several publishers. Signed with Prentice Hall. Crowl and Louvar start to work!**
- 1989: NSF Funded 2-week workshop at BASF, Wyandotte on “Chemical Process Safety, Health and Loss Prevention” 14 registrants.**
Registrants given nearly complete draft of textbook.
- 1990: CCPS published problem set for students.**

History

1990: 1st edition of textbook published.

1991: CCPS forms Safety and Chemical Engineering Education Committee (SACHE). Activities include:

Course modules

Problem sets

Workshops

Videos

Other resources

1993: Crowl moves to Michigan Tech for appointment as Herbert H. Dow Professor for Chemical Process Safety.

1993 to

2007: Plenty of activity by SACHE but limited response from the academic community.



History

- 2007:** December: T2 Laboratories Explosion, Jacksonville, FL
- 2009:** September: U.S. Chemical Safety Board issues report on T2 Labs accident. Recommendations to AIChE: “Work with the Accreditation Board for Engineering and Technology, Inc. to add reactive hazard awareness to baccalaureate chemical engineering curricula requirements. “
- 2009:** November: AIChE Education and Accreditation Committee adds the following words to the chemical engineering criteria:
- “The curriculum must provide a thorough grounding in the basic sciences including chemistry, physics, and/or biology, with some content at an advanced level, as appropriate to the objectives of the program. The curriculum must include the engineering application of these basic sciences to the design, analysis, and control of chemical, physical, and/or biological processes, **including the hazards associated with these processes.**”
- 2010:** SACHE issues safety guidelines document.
- 2012:** New criteria goes into effect.



Adventures with Integrating Process Safety Content

Up until the early 1980's, process safety was almost entirely in the industrial domain.

- A lot of industrial information was not published.**
- The existing available information was scattered throughout a large number of sources.**
- The industrial folks usually stopped the development once their immediate problems were solved.**
- Many equations used fixed units.**
- For many equations the fundamental basis was long forgotten.**

BONUS!

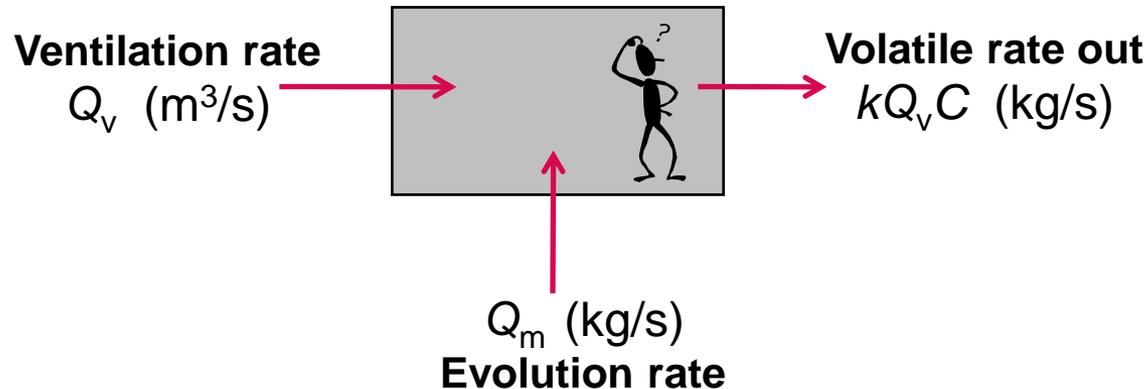
- **Industrial folks were delighted to assist since they understood the importance of academic instruction in process safety.**
- **For the most part, no academic had approached them before!**
- **They went out of their way to assist!**
- **For most cases there were no proprietary issues.**
- **AICHE provided enormous resources for learning. This included Safety and Health Division, CCPS, DIERS, others.**

Where did this come from??

Industrial Ventilation, A Manual of Recommended Practice

Ventilation requirements for evaporation of a solvent:

$$\text{Cu. Ft Dilution per hour} = \frac{403 \times \text{sp. gravity of solvent} \times 1,000,000 \times \text{pints solvent/hr} \times k}{\text{molecular weight of solvent} \times \text{TLV}}$$



$$V \frac{dC}{dt} = Q_m - kQ_v C \text{ at steady state: } C = \frac{Q_m}{kQ_v}$$

Obstacles to Adding to Curriculum – Late 1980s

- **“No room in curriculum”**
Plenty of new courses added in hot areas.
- **“Should be taught by industry”**
Industry wants a better graduate,
Easier to teach undergrads earlier,
Not all grads go to large companies → T2 labs.
- **“No classroom materials available”**
Textbook now available,
Tons of free SACHE materials (www.sache.org)
AIChE on-line instruction
- **“Faculty don’t have the proper background”**
SACHE workshops,
Lots of industrial help,
Global Congress on Process Safety,
Books, CCPS and others.
AIChE Process Safety Progress.

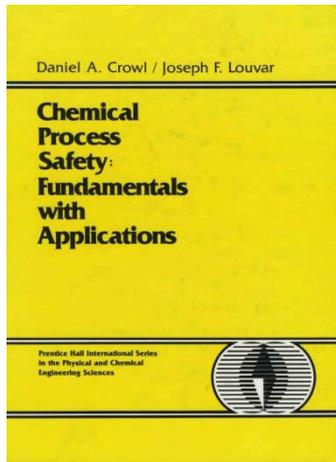
Adventures with Writing a Text on Process Safety

Goals for Textbook:

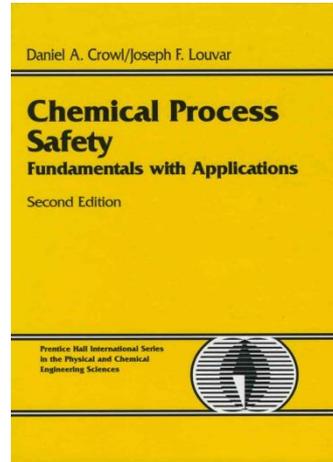
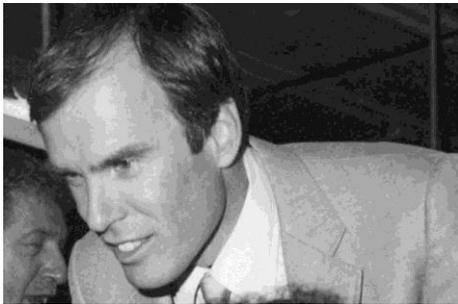
- Present process safety in a textbook of equal stature to other traditional chemical engineering texts.
- Provide a textbook of value to industry and academia.
- Demonstrate the rich, fundamental basis for process safety.
- Must be published in a top textbook line.

A **traditional** textbook on process safety had never been done before:

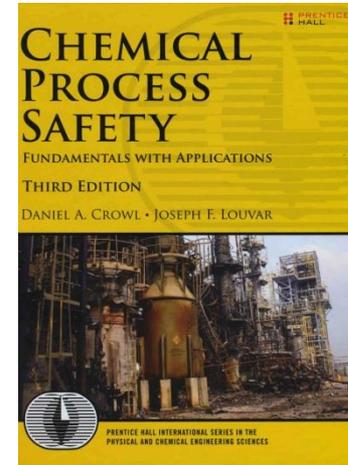
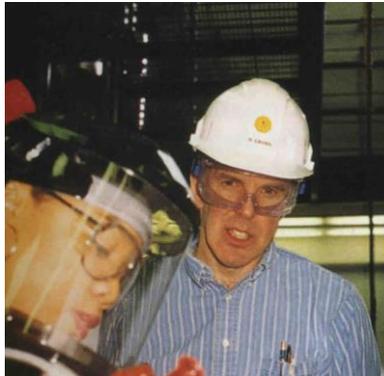
- The information must develop progressively.
- Fundamental equations must be derived and all assumptions listed.
- Plenty of active figures and tables
- Lots of example problems
- Lots of homework problems demonstrating how to apply concepts, with solutions manual.



First Edition
1990
426 pages



2nd Edition
2002
625 pages



3rd Edition
2011
723 pages



Trivia Question: What was the original title of Crowl and Louvar's textbook as submitted to Prentice Hall, the publisher?

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Answer: "The Fundamentals of Chemical Process Safety"

Summary

- **Up until the mid 1980s process safety technology was almost entirely in the industrial domain.**
- **Efforts started in the mid-1980s to include process safety instruction in the undergraduate chemical engineering curriculum.**
- **Industrial folks were delighted to assist.**
- **Many people and groups worked diligently to provide instructional materials, workshops, symposia and other items to chemical engineering educators.**
- **Despite these continuing efforts, very little progress on this from early 1990s until 2009.**
- **The new ABET criteria has resulted in a new increased level of process safety instruction for chemical engineering undergraduates.**



“A BAD situation might turn out to be the best thing that ever happened to you.”

“Don’t quit before the blessing occurs.”

**Thank you!
Questions?**