

SACHE News

Safety and Chemical Engineering Education - Spring 1999

Status of SACHE

J. F. LOUVAR, CHAIR
CCPS UNDERGRADUATE EDUCATION COMMITTEE

Meetings

I just returned from a SACHE committee meeting in Cleveland. It was on a Saturday and it started at 7:00 a.m.! We had 16 committee members there at 7:00 a.m. Now that's dedication.

1999 Workshop

The 1999 faculty workshop in Freeport, Texas (Dow Chemical Plant) is on schedule (May 16, 17, 18, and 19). The purpose of this workshop is to give professors information and experiences that will help them add some safety content into their courses. It will be similar to the very successful workshop that we conducted in Freeport last year.

Twenty-three professors and two graduate students will attend the 1999 workshop. They will acquire hands-on and in-plant experience on chemical reactivity, process hazardous analysis, and relief systems. Classroom lectures and discussions will be enhanced with tours in Dow's experimental safety labs and their Toluene Diisocyanate and Polymerization Plants.

2000 Workshop

We approved the organization and scheduling of another workshop in the fall of the year 2000. This workshop will be in the facilities and plants of BASF's site in Wyandotte, Michigan. The theme of this workshop will be "safe designs," including: business considerations, block diagrams, conceptual design revisions, PFDs,

P&IDs, safety reviews, safety features, etc. We are inviting department chairs, professors, and graduate students. Anyone interested in attending the year 2000 workshop should contact D. Cowl (cowl@mtu.edu).

1999 Products

Our SACHE member universities will receive the following products in 1999:

- CCPS Book of Choice (e.g., the new book: *Guidelines for Pressure Relief and Effluent Handling Systems*).
- AICHE Safety Course at ½ price
- Case history on Bhopal (with video)
- CD-ROM with all Loss Prevention Symposium papers with easy search features
- NIOSH pocket guide for Chemical Hazards
- Explosion Research--Venting of Low Strength Enclosures (CD-ROM)
- Reactive Chemicals Video
- South Texas Symposium papers on CD-ROM
- Workshop Proceedings from Dow Chemical, Freeport, Texas

As indicated, this is a large number of very valuable products. This year we estimate the \$300 fee for SACHE membership will give you products worth \$3,000; a pretty good return on investment. The real return, however, is not dollars but the important information that will be passed on to your students. This, in turn, will help our future engineers to prevent injuries and accidents.

An Invitation

All department chairs, professors, and graduate students are invited to a SACHE reception at the fall annual meeting in Dallas. We plan to have wine and hors d'oeuvres prior to giving you the status of SACHE. We will additionally have breakout meetings to acquire your ideas concerning SACHE products. The reception will be on November 2 from 4:30 to 6:30 p.m.



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SACHE, or Safety and Chemical Engineering Education, is a project under the auspices of AIChE's Center for Chemical Process Safety (CCPS). SACHE's charter is to enhance the presentation of process safety in undergraduate education.

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The opinions expressed in the articles contained in the *SACHE News* are not necessarily the opinions of the Center for Chemical Process Safety or the American Institute of Chemical Engineers.

Articles related to any aspects of safety in the academic community are solicited from both the academic and industrial community for publication in *SACHE News*. Material should be sent directly to the editor for consideration.

Undergraduate Education Committee

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SACHE Acknowledges Corporate Partners and Sponsors

RONALD J. WILLEY AND RON DARBY

As you may know, the Undergraduate Education Committee of the CCPS (SACHE) is a joint partnership between industrial and academic participants. The purpose of the Committee is to develop, promote and facilitate materials, methods, information, etc. for incorporating subjects relevant to process safety into the chemical engineering educational experience. Since process safety has emanated directly from industry (not academia), and finds direct application in all industries, our corporate partners are an indispensable component of this activity.

The objectives of the Committee can be summed up by the passage written in the spring of 1993 by L. F. Wright, Vice President of Manufacturing/Engineering, Dow Chemical Company. "During the past several decades the chemical industry has spent considerable resources and effort to reduce workplace hazards and to prevent major accidents. However, despite these efforts major chemical plant incidents still occur causing capital losses and personnel injuries. It is clear that we must focus on continuous improvements in every aspect of our operation. The academic community can play an important role in this effort. First, they can provide graduates with a much broader understanding of fundamentals of chemical process safety. Second, they can improve students' awareness of the importance of safety. Finally, they can provide a valuable resource to address some of the safety research needs."

One vital activity of our corporate sponsors has been their partnering with SACHE to assist in preparation, instruction, and participation of the SACHE Faculty Workshops on Process Safety. In the past three years, SACHE has received financial support from Dow Chemical Co., Dow Corning, Inc., Du Pont, BASF, Union Carbide Corp., Rohm and Haas, Anderson-Greenwood, and the Dow Foundation. We acknowledge and gratefully appreciate this support, without which these workshops would not have been possible. We especially note the three corporate hosts for the workshops: BASF in 1996 and 1997, and, more recently, Dow Chemical Company and Anderson-Greenwood in 1998 and 1999. Personnel within these organizations worked many hours to ensure that faculty would have a meaningful experience - an experience that would be brought back to students in terms of more effective teaching and transmission of messages

related to process safety. If their support and our efforts prevent one accident similar to Bhopal, Seveso, or Pasadena, we have returned their financial commitment 5,000 fold, and have created a more responsible workplace.

Our corporate partners have been there with us since the beginning. We know that they will continue to be there in the future. They have devoted countless hours of highly dedicated, selfless, voluntary effort to help make process safety an integral part of the chemical educational experience, for which too little recognition has been received. On behalf of all faculty who have participated in SACHE workshops, and from all faculty who are SACHE supporters, we want to take this opportunity to extend our strongest gratitude to our corporate partners and sponsors.

Loss Prevention CD-ROM

DENNIS HENDERSHOT

For more than 30 years, AIChE's annual Loss Prevention Symposium, sponsored by the Safety and Health Division, has been a reliable source of practical information on preventing accidents in the chemical process industries. This 2 CD-ROM set includes more than 1000 papers and over 20,000 pages of process safety information, and makes it readily accessible. Loss Prevention papers from the "lost years," which were delivered but never published in any journal, have been recovered from the personal files of Safety and Health Division members and are also included. One CD contains all papers presented at the first 31 Loss Prevention Symposia, from 1967 through 1997. The second CD contains the proceedings of the annual conferences and workshops sponsored by the Center for Chemical Process Safety from 1987 through 1994.

The CD set was developed by Performance Technologies, Inc. and uses Folio Infobase Software. The software has been tested on Windows 95, 98, and NT 4.x systems. The database can be accessed from the CD to minimize disk space requirements, or, if there is about 1 GB of available hard disk space, the software and database can be loaded on a PC hard disk for greater speed and convenience. Each of the two databases (Loss Prevention Symposia and CCPS Conferences) can be searched by author, title, key word, and subject. It is also possible to do a full text search on the entire contents of the CD for

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EDITORS NOTE: The following essay is the second of two winning entries in the 1998 SACHE Student Essay Contest. The first essay by Heather G. Kauth of Michigan Technological University was published in the October, 1998, issue of *SACHE News*. Each student received a \$500 award and a certificate.

Safety Relevance in the Undergraduate Education

MICHAEL HICKNER

Michigan Technological University

“Safety should be equal to job function,” says Daniel Crowl in his safety course. Every chemical engineer, no matter how experienced, must heed this statement every day they go to work. There is no better place to start training safety-minded engineers than during their undergraduate years. There are courses in mass transfer, thermodynamics, kinetics and unit operations, but many undergraduates are not exposed to formal safety training. The only safety instruction they get is in their lab courses. Most know to wear safety glasses near machinery or use gloves while handling toxic chemicals, but they do not have the advanced skills that are taught in a dedicated safety course.

Every person that steps inside an industrial lab or manufacturing facility must be conscious of his or her own safety and the safety of those around them. Many students are not exposed to the bare minimum of safety required in an industrial facility unless they get a summer intern or a co-op position. Undergraduate lab courses such as organic chemistry provide an hour or two at most of safety instruction. Lab safety is only the beginning of one’s safety education. Many graduating chemical engineers that have not been through a safety program do not know what lock-tag-try or double block and bleed is, much less know how to apply them. Integrating these basic industrial safety concepts into the undergraduate chemical engineering curriculum is as important as studying distillation.

A safety course should be a required part of the undergraduate sequence. It is practically impossible to cover all of the facets of industrial safety in a semester course. A safety course will not totally prepare a student for industry, however it will get him or her familiar with some of the modern safety practices and provide a starting point for entering industry. Industrial safety must be introduced early and often in the undergraduate education.

It needs to be addressed in every core chemical engineering course. When a new process or unit operation is introduced an instructor could comment on some of the safety issues involved with the operation of the equipment. For instance, fail safe valve points could be located. Two minutes is all it takes to make students aware that good designs are also safe designs.

The primary goal of a company is to make money. Sacrificing safety can save dollars in the short run, however a lack of safety often has dire consequences in the future. One major accident can cost a company hundreds of millions of dollars and even put them out of business. Just a reputation of not being perfectly safe can hurt the company’s image in its host community and discourage new customers and prospective employees. Well-educated engineers, even ones that have not had formal safety training, realize that an accident in their facility is the last thing they want to happen. The problem is that not all engineers are taught the methods to prevent accidents.

A good safety program costs a company money and manpower, but it is a wise investment. It is insurance against a catastrophic loss. One of the biggest problems that a plant faces when trying to improve safety is finding qualified personnel to make decisions and guide the safety program. Ignorance is often what holds a facility back from becoming safer. There are too many rules of thumb that have been around for so long no one questions whether these long-standing practices are the safest way. A safety course will provide the fundamental basis for designing the safest operation, from charging a reactor to storing waste material.

Any chemical engineer involved with a process must think about safety at all times, from the design phase through start-up to production. An engineer needs to have all of the basics to run a safe operation and he or she must be able to realize when they are in over their head and need to call an expert. An unsafe situation can not wait for a monthly inspection to catch it. Safety issues need to be addressed immediately. Perhaps knowing the limits of one’s knowledge is the most important skill a safety course can teach. The purpose of an undergraduate safety course should be two-fold. It should give a chemical engineer the basic tools to recognize an unsafe situation and correct it. In addition, it should help develop an engineer’s ability to know when he or she does not have the answer and needs to call in an expert.

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Safety Relevance

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The chemical engineering program at Michigan Tech features a mandatory safety course as well as safety training in the Unit Operations Laboratory (UO Lab). In the safety course, students study things like government regulations, release mechanisms, explosion models and other hazards. The course does not cover all of the regulations and theories, but it does help prepare the students for the UO Lab. The UO Lab has a safety program similar to an industrial facility. The program is termed PAWS or Preventing Accidents With Safety. The UO groups take turns preparing reports on safety issues and there is a system for reporting unsafe conditions in the lab. The Lab also has its own safety dress code that is different from the other undergraduate lab courses. Hardhats and safety glasses are required as well as ankle-high boots.

Students that go through the Tech program get a double-dose of industrial specific safety instruction. They are introduced to the basic principles and theories in the lecture course and apply their knowledge in the UO Lab. Safety is one of the highest priorities in industry. Undergraduates need formal safety instruction before they are sent out into industry. The engineers at Tech are exposed to the seriousness of safety and know what is expected of them in industry. Michigan Tech's program is not designed to produce safety experts, but its graduates are well equipped to handle many safety issues that arise in an industrial setting.

Many schools have safety courses and other safety oriented components in their undergraduate programs, but they are not required for graduation. Most students would rather study polymers or reactor design in their elective courses. They do not realize how important an issue safety is. Safety courses need to become part of the core curriculum for chemical engineers. The incidence of accidents is not high in the chemical industry, but there is great potential for catastrophic disasters. These accidents result in huge dollar losses and more importantly the loss of human life. Accidents also hurt the reputation of the industry and communities are less likely to be receptive to new facilities. Everyone in a plant needs to be responsible for safety and chemical engineers have the opportunity, through a few small changes to their undergraduate courses, to make a difference in the way safety is handled in the industry.

AICHe Safety and Health Division Web Site

DENNIS HENDERSHOT

The web site of the Safety and Health Division of AICHe is now on line. You can access it at:

<http://www.chem.mtu.edu/org/aiches&h/index.html>

One useful item which can be downloaded from the web site is a complete database of all of the articles published in the journal "Process Safety Progress" (formerly "Plant/Operations Progress") from 1982 through 1998. The database includes article citation information and key words only, not the full text of the article. The database is provided in ProCite 3.4 format, Microsoft Access 7.0 format, and also as tab delineated text suitable for import into other database software.

The web site will also include the Safety and Health Division newsletter, and the "Call for Papers" for the Division sponsored meetings and conferences. The "Call for Papers" for the 2000 Loss Prevention Symposium is available for download currently.

The Safety and Health Division welcomes any useful links for the web site. If your university has useful process safety information on its web site, please send the information to the webmaster and we will add a link. Also, we welcome suggestions for other sites containing useful process safety information for which we can provide links.

Student Essay Award

The popular SACHE essay contest for undergraduate chemical engineering students will return in 1999. Prepare a 1500 word maximum essay on one of the following topics or equivalent:

- Safety in the unit operations laboratory.
- Integration of safety into undergraduate education.
- Safety relevance in undergraduate education.
- Most important safety concept taught in the university.
- What can industry do to help universities add safety to their courses?

Send your essay entries to:

Dr. J. F. Louvar
BASF Corporation
1419 Biddle Avenue
Wyandotte, MI 48192-3736

Deadline: June 1, 1999

The two winning essays will each receive \$500!

Two honorable mention awards will also be made.

34th Annual Loss Prevention Symposium
AIChE 2000 Spring Meeting
Atlanta, Georgia
March 5-9, 2000

Call for Papers

Overview of the Symposium

The Loss Prevention Symposium, organized by the American Institute of Chemical Engineers Safety and Health Division, Group 11A, has been held annually since 1967. The objective of the symposia is to promote safety in the chemical process and allied industries by providing a forum for practitioners from industry, academia, and government to share experiences, technological advances, and new ideas.

Original, unpublished material is preferred. Authors are encouraged to submit an abstract. Accepted papers will be published in the Symposium Proceedings and may also be chosen for publication in the Division journal, Process Safety Progress. The 34th Symposium will consist of six sessions of five to six papers each. The session topics are described below.

Symposium

Chair: Ephraim A. Scheier
Occidental Chemical Corp.
5005 LBJ Freeway, 14th Floor
Dallas, TX 75244-6119
(972) 404-3686
(972) 404-3219 (FAX)
ephraim_scheier@oxy.com

Symposium

Vice-Chair: Dennis Hendershot
Rohm & Haas
P.O. Box 584
Bristol, PA 19007
(215) 785-7243
(215) 785-7077
nagdh@rohmmaas.com

- 1. Advances In Fire Protection** – The field of Fire Protection has been the beneficiary of research, technological innovations and improved management systems. The next millennium promises new challenges and opportunities. Papers describing advances in Fire Protection are sought.

Chair: Kris Chatrathi
Fike Corporation
704 South Tenth Street
Blue Springs, MO 64015
816-229-3405, Ext.468
816-228-9277 (FAX)
kchatrathi@fike.com

Vice Chair: Erdem Ural
Fenwal Safety Systems
700 Nickerson Road
Marlborough, MA 01752
508-429-3190
508-429-2990 (FAX)
erdem@world.std.com

- 2. Health and Toxicology Aspects of Loss Prevention** – This session invites papers related to toxic hazard identification and evaluation which may be applied to both new and existing facilities. Potential topics include toxic hazard recognition and evaluation, exposure limits, toxic dose, and exposure and toxic risk assessment techniques.

Chair: Scott Ostrowski
Exxon Chemical Americas
Baton Rouge Chemical Plant
P.O. Box 241
Baton Rouge, LA 70821-0241
225-359-7400
225-359-4045 (FAX)
swo@EXXON.sprint.com

Vice Chair: James C. Rock
Director, Occupational Health & Safety Institute
Texas A&M, Dept. of Nuclear Engineering
College Station, TX 77843-3133
409-862-4409
j-rock@tamu.edu

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- 3. Fire, Explosion and Reactivity Hazards** — The analysis, prevention and mitigation of fire and explosion hazards continue to be important issues to the loss prevention community. We invite papers that identify, analyze or offer design guidance on fire and explosion hazards.

Chair: John Murphy
Wilfred Baker Engineering, Inc.
8700 Crownhill, Suite 310
San Antonio, TX 78209-1128
210 824-5960
210 824-5964 (FAX)
jmurphy@wbeng.com

Vice-Chair: Robert W. Johnson
Unwin Company
1920 Northwest Boulevard, Suite 201
Columbus, OH 43212-1147
614 486-2245
614 486 2141 (FAX)
rjohnson@unwin-co.com

- 4. Overpressure Protection Alternatives** — The proper selection, design, installation and maintenance of systems for overpressure protection is an integral part of process design. Options range from rupture disks to High Integrity Process Shutdown Systems. Papers addressing issues related to overpressure protection are sought.

Chair: Sam Mannan
Mary Kay O'Connor Process Safety Center
Texas A&M University
337 Zachry Engineering Center
College Station TX 77843-3122
409 862-3985
409 845-6446 (FAX)
mannan@tamu.edu

Vice-Chair: Joe Natale
Mobil Technology Company
600 Billingsport Road
Paulsboro, NJ 08066-0480
609 224-3261
609 224-3874 (FAX)
jrnatale@pau.mobil.com

- 5. Electrical Equipment Design for Application in Hazardous Areas** — This session is intended to review new developments in the field of electrical equipment design for hazardous areas including the impact of recent changes in the National Electric Code (NFPA 70) including Articles 500 and 503. Article 503 of the NEC is intended to bring the NEC in line with the European electrical codes. We invite papers discussing the impact of hazardous electrical equipment design and installation utilizing the new code changes.

Chair: Dennis Hendershot
Rohm & Haas
Bristol, PA
215 785-7243
215 785-7077 (FAX)
nagdh@rohmhaas.com

Vice-Chair: Dick Schwabb
79 Aspen Drive
Basking Ridge, NJ 07920
908 580-0449

- 6. Case Histories and Lessons Learned** - Reviews of Process Safety Incidents and near misses provide valuable learning opportunities. Papers detailing incidents, near misses and lessons learned are requested.

Chair: Henry Febo
Factory Mutual Research Corporation
1151 Boston-Providence Turnpike
Norwood, MA 02062
781 255-4771
781 762-9375 (FAX)
henry.febo@factory-mutual.com

Vice-Chair: Roy Sanders
PPG Industries, Inc.
P. O. Box 1000
Lake Charles, LA 70602
318 491-4322
318 491-4860 (FAX)
rsanders@ppg.com

To Present a Paper

Please contact the appropriate session chair and submit a typed abstract of 150-200 words by June 1, 1999. Include the names, addresses, telephone numbers and affiliations of the authors with the abstract. Electronic submissions by e-mail or computer disk are encouraged. Contact the session chair for the preferred electronic file format for diskettes. Session chairs will select papers to be presented and contact the authors by July 1, 1999. Authors of selected papers will need to complete a Proposal to Present (PTP) on the AIChE worldwide web site by August 1, 1999. Contact the session chair to make other arrangements if you are unable to submit an electronic PTP. Final manuscripts for publication in the Symposium Proceedings are due to the session chairs by November 6, 1999.

Status of SACHE

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Essay Contest

We have another essay contest in 1999. Give your students an opportunity to win \$500. Our specifications are enclosed together with a winning essay from 1998.

Add Chemical Process Safety to Chemistry Curriculum

Dennis Hendershot, Joe Louvar, and Owen Kubias of our SACHE committee have recently published this article in an ACS periodical. As you know, our chemists are also interested in safety. They are particularly interested in success stories from Chemical Engineering Departments. The abstract of their article follows:

Abstract

Chemists are key contributors to understanding and managing process safety. Their contribution begins at the earliest stages of product and process development, in the initial selection of technology. Indeed, it is at these stages that the chemist has the greatest opportunity to select an "inherently safer" product or process by identifying raw materials, chemical intermediates, catalysts, chemical reactions, and physical transformation operations which minimize or eliminate hazards. Also, there is a need for chemists to understand safety issues associated with process chemistry and physical transformation operations throughout the life of the product and process.

The chemical process industry (CPI) must deal with all of the general safety concerns of industry, such as trips and falls, noise, ergonomics, rotating and other moving equipment hazards. In addition, because the CPI transforms matter from one form into another through both chemical and physical processes, additional hazards are introduced. The term "process safety" refers to the understanding and management of these unique hazards. Process safety concerns include acute and chronic toxicity of materials, fires and explosions, unexpected chemical reactions, and uncontrolled chemical reactions.

We believe that an understanding of potential process safety issues, both in the laboratory and for industry scale manufacturing operations, should be a component of chemistry education. Chemists should learn about tools and techniques used to manage process safety issues. More importantly, they should develop recognition of the importance of safety, both in the laboratory and in industry, and an attitude that attention to safety is an inseparable part of the work of a chemist. This paper describes a relatively new and successful initiative in chemical engineering education. We encourage a similar initiative in the education of chemists.

New SACHE Module The Bhopal Disaster

RONALD J. WILLEY

At about 12:45 a.m. on Monday, December 3, 1984, an event occurred in Bhopal, India, that changed the way chemical process safety is practiced throughout the world. On that morning, 41 metric tons of a toxic gas, mainly consisting of methyl isocyanate (MIC), entered into the atmosphere from a Union Carbide India Limited (UCIL) pesticide plant. The release traveled with the prevailing wind into heavily populated areas located near the plant. Although accurate figures reflecting deaths and injuries do not exist, it is known that more than 1,000 people were killed and thousands more were injured or affected. Panic prevailed in the city of 900,000 inhabitants. In terms of loss of life, this is the largest chemical plant disaster recorded to date.

This newest SACHE slide module goes into the technical details behind the disaster. The module includes a video and 54 slides about the disaster. The video provides students with scenes from Bhopal and discusses the two major theories of how the event occurred. The slides also focus on the two major theories (the water washing theory and the sabotage theory). However, the slides also present the situation beforehand, the process chemistry involved, and methods to prevent such accidents in the future.

The Bhopal disaster is one of the worst chemical accidents to have happened. It increased public awareness about chemical process safety. Further, it was the event that eventually led to the establishment of SACHE when the AIChE formed the Center for Chemical Process Safety in 1985 as a response to prevent such accidents from happening again. We must keep reminding students about events such as Bhopal, and continually seek methods of prevention.

CD-ROM

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any word or combination of words. Papers or portions of papers can be printed or copied into other software. The CD can replace a shelf full of books and three ring binders containing papers, and its search capability makes it possible to actually find valuable information when you want it.