

SACHE News



Safety and Chemical Engineering Education - Spring 2003

Status of SACHE

DENNIS HENDERSHOT, CHAIR
CCPS UNDERGRADUATE EDUCATION COMMITTEE

General

Undergraduate Education Committee organization changes

2003 Workshop scheduled for September

Revised product shipment schedule

Looking for product suggestions and authors

Essay contest and awards

Undergraduate Education Committee

Owen Kubias has retired after years of service to the CCPS Undergraduate Education Committee, first as chair of the committee, and subsequently as the CCPS staff representative. We all thank Owen for his many years of contributions to safety education. At the 2002 AIChE National Meeting in Indianapolis, the committee treated Owen and his wife to dinner in honor of his retirement.

A familiar face, Joe Louvar, will replace Owen as the CCPS staff representative. Joe has been the chair of the Undergraduate Education Committee for many years. Traditionally the chair of the committee has been an industrial representative. Since his retirement from BASF, Joe has been a faculty member at Wayne State University, and Joe will continue to actively serve SACHE as the CCPS staff representative. Thanks to Joe for many years of contributions, and we look forward to more in the future in his new role.

I have agreed to take on the job of Undergraduate Education Committee Chair, with Bob Rosen of BASF as my vice-chair/co-chair. I have been involved in the SACHE effort for a number of years as an industrial

representative to the committee from Rohm and Haas Company. I have been with Rohm and Haas for 32 years, first in process research and development and engineering design, and subsequently in process safety since about 1982. Bob and I are looking forward to continuing progress in the SACHE effort to enhance the safety content of chemical engineering education.

2003 Workshop

The 2003 SACHE Workshop will be held at ExxonMobil Chemicals in Baton Rouge, Louisiana. Scott Ostrowski of ExxonMobil, Ralph Pike of Louisiana State University, and Bob Bethea of Texas Tech University are putting together an excellent program for the workshop, including topics such as inherently safer design, green engineering and design, fundamentals of fire and explosions, design of safety instrumented systems and layer of protection analysis. Because the United States government has identified the ExxonMobil site as a "high security" facility, all attendees for this workshop must be United States citizens. We regret the inconvenience that this may represent to some SACHE members who wish to attend, but it is beyond our control. If you are interested in participating in this year's workshop, please contact Dan Crowl at crowl@mtu.edu.

Revised Product Shipment Schedule

In an effort to maintain our low SACHE membership cost, we are modifying our shipping schedule for products in the future. We will do one shipment each year, in the early fall, with the full year's set of products. The spring shipment has been particularly expensive to maintain because it really is a large set of individual shipments, each made as a university renews its membership. By late summer, we receive nearly all of the membership

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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 communities for publication in *SACHE News*. Material should be sent directly to the editor for consideration.

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F. Owen Kubias and the History of SACHE

EDITORS NOTE: At the end of 2002, F. Owen Kubias retired as Center for Chemical Process Safety Staff Consultant. Owen's career in loss prevention has been intimately involved with AIChE, the Safety and Health Division, CCPS, and SACHE. Owen graciously agreed to share the highlights of his career. His story not only documents the magnitude and significance of his contributions to chemical process safety and chemical engineering education, but illustrates the impact that one person can have on our profession.

I was born and raised in Cedar Rapids, Iowa, a town with a large Czech population. When I graduated from high school, we were at war. I enlisted in the Navy and entered their Radar Technician training program. After I was discharged, I enrolled in the engineering school at what is now called Iowa State University. After my freshman year, I had to choose a major. The Navy experience had changed my mind about electrical engineering. A guidance counselor suggested Chemical Engineering, since I had gotten an "A" in freshman chemistry. The rest is history.

In my junior year I had a "blind date" with a redhead and married her in 1950. We have two boys: Craig, a Presbyterian minister and college professor, and Kirk, an airline pilot.

After college graduation, Mallinckrodt hired me. My first assignment was in the process development laboratory. When they decided to put engineers in the plant, I became process engineer for the north section of the plant. A few years later, they decided to divide the plant into four areas with a superintendent for each area. I got the job of area superintendent of the section where I had been process engineer.

As the company grew, Mallinckrodt decided they needed a corporate Loss Prevention Department; and I was asked to manage it. It was in this position that I learned how willing the chemical industry was to exchange experiences and solutions in the area of process safety. I joined the Chemical Section of the National Safety Council, and chaired it one year. I also served on the Safety Committee of the organization that was then known as the Manufacturing Chemist Association. The Association was waging a campaign to get chemical engineers on the

National Fire Protection Association standards committees. I volunteered for the NFPA committee that managed the NFPA 49, 325 and 704 documents and ended up chairing the Committee for over 20 years.

At about that time AIChE initiated the Loss Prevention Symposia, which again emphasized our industry's willingness to share experiences in the process safety and fire protection areas. I believed this was a great step forward for the Institute and its members. I was proud to be a part of that activity!

In 1973 I joined the Glidden/Durkee Company as their Loss Prevention Manager.

In the early 1980's Gene DeHaven of Dow's California operations organized a committee to explore founding a Safety and Health Division in AIChE. I was a member of that committee. The division became a reality in the mid-1980's. One of the first projects was to incorporate loss prevention into the 6 or 7 major chemical engineering courses. The division decided to ask Tom Carmody, the director of the Center for Chemical Process Safety (CCPS), if writing a set of problems demonstrating process safety for the core courses couldn't be part of CCPS's work. He agreed that it would be a good project, but wasn't sure CCPS could fund it completely.

About that time we learned that there might be some National Science Foundation money available for our work. CCPS applied for and received a grant. That was the initiation of the CCPS Undergraduate Education Committee. Since I was chairman of the Health and Safety Division at that time, I took the job of chairing that CCPS committee. The committee drew up a set of criteria for the project and asked for bids from interested Universities. The proposal by Reed Welker and Charles Springer from the University of Arkansas was accepted. The student book became a best seller for CCPS.

Joe Louvar, Dan Crawl, and I gave papers at the 1990 Annual Meeting in Chicago on the integration of process safety into the chemical engineering curriculum. While waiting for our late afternoon presentation, we conceived the acronym SACHE – Safety and Chemical Engineering Education. We also discussed how to continue the committee's activities and came up with the idea of offering teaching materials demonstrating process safety to universities each year for a nominal fee.

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New SACHE Modules

These SACHE modules have been shipped to the member universities. Faculty and students should contact their SACHE representative for access to these and other SACHE products, including slide and PowerPoint presentations, videos, problem sets, NIOSH publications, and CCPS books. Recent SACHE deliverables are posted at <http://www.aiche.org/sache/sachedel.htm>.

Mini-Case Histories

Joe Louvar
Wayne State University

This product emphasizes learning from history or being doomed to repeat it. It includes three sections: a) Mini-Case Histories, b) Process Safety Beacon, and c) Safety Concepts as described below:

- a) Mini-Case Histories: There are eight PowerPoint presentations, with notes, that cover the accidents at Bhopal, Monsanto, Phillips, Flixborough, Morton, Tosco, Hickson, and Sonat. The root causes of each accident are included, such as, poor designs, lack of training, and poor management. The information summarized in these case histories was taken from SACHE products, and reports by the Chemical Safety Board.
- b) Process Safety Beacon: The Center for Chemical Process Safety is publishing monthly, one-page case histories or lessons learned. They are available on the Internet via CCPS Beacon. A few of the Beacons are included in this product to remind readers that these lessons are available.
- c) Safety Concepts: This product includes six PowerPoint presentations: i) Relief Valves, ii) Prevent Runaway Reactions, iii) Manage Design, Construction, and Operations, iv) BLEVEs, v) Explosions, and vi) Prevent Explosions. The concepts covered are those that are especially relevant to chemical plant accidents.

The Mini-Case Histories and Safety Concepts are deliberately developed in a PowerPoint format to give the users the opportunity to add slides or lessons concerning their own interest.

Fire Protection Concepts

J. Reed Welker
University of Arkansas

This video presentation consists of two parts. The first, "Fundamentals of Fire Behavior," is just over 30 minutes long and describes some of the fundamental characteristics of fires. It begins with a working definition of what constitutes a fire, and continues with a discussion of the fire triangle as traditionally applied to fire behavior. It also discusses the presence of chain reactions in a flame.

Examples of fires burning gases, liquids, and solids are shown; and the results of the three types of fire behavior are discussed. The difference between a premixed flame and a diffusion flame is shown. Examples of colorless flames are discussed. Finally, the appearance of turbulence and buoyancy are presented along with their effects on the behavior of size of flames.

The second part of the video presentation, "Fire Extinguishment and Control," is just over 40 minutes long and describes some of the major aspects of fire protection. Fire prevention is stressed as the best goal.

The three main classes of fires defined by the National Fire Protection Association standards are presented. Then both passive and active methods of fire control are considered. Passive methods include inventory reduction, replacement of flammable materials with nonflammable materials, separation of processes and storage, diking and impoundment, and fireproofing of structures. Active methods (following detection) include water for extinguishment and exposure control, regular and high expansion foam, dry chemicals, vaporizing liquids, and inerting agents. Some examples of tests using some of these methods are shown.

EDITORS NOTE: This is the second of two winning entries in the 2002 SACHE Student Essay contest. The first essay by Faith Tartaglia, Syracuse University, was published in the Fall, 2002, issue of *SACHE News*. Each student received a \$500 award and a certificate at the AIChE Annual Meeting in Indianapolis.

Integration of Safety into Undergraduate Education

Brian Dunham
University of Missouri at Rolla

In the chemical engineering curriculum, many different subjects are taught, which cover a wide variety of materials. Material balances, thermodynamics, and transport phenomena act as a foundation for this discipline. After a student graduates, he or she will go off into industry and apply these concepts to fields such as design and process optimization. In order to effectively do his or her job, the student must be familiar with not only the processes they deal with, but also the hazards and risks that accompany them. For this reason, chemical process safety should be a cornerstone in the education of any chemical engineer. To do so, the concept should be introduced early on in the curriculum, and then build upon through the student's final classes.

In order to properly integrate safety into a future engineer's education, basic concepts should appear in early chemical engineering classes. Safety is a broad topic that can range from very trivial to very complex. A student with minimal engineering experience could learn the fundamentals of safety, so the first chemical engineering courses could focus on the basics. The first chemical engineering course offered to the students normally covers a wide variety of topics, so the addition of a safety section would not seem out of place. Professors could lecture over concepts such as safety features used in process plants and the chemical engineer's role in safety on the job site. The students could research case studies on chemical plant incidents and learn about how several minor violations can propagate into a full-blown catastrophe. From this point, the students would be introduced to the basic concepts of safety and have a better initial idea of what a chemical engineer really does.

After the initial courses in the curriculum, the students begin to take the math-intensive subjects, such as transport phenomena. These subjects are also very important in

the development of process safety. It is from this material that models are formed of explosions and other possible incidents. From these models, an engineer can better understand the associated hazards and attempt to minimize or eliminate their effects. To better prepare the chemical engineering student, modeling should be covered in the applicable transport phenomena classes. Fluid mechanics courses can devote time to covering flow through holes or pipes that have been sheared off through an incident. Safety and relief valve sizing could also be introduced and covered with momentum transfer. Heat transfer can cover explosions (BLEVEs) and vapor cloud explosions can be discussed in depth as well. Mass transfer can cover such topics as dispersion modeling and pool evaporation. Students often times lose sight of the relevance of transport phenomena since vast amounts of theory are presented. By introducing safety concepts into transport phenomena, students could better apply mass, heat, and momentum transfer to real world situations and better understand its relevance.

After students are introduced to transport phenomena, they get to see it applied in the unit operations laboratory. This is an opportune time for them to see the application of safety as well. Since the students receive hands-on experience with process units, they must understand what can go wrong and what means of protection are available. Different types of process safety analysis could be introduced and practiced in the lab. Students could be assigned to perform either an informal safety review or a HAZOP analysis on a unit in the lab, and then report their findings and suggestions. The class could also take a field trip to a nearby production facility and learn about how safety is dealt with and applied in industry.

In their final semesters, students could tie together all they have learned through senior design, and an individual process safety course. Safety is always an important aspect in real world design, and it should be stressed in this class as well. In their design projects, the students should be encouraged to analyze their process, implement safety devices and features, and finally size and provide cost analysis for those items. In the process safety course, students could be refreshed on the modeling and general concepts they learned in previous courses, while also performing a more in-depth study of safety. Important topics not covered previously can, subsequently, be thoroughly discussed. This can also be a place for students to give feedback about how safety can be better integrated into the course curriculum.

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Call for Papers
38th Annual Loss Prevention Symposium
AIChE 2004 Spring National Meeting
New Orleans, Louisiana
April 26-29, 2004

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 symposium 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 be chosen for publication in the Division journal, *Process Safety Progress*. The Symposium will consist of six sessions of five or six papers each. The session topics are as follows.

1 Fire, Explosion and Reactive Hazards

The analysis, prevention and mitigation of fire, explosion and reactivity hazards continues to be important to the Loss Prevention community. The reactivity issue is very timely due to the recent recommendations of the U.S. Chemical Safety and Hazard Investigation Board (CSB) on reactivity. This session invites papers that identify, characterize or offer design guidance on fire, explosion and reactivity hazards.

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2 Loss Prevention Aspects of Large Storage Tank Design

This session invites papers addressing design issues related to large storage tanks. Siting and spacing, seismic design, mechanical integrity, fire protection, overflow prevention and protection, secondary containment, and floating roofs are a few of the design issues that are the subjects of current work and discussions. Designs must also allow for cleaning, inspection and maintenance.

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3 Safety Instrumented Systems/Layer of Protection Analysis

Protection safeguards must reliably and effectively detect, diagnose and control process deviations before they can result in loss events such as fires and explosions. Topics related to analyzing, designing and implementing these safeguards include abnormal situation management (ASM), layer of protection analysis (LOPA), safety instrumented systems (SIS), human factors, and alarm management.

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4 Advances in Consequence Modeling

Engineers often use consequence analysis tools to assess the risks of accidental or deliberate incidents, as well as to communicate them to the regulatory agencies, to the public and to company management. Such tools are invaluable in establishing priorities for the cost-effective allocation of the company's resources for mitigation. Papers are invited that describe advances in all areas of consequence modeling, including material/energy release, dispersion/dissipation, fire/explosion, domino effects, loss/injury impacts, and mitigation modeling.

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5 Engineering Solutions to Facility Security Challenges

Co-sponsored by Area 12d - Process Development Division (Manufacturing)

Session focus is on developing engineering solutions to reducing facility vulnerability to sabotage and terrorist attack through enhancing security or reducing the consequences of a hazardous chemical release. Inherently safer alternatives that reduce or remove the hazards, and improvements in the design, layout, and operation of equipment handling hazardous chemicals that would make the facility a less attractive target, will be discussed.

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6 Case Histories and Lessons Learned

Co-sponsored by Area 12d - Process Development Division (Manufacturing)

Reviews of Process Safety Incidents and near misses provide valuable learning opportunities. Papers dealing with incidents, near misses and lessons learned are requested.

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To Present a Paper

Please contact the appropriate session chair and submit a typed abstract of 150-200 words by July 1, 2003. Include the names, addresses, telephone numbers and affiliations of the authors with the abstract. Electronic submissions by email or computer disk are encouraged. Session chairs will select papers to be presented and contact the authors by August 1, 2003. Authors of selected papers will need to complete a Proposal to Present (PTP) on the AIChE Web site by September 30, 2003. 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 December 10, 2003.

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Undergraduate Safety Education

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Whether it is in the industry or in the classroom, safety should always play an important role in an engineer's work. It is crucial for students to learn about the dangers and risks that appear when safety is taken lightly. By learning about safety throughout his or her entire college career, a student is more likely to remember its importance and its main concepts. This knowledge will better equip the freshly graduated chemical engineer to design inherently safe processes and minimize hazards in the facility. They will make more conscious decisions that may impact the environment and other people. With the integration of chemical process safety in the chemical engineering curriculum, students will be better prepared to meet the challenges that they will face later on in their professional careers.

Status of SACHE

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renewals and are able to make a single large shipment, reducing handling costs. We are also looking into making our products available on line over the Internet in the future, but this may take some time to work out.

Looking for Product Suggestions and Authors

SACHE is always looking for additional participation from all of our community. If you have an idea for a new SACHE product, and especially if you are interested in developing a new product to share with your colleagues, please get in touch with us. Many of you may already have materials, which you are using in your own classes, that would be valuable to others. If so, please let us know and we can discuss how to make this material available through SACHE.

Essay Contest and Awards

Remember that SACHE continues to sponsor its student essay contest, and the 2003 topic is Reactive Chemistry. See the Fall 2002 SACHE newsletter for details on this year's contest. Entries can be emailed to Joe Louvar at jlouvar@che.eng.wayne.edu. The SACHE and the Safety and Health Division of AIChE will also sponsor awards for the best use of the principles of safety and best application of inherent safety principles again in 2003.

Owen Kubias

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At the Annual Meeting in Los Angeles in 1991, we offered this program to a meeting of chemical engineering professors attending the Annual Meeting. Over 30 schools bought into the SACHE program. We now have over 125 university members.

When I retired from the Glidden Company in 1990 I joined the staff of CCPS as Staff Consultant for SACHE, as well as managing the development of a couple CCPS books.



Owen Kubias (center) received a plaque from Joe Louvar (left) and Scott Berger of CCPS (right) at the 2002 AIChE Annual Meeting in Indianapolis in recognition of his significant contributions to SACHE.

Summary

SACHE continues to grow and improve its products and services. We welcome your feedback and participation in our efforts. We are looking into increased use of teleconferencing and on-line conferencing for future SACHE committee meetings, and this should make participation easier for those for whom travel is becoming difficult. Bob Rosen and I look forward to an exciting future for SACHE in its continuing efforts to enhance safety education for chemical engineers.