



# SACHE News

AIChE Alliance  
Safety and Chemical Engineering Education

## Safety and Chemical Engineering Education - Spring 2010

### 2010 SACHE Faculty Workshop

The 2010 SACHE Faculty Workshop will be held August 15-18, 2010, at the ExxonMobil Baytown, Texas, complex. Participants will only be responsible for their travel expenses to the Houston Intercontinental Airport (IAH). All other onsite expenses (meals, lodging, local transportation, etc.) will be provided.

The 2010 Workshop is designed to provide selected chemical engineering faculty from universities around the county with a first-hand prospective of current safety and risk management topics. During the workshop, visiting faculty will be provided with classroom training delivered in stand-alone modules of approximately one hour duration. The workshop instructors are industrial experts in the area of chemical process safety. The content will be reinforced with specific plant tours arranged by ExxonMobil. One of the primary objectives of the Workshop will be to provide the participating professors with process safety related content and materials that they can use during class lectures at their home universities. The theme for this workshop is "Achieving Safe and Reliable Process Operations."

Another feature of this workshop will be to provide the participants with information regarding the resources available from SACHE, local AIChE sections, the U. S. Chemical Safety Board, local industry, and a number of other readily accessible sources.

Anyone interested in participating or wanting further information should contact Ken Cox, the SACHE director of the workshop, at [krcox@rice.edu](mailto:krcox@rice.edu). A registration form is available at [http://www.owl.net.rice.edu/~krcox/sache2010/registration\\_sache.doc](http://www.owl.net.rice.edu/~krcox/sache2010/registration_sache.doc).

### Preliminary Schedule

#### Sunday, August 15

- 1:00 – 3:00. Arrive at Hilton Houston NASA Clear Lake
- 3:00 – 4:00 Registration at Hotel Lobby
- 4:00 – 6:00 Introductions, Orientation, and Team Building
- 6:00 Dinner at Hilton

#### Monday August 16

- 7:30 – 8:00. Travel to ExxonMobile
- 8:00 – 8:15 Breakfast
- 8:15 – 8:45 Welcome and Housekeeping
- 8:45 – 9:45 Introduction to Fires and Explosions
- 9:45 – 10:00 Break
- 10:00 – 11:30 Introduction to Dust Hazards
- 11:30 – 12:30 Lunch
- 12:30 – 1:15 Metal Alkyl Hazards
- 1:15 – 2:15 Organic Peroxide Hazards
- 2:15 – 2:30 Break
- 2:30 – 3:45 Human Factors
- 3:45 – 4:00 Break
- 4:00 – 5:00 Process Safety Resources
- 6:30 Dinner at Hilton

#### Tuesday, August 17

- 7:30 – 8:00 Travel to ExxonMobile
- 8:00 – 8:15 Breakfast
- 8:15 – 8:45 Housekeeping and Announcements
- 8:45 – 9:45 Chemical Safety Board Topic
- 9:45 – 10:00 Break
- 10:00 – 11:30 Teaching Risk Assessment
- 11:30 – 12:30 Lunch
- 12:30 – 1:45 Inherently Safer Design
- 1:45 – 2:00 Break
- 2:00 – 3:00 Pressure Relief Devices
- 3:00 – 4:00 Safety Instrumented Systems
- 4:00 – 4:15 Break
- 4:15 – 5:15 SACHE Resources and ABET Requirements
- 6:30 Dinner at Kemah Aquarium

#### Wednesday, August 18

- 7:30 – 8:00 Travel to ExxonMobile
- 8:00 – 8:15 Breakfast
- 8:15 – 8:30 Housekeeping and Announcements
- 8:30 – 9:30 Process Safety Incidents Discussion
- 9:30 – 9:45 Break
- 9:45 – 11:30 Tour of Baytown Refinery
- 11:30 – 12:30 Lunch

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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.

*SACHe News* is published twice annually by the Undergraduate Education Committee of the AIChE Center for Chemical Process Safety. All original material is copyrighted by the AIChE Center for Chemical Process Safety.

The opinions expressed in the articles contained in *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 aspect 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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## 2008 SChE Faculty Workshop Experience

Joshua D. Ramsey  
Oklahoma State University

Two years ago I was fortunate to attend the SChE faculty workshop shortly after joining the faculty at Oklahoma State University. As a new faculty member I had many responsibilities to which I was adjusting. It was especially difficult going from being a postdoctoral researcher who was solely responsible for research and publishing to a faculty member now responsible for generating funding, developing new ideas, recruiting and advising graduate students, and teaching undergraduate classes. I felt adequately prepared for performing research but lacking when it came to teaching undergraduate classes that emphasize practical application of industrial technologies. I had taken these classes as a student and benefitted significantly from my two summer internships as a refinery process engineer, but compared to the more senior faculty in the department, I lack their years of experience working in the oil and gas industries or serving as engineering consultants. While certainly no class or workshop is a substitute for these experiences, I am grateful that I had the opportunity to attend the SChE workshop where I was exposed, in some cases for the first time, to chemical process safety issues that our students are expected to know before entering industry.

The SChE workshop I attended in 2008 in Philadelphia was attended by faculty from all over the country. The workshop was organized by esteemed faculty known for their contributions to engineering education in the area of process safety and was generously hosted by regional industrial partners Arkema, Rohm & Haas, and Sunoco. Steve Selk from the Chemical Safety Board (CSB) opened the workshop explaining the role of the CSB in accident investigation and focusing on recent accidents at the First Chemical Corporation in Mississippi and the T2 Labs in Florida. During the course of the workshop engineers from Arkema, Rohm & Haas, and Sunoco covered additional process safety topics such as human

factors, static electricity, chemical reactivity, dust explosions, fire protection of atmospheric storage tanks, emergency relief systems, and inherently safer designs. The information content was high, but the interspersed case studies and plant tours divided the workshop into informative, enjoyable sessions.

While the field of chemical engineering has remained over the years unchanged in many ways, companies realize now more than ever that improving process safety is not only a reasonable demand from their workforce, the community, and society, it is an imperative component to remaining in business. As a result, companies now expect more from our graduates, and the emphasis on process safety is increasing in the classroom and on the job. The SChE faculty workshop was a great opportunity for new faculty like me (and more experienced faculty) to learn how to best incorporate these process safety topics into the classroom. In addition to the usefulness of the formal workshop, I also benefitted from the time visiting with other faculty about how they incorporate safety into their undergraduate programs. As a result of the experience, I am now much better prepared to integrate this critical topic into my classes. The workshop made an impact on me, and more importantly, has had an impact on my students.



**Chicago, IL**  
**March 13-16, 2011**  
**Call for Papers Now Open**

<http://www.aiche.org/Conferences/specialty/GCPS.aspx>

## SACHE Products for 2011

The SACHE educational resources are available on the SACHE website (<http://www.sache.org>) for 2003 through 2010. A userid and password are required to download these resources. The SACHE representatives can add new members to their institution's list of users.

Two products have been posted for 2011 at this time.

### Compressible and Two-Phase Flow with Applications Including Pressure Relief System Sizing

J. Wagner and R. Whiteley  
Oklahoma State University

This SACHE product introduces mass, momentum, and energy balances for fluid flow in pipes and orifices. A brief review of incompressible fluid flow reinforces fundamentals and illustrates problem-solving techniques using spreadsheets to introduce concepts of compressible flow in pipes and orifices. These materials can be used in several courses; e.g., fluid mechanics, heat transfer, and senior design courses.

The differential momentum balance for real gases is used to describe vapor flow in pipes including limitations of sonic velocity (choked flow) on mass flow rates (illustrated with examples). The material on two-phase flow is limited to friction losses and slip. Friction factor and void fraction correlations based on both separated flow and homogeneous flow models are presented (illustrated with examples of flashing and non-flashing systems). Important for sizing emergency relief systems, flashing liquid flows modeled as non-equilibrium flow in short pipes and nozzles are discussed along with the effect of sub-cooled liquid at the relief inlet.

The Pipe Flow.xls and Pipe Flow 3-Point.xls applications each contain over three thousand lines of Visual Basic<sup>®</sup> code to solve the mass, momentum, and energy balances for single-phase liquid, single-phase vapor, or vapor-liquid two-phase flow in pipes of constant diameter. Users can select the type of flow problem (calculate flow, inlet pressure, or outlet pressure) and correlations for

two-phase friction factor and void-fraction. Both applications accommodate single and multi-component systems.

Pipe Flow 3-Point.xls fits property expansion models to user input results for three adiabatic flash calculations. These models are used to calculate the physical and transport properties and vapor quality required for the numerical integration of the differential momentum balance.

Pipe Flow.xls uses Chemstations' Chemcad<sup>®</sup> process simulator as a VBA server to perform flash calculations and to calculate the physical and transport properties, as well as the vapor and liquid phase compositions.

Nozzle Flow.xls and Nozzle Flow 3-Point.xls are Visual Basic<sup>®</sup> applications for sizing or rating relief valves or flow through orifices. Nozzle Flow 3-Point.xls uses property expansion models based on the results of user input isentropic flash calculations, while Nozzle Flow.xls uses Chemcad<sup>®</sup> to directly perform flash calculations.

This SACHE product is a companion to several previously published SACHE products by Darby (2005), Grossel and Louvar (2006), Parvin and Sterling (2003), and Wagner (2004).

**Student access:** All files are available to students logged into the site.

### Jeopardy Contests for Process Safety

J. Bernardi  
Lubrizol Corporation

This SACHE product contains some important elementary concepts in chemical process safety. The understanding of these concepts is assessed and reinforced with two class Jeopardy Games. For the game, it is recommended to divide the class into teams of four or five students. Topics include process descriptions, process safety management, process control, flammability, corrosion, relief device basics, and Design Institute for Emergency Relief Systems (DIERS).

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This SACHE product includes:

- Background resources for some questions (student resources to study)
- Two PowerPoint case history presentations (student resources to study)
- Jeopardy Game instructions for the game facilitator, and
- Two Jeopardy Games

**Student access:** The background resources and the two PowerPoint presentations are available to students through the site.

### Links to Other SACHE Resources

In addition to the SACHE Products, there are links to other resources. These include links to other websites and additional SACHE documents and files. A few illustrative examples are given here.

#### [SACHE Problem Set Volume 1](#)

SACHE Problem Set Volume 1 includes all questions but no answers. The solution manual can be downloaded by faculty from the 2005 SACHE Products.

*Submitted by:* Jan Wagner, 4/2/2005

#### [SACHE Problem Set Volume 2](#)

SACHE Problem Set Volume 2 includes all questions but no answers. The solution manual can be downloaded by faculty from the 2005 SACHE Products.

*Submitted by:* Ron Willey, 3/9/2005

#### [Safety Course Resource Page](#)

This link contains many resources for both a course in process safety and laboratory safety. The download tab links to a resource page with downloads for 1) a chemical inventory program, 2) a lab inspection form, 3) a Job Safety Assessment (JSA), and 4) HAZOP forms.

*Submitted by:* Daniel A. Crowl, 10/18/2004

#### [Fires and Explosions \(PowerPoint\)](#)

Presentation designed for a one hour lecture in a process safety or design class based on information presented at the 2003 SACHE Faculty workshop on Designing for Safe and Reliable Process Operations held at the ExxonMobil Chemical Plant in Baton Rouge, LA.

*Submitted by:* Ralph W. Pike, 8/3/2004

#### [Pressure Relief Safety Valves \(PowerPoint\)](#)

Presentation designed for a one hour lecture in a process safety or design class based on information presented at the 2003 SACHE Faculty workshop on Designing for Safe and Reliable Process Operations held at the ExxonMobil Chemical Plant in Baton Rouge, LA.

*Submitted by:* Ralph W. Pike, 8/3/2004

#### [Process Safety Management: PSM and PHA](#)

PowerPoint presentation designed for a one hour lecture in a process safety or design class based on information presented at the 2003 SACHE Faculty workshop on Designing for Safe and Reliable Process Operations held at the ExxonMobil Chemical Plant in Baton Rouge, LA.

*Submitted by:* Ralph Pike, 7/31/2004

#### [Inherently Safer Design \(PowerPoint\)](#)

Presentation designed for a one hour lecture in a process safety or design class based on information presented at the 2003 SACHE Faculty workshop on Designing for Safe and Reliable Process Operations held at the ExxonMobil Chemical Plant in Baton Rouge, LA.

*Submitted by:* Ralph W. Pike, 7/31/2004

#### [Fault Detection Consequence \(PowerPoint\)](#)

Presentation designed for a one hour lecture in a process safety or design class based on information presented at the 2003 SACHE Faculty workshop on Designing for Safe and Reliable Process Operations held at the ExxonMobil Chemical Plant in Baton Rouge, LA.

*Submitted by:* Ralph W Pike, 8/3/2004

#### [Combustible Dust Hazards](#)

Overview for the kinds of industries where Combustible Dust Hazards are an issue. Also, recommendations for prevention and mitigation along with how to test to see if a specific manufacturing facility has a problem with either their raw ingredients, byproducts/scrap, and/or finished goods.

*Submitted by:* Professor Albert V. Condello, III, 2/2/2009

## SACHE Student Safety Certificate Program

A Certificate of Safety Achievement is presented by SACHE and AIChE to students who demonstrate proficiency in process safety training modules developed for SACHE. The program allows students to receive recognition for their efforts provided they are members of AIChE. Student application for AIChE membership is available from <http://www.aiche.org/students>.

The following modules are presently in the program at [http://sache.org/student\\_certificate\\_program.asp](http://sache.org/student_certificate_program.asp).

### **Inherently Safer Design (Dennis Hendershot, CCPS Staff Consultant) (2009)**

Provides information for understanding inherently safer design of chemical processes and plants.

### **Safety in the Process Industries (Dan Crowl, Michigan Technological University, 2008)**

Video series that introduces the application of chemical process safety technology in an actual chemical facility.

### **Risk Assessment (Ralph W. Pike, Louisiana State University, 2008)**

### **Runaway Reactions (Amy Theis, Fauske and Associates, 2008)**

### **Chemical Reactivity Hazards (Robert Johnson, Unwin Co., 2008)**

Web-based SACHE product that provides an overview of the basic understanding of chemical reactivity hazards; supplemented with selected issues of the *Process Safety Beacon* from the SACHE archive.

After students have completed a module, they must successfully complete an on-line questionnaire, which is available at [http://www.aiche.org/SACHE\\_Questions.aspx](http://www.aiche.org/SACHE_Questions.aspx) to receive recognition. Lists of students who successfully complete a module will be sent to their SACHE school contact or department in addition to companies who are supporting the program. The lists of student who have completed certificates in 2008, 2009 and 2010 are posted at [http://sache.org/student\\_certificate/documents/Completed2009.pdf](http://sache.org/student_certificate/documents/Completed2009.pdf) and [http://sache.org/student\\_certificate/documents/Completed2009.pdf](http://sache.org/student_certificate/documents/Completed2009.pdf).

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