



# Rocky Mountain AICHE News

March 2005

Volume 14 Number 6

## March Section Meeting: Tour of National Institute of Standards and Technology (NIST)

The evening begins with an overview of the National Institute of Standards and Technology (NIST) by Zelda Chapman Bailey, the director of the NIST Boulder Laboratories. Daniel G. Friend, Deputy Division Chief, will then present an overview of the Physical and Chemical Properties Division. The meeting will continue with tours of the NIST Laboratories in 6 groups. Three of the groups will start off by visiting the atomic clock that is in the lobby, the other 3 will be led to building 2 and 24 (these are adjoining buildings) to start the other tours. Each group will make only 4 of the tour stops, since time will be limited. Each tour stop will be no more than 15 minutes in duration, to allow for a few questions and moving about. Any attendee that misses something they are interested in will be free to return to NIST on another occasion for a personalized tour. This is never a problem; we love to talk about our work. The group that does not initially see the clock will be able to visit that exhibit after the tours in the other buildings. The tour stops and tour stop hosts include the following:

- **Atomic Clock:** Tour guides, Building 1
- **Superconducting Magnets:** Loren Goodrich
- **Infrastructure Safety** (investigation into collapse of World Trade Center towers): Tom Siewert
- **Surface Energetics, Chemical Analysis:** Tom Bruno
- **Cryogenic Technologies:** Ray Radebaugh

## March Section Meeting

- Speakers:** Overview of National Institute of Standards and Technology (NIST)  
Zelda Chapman Bailey, Director  
NIST Boulder Laboratories
- Overview of the Physical and Chemical Properties Division  
Daniel G. Friend, Deputy Div. Chief
- Date:** Tuesday, March 15th
- Time:** 6:00 Social Hour – NIST cafeteria  
6:30 Dinner – NIST cafeteria  
7:15 Zelda Chapman Bailey  
7:25 Daniel G. Friend  
7:45-9:00 NIST Laboratory Tours
- Menu:** Fresh Garden Salad  
Spinach & Cheese Enchiladas  
Roasted Turkey w/ cranberry sauce  
Hot Garden Vegetables  
Garlic Mashed Potatoes  
Dessert Bar
- Location:** National Institute of Standards and Technology (NIST)  
325 Broadway, Boulder
- Cost:** Members: \$20  
Non-Members: \$25  
Students & Unemployed: \$10

Please RSVP by **Friday, March 11<sup>th</sup>** (early RSVPs are greatly appreciated!). Indicate your name, phone number, and number of attendees by e-mailing Tom Wellborn at [rockyaiche@yahoo.com](mailto:rockyaiche@yahoo.com). Alternatively, you may leave a voice mail for Tom at 303-933-0533.

- **NIST Scientific and Technical Databases:** REFPROP, Marcia Huber and ThermoDataEngine TDE, Chris Muzny
- **Standard Reference Densimetry:** Mark McLinden
- **Thermal Conductivity Measurements:** Richard Perkins
- **Viscometry:** Arno Laesecke

Biographical information for each of the tour stop hosts can be found below.

**Thomas J. Bruno** is a research chemist in the Physical and Chemical Properties Division at the National Institute of Standards and Technology, Boulder, Colorado (Phone: 303-497-5158, E-mail: bruno@boulder.nist.gov). He received his B.S. in chemistry from the Polytechnic Institute of Brooklyn (1976), and his M.S. and Ph.D. in physical chemistry from Georgetown University (1978, 1981). He served as a National Academy of Sciences-National Research Council postdoctoral associate at NIST, and was later appointed to the staff. He has done research on properties of fuel mixtures, explosives, reacting fluids, and environmental pollutants. He is also involved in research on supercritical fluid extraction and chromatography of bioproducts, the development of novel analytical methods for environmental contaminants, novel detection devices for chromatography, and he manages the division analytical chemistry laboratory. In his research areas, he has published approximately 120 research papers, 7 books, and has been awarded 10 patents. One of his books, Handbook of Basic Tables for Chemical Analysis, is the 5th best selling book in analytical chemistry. This book is now in its second edition. He was awarded the Department of Commerce Bronze Medal in 1986 for his work on the thermophysics of reacting fluids. He has served as a forensic consultant and/or an expert witness for the U.S. Department of Justice (notably during the federal trial of Terry Nichols for the Oklahoma City bombing), various United States Attorney's offices, and various offices of the U.S. Inspector General. He received a letter of commendation from Department of Justice for these efforts in 2002.

**Daniel Friend** is the Deputy Chief of the Physical and Chemical Properties Division, overseeing its operations on the Boulder campus of the National Institute of Standards and Technology. (Phone:303-497-5424; E-mail: daniel.friend@nist.gov). He joined NIST in 1981 as a National Research Council/National Academy of Sciences Postdoctoral Research Associate working on the kinetic theory of gases. He maintains an interest in kinetic theory, as well as the modeling of Thermophysical

properties of a wide variety of fluid systems, and currently also serves as the Leader of the Theory and Modeling of Fluids Group within the Division. Dr. Friend is the Associate Editor of the International Journal of Thermophysics for the theory section, and serves on additional editorial boards. He is the U.S. National Representative to the International Association for the Properties of Water and Steam, and maintains membership and various activities within AIChE, ASME, and APS. He was educated at Cornell University and the University of Colorado, where he received his doctoral degree in theoretical physics.

**Loren Goodrich** has been a physicist with the Magnetics Group of the Electromagnetics Division at the National Institute of Standards and Technology in Boulder for 25 years. He received his Ph.D. in Solid State Physics from Iowa State University in 1980. He holds many positions in the International Electrotechnical Commission (IEC) Technical Committee 90 on superconductivity, including Chairman. His current research interests in large-scale superconductor applications include: high-current variable-temperature critical-current measurements on low and high temperature superconductors, variable-duty cycle data acquisition, interlaboratory comparisons of superconductor measurements, low-noise high-current supplies, low-voltage measurements, superconductor critical-current simulation, and automated experimental control, data acquisition, and analysis systems.

**Marcia Huber** is a research chemical engineer with the Theory and Modeling of Fluids Group of the Physical and Chemical Properties Division at the National Institute of Standards and Technology (Phone: (303) 497-5252; E-mail: Marcia.Huber@NIST.Gov). She obtained a BS in Chemical Engineering from the University of Pittsburgh and a PhD from the Colorado School of Mines. She came to NIST initially as a National Academy of Sciences-National Research Council postdoctoral associate, and was later appointed to the staff. Her interests include modeling thermophysical properties including phase equilibria, properties of refrigerants, petroleum fluids, viscosity, and thermal conductivity. Recently she has been involved in the development of the REFPROP computer program.

**Arno Laesecke** is a research chemical engineer with the Experimental Properties of Fluids Group of the Physical and Chemical Properties Div. at the National Institute of Standards and Technology (Phone: (303) 497-3197; E-mail: Arno.Laesecke@Boulder.NIST.Gov). He joined NIST in 1988 as a visiting scientist with support from the German Science Foundation and the Joy L. Barton Charitable Trust and became a staff member in 1993. His interests include viscosity, thermal conductivity, and

dielectric measurements of fluids, preferably metastable and/or polar, and the development of microscale thermophysical properties sensors for high-throughput and combinatorial studies. During 1991–1992, he was in the corporate research department of DaimlerChrysler AG, where he participated in the early development of the fuel-cell-powered NECAR. He earned his Dipl.-Ing. and Dr.-Ing. degrees in chemical engineering with honors at the Univ. of Stuttgart (Germany). He is an IUPAC fellow and a member of AIChE and ASTM.

**Richard Perkins** is a research chemical engineer in Physical and Chemical Properties Division of the National Institute of Standards and Technology (Phone: (303) 497-5499; E-mail: Richard.Perkins@Boulder.NIST.Gov). His education included a B.S. and Ph.D. in Chemical and Petroleum Refining Engineering at the Colorado School of Mines. After 2 years of postdoctoral studies of natural gas hydrates at Rice University, he moved to NIST in 1985 to begin studies of biochemical separation processes and convection in porous media. He joined the Experimental Properties of Fluids Group in 1988 where his work has included measurement and correlation of the properties of thermal conductivity, thermal diffusivity, viscosity, specific heat, and sound speed. These properties have been studied over wide ranges of temperatures (60-750 K) and pressures (0-700 bar). Applications of this property information include calibration standards, cryogenic design, rocket propulsion, natural gas processing, replacement of ozone depleting refrigerants, and “green” chemical processing.

**Mark McLinden** is a research chemical engineer in Physical and Chemical Properties Division of the National Institute of Standards and Technology (Phone: 303-497-3580, E-mail: markm@mail.boulder.nist.gov). He holds a Ph.D. in chemical engineering from the University of Wisconsin. Much of his research at the NIST Physical and Chemical Properties Division has focused on the properties of alternatives to the ozone-depleting CFC and HCFC refrigerants; this work has included the development of property models and their implementation in the NIST REFPROP database. He chaired the IEA (International Energy Agency) Annex 18-Thermophysical Properties of the Environmentally Acceptable Refrigerants from 1990 to 1999, and served on an ISO Working Group which developed an international standard for refrigerant properties. More recently, he has designed and constructed state-of-the-art apparatus for highly accurate measurements of fluid p-V-T properties over wide ranges of temperature and pressure. He is a member of ACS and ASHRAE and a life member of AIChE.

**Chris Muzny**, a physicist at NIST, received his B.S. in physics and mathematics from Oklahoma State University, and his M.S. and Ph.D. in physics from the University of Colorado. He joined the scientific staff of the National Institute of Standards and Technology in January, 1999 after spending the previous three years as a P.R.E.P. Post-doctoral associate. He has carried out both light and neutron scattering experiments on a wide variety of systems including pure fluids, dendritic polymers, clays, conventional polymers, micelles, silica and polystyrene colloids. He has developed several instruments for light and neutron scattering on macromolecular systems including ones for low-angle laser light scattering, neutron scattering under shear and scattering from conventional fluids at low wave vectors. In 2004 Dr. Muzny moved to the TRC Group in Division 838 where he is currently developing methods of dynamic data evaluation for thermophysical properties.

**Ray Radebaugh** has been the Group Leader of the Cryogenic Technologies Group for the National Institute of Standards and Technology in Boulder, Colorado, since 1995 and a physicist there since 1966. He received a B.S. in physics from the University of Michigan in 1962 and M.S. and Ph.D. in Physics from Purdue University in 1965 and 1966, respectively. He has conducted and supervised research on cryogenic refrigeration techniques, such as dilution, electrocaloric, thermoelectric, pulse tube, Stirling, and Joule-Thomson refrigerators, and conducted studies of heat transfer and heat exchangers. He has also been involved in measurements of cryogenic fluid flow and other cryogenic processes. Dr. Radebaugh has published over 120 papers as part of the open literature. He has received several awards, including the Department of Commerce Gold Medal in 2003, the Silver Medal in 1995, three best paper awards at the Cryogenic Engineering Conferences, the R&D 100 Award in 1990 for the thermoacoustically driven pulse tube refrigerator, and the J&E Hall Gold Medal in 1999 from the Institute of Refrigeration in England for his pioneering work on pulse tube refrigerators. He has been an invited speaker at numerous conferences, including the plenary speaker at the 1996 International Cryogenic Engineering Conference and the 1998 Applied Superconductivity Conference. He has taught more than 20 short courses on cryocoolers since 1981.

**Tom Siewert** is Acting Chief of the Materials Reliability Division, and has published widely in the areas of mechanical property measurements and nondestructive evaluation. He has a B.S. in applied mathematics and physics, an M.S. in material science, and M.S. in metallurgy, and a Ph.D. in metallurgy, all from the University of Wisconsin.

## AICHE 2005 Rocky Mountain Regional Conference

AICHE's Regional Student Conference is an annual event that attracts the best and the brightest engineering students from colleges across the Rocky Mountain Region. The goal of this event is to provide opportunities for dedicated students to share their technical knowledge, compare notes on their university experiences and plans for the future, and meet with industry professionals such as yourself. You will have the opportunity to meet the next generation of chemical engineers and share your professional experiences.

Highlights include:

- Industry workshops
- Corporate tours of NREL, Coors Brewery, Denver Water Treatment Plant, and the Suncor Energy Refinery
- Student Research Paper Competition
- Student ChemE Car Competition
- Awards Banquet on April 2 at 6:30 p.m. at the CSM Student Center, Ballrooms A & B

For more information, check the website [www.mines.edu/stu\\_life/org/aiche](http://www.mines.edu/stu_life/org/aiche).

### March Puzzler: Can you find a solution?

**Location:** Chemlink Pearl River Water Treatment Chemicals Plant (1986) in Pearl River, MS

**Problem:** Water solvating of melamine formaldehyde acid colloid is a mildly exothermic batch process requiring a water jacketed, stirred stainless steel tank. Batch preparation involves charging the tank with appropriate amounts of formaldehyde and cool condensate from the plant steam system, and manual addition of 100 lb bags of melamine colloid into the open top of the stirred tank at a rate which prevents excessive solution temperatures until the desired concentration is reached. Insufficient cooling during the solvation process results in conversion of the colloid solution to a gelatin, unusable for its purpose in water treatment.

The cooling system also used surplus condensate in a closed system consisting of a pump which circulated the cool condensate through the tank

jacket and to the tube side of an exchanger before returning to the pump. An open loop, single pass system pumped river water through the shell side of the exchanger for cooling.

The process had been designed to produce an 8,000 gal truckload in 2 hours, but the rate of heat removal was insufficient to avoid excessive temperature increase. Instead, approximately 5 hours was required to create a load of solution for customers. The company was supplying local customers with truck loads from a similar plant 500 miles away at a freight cost of \$1,000/day.

The cooling water level in the jacket of the stirred tank was examined and found adequate. Calculation of the heat transfer coefficient and fouling factor using a temperature survey taken during the batch process revealed no jacket fouling and the tank agitation and cooling loop circulation rate were also found within specification. However, the heat transfer coefficient of the river water cooler was approximately 40% of design. Maintenance records showed the cooler had just had its bundle pulled and cleaned, with no evidence of fouling.

**Diagnosis:** Close field examination of the exchanger configuration revealed that the river water entered on the top of the shell and exited on the opposite side of the exchanger on the bottom. The original design showed the opposite configuration, but the piping had been altered in the field for unknown reasons. Since the pressure of the river water system was only about 30 psig, the modified arrangement assured entrapment of a large air bubble on the shell side, which in turn prevented the water from covering the tubes, effectively derating the exchanger to approximately 40% of design.

**Solution:** Check the web-site at <http://www.aiche-rm.org> for the solution to this problem. If you don't have access to the web, keep reading, you may find the solution in this issue.

### NEW MEXICO CORNER

The next local New Mexico AIChE meeting will be in April. Check next month's newsletter for details. For more information about the New Mexico meetings, contact Kerri Pratt at [PrattKL@cdm.com](mailto:PrattKL@cdm.com)

## WHAT HAVE I MISSED?

### FEBRUARY- Golden

Approximately 26 AIChE members braved the fickle winter Colorado weather to hear Glenn Sprenger, President of GR Sprenger Engineering, Inc., give a presentation on "Sampling of Solids in the Chemical, Mining, and Pharmaceutical Industries" at the Fairview Bible Church on February 15th, 2005. Opening remarks were provided by Rocky Mountain Section Program Chair Tom Wellborn, which included an interesting short presentation on how to represent the equation  $1+1=2$  in a fashion more interesting to engineers.

Sprenger began his presentation by describing the conditions which led to the development of an "In Line Dry Material Sampler", for which a patent was granted in 1985. A major chemical company realized their current device was not obtaining accurate samples and Sprenger and a colleague were charged with developing a device which did. Sprenger first thoroughly examined sources of solids sampling error from available literature and found especially germane discussions in publications by French engineers Pierre Guise and Francis Pitot. He also determined that if an accurate sample could be obtained, a device called a riffler essentially set the standard for accurate determination of sampling results. His review of all commercially available sampling devices revealed they were intensely mechanical in nature and employed many moving parts. In virtually all cases, the moving parts themselves created significant sampling errors, but of differing nature unique to the method employed.

Sprenger decided the essential design criteria should be no moving parts, and employed a clever method which took an accurate sample of the entire solids stream as it flowed through the device. The method was derived after he observed that all solids piles sort themselves while being created, as large particles tend to fall to the outside and small collect in the center, an effect his design avoided. In addition, the new design could be staged to reduce the sample size to the desired amount, while still obtaining an accurate sample. Key design considerations include the maximum particle size of the solids stream, the angle of repose of the heterogeneous solids mixture, and sizing the cross sectional flow area at 125% of minimum distribution flow.

The new design was extremely successful, and widely applied in many similar applications. However, new challenges were encountered when the device was applied to solids streams which exhibited very fine particle size distributions such as powders. The problem encountered was "bridging", which plugged the device. After careful consideration, Sprenger modified the design

to prevent its occurrence. When it was proven successful, Sprenger realized the modification merited its own patent, which was granted in 1995 as an "Apparatus for Collecting Small Samples from Flowable Solids".

Sprenger concluded the presentation with the revelation that new modifications had been made which are expected to result in additional patents for refinements to the device. After the presentation, attendees enjoyed examining the original prototype which Sprenger had created in his own garage.

*Glenn Sprenger and Tom Wellborn at the February AIChE Meeting*



*Glenn Sprenger's In Line Dry Material Sampler*



## AIChE Meetings

### 2005

Apr 10-14	2005 Spring Nat'l Atlanta, GA
Apr 11-13	20 <sup>th</sup> CCPS Int'l Atlanta, GA
May 2-5	Offshore Tech Houston, TX
Sept 26-29	Safety in Ammonia Plants Toronto, Ontario
Oct 30-Nov 4	2005 Annual Mtg. Cincinnati, OH
Nov 2-4	AIChe/ACS Mgmt Cincinnati, OH

### 2006

Apr 23-27	2006 Spring Nat'l Orlando, FL
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For further information, contact  
National AIChE.

### National AIChE Contact Info

#### **AIChExpress Service Center:**

(US/Canada): 1-800-AIChemE  
(1-800-242-4363)

(International): 212/591-8100

Fax: 212/591-8888

E-mail: [xpress@aiiche.org](mailto:xpress@aiiche.org)

**Member Services:** 212/591-7981

**Career Services:** 212/591-7670

**Govt. Relations:** 202/962-8690

**Govt. Relations Fax:** 202/962-8699

**Web Page:** <http://www.aiiche.org>

## Rocky Mountain AIChE Officers

Glenn Sprenger	Director & Membership 720/873-4756 <a href="mailto:Gsprenger@allosource.org">Gsprenger@allosource.org</a>
Kevin Milliman	Chair 303/804-2374 <a href="mailto:Kevin.Milliman@earthtech.com">Kevin.Milliman@earthtech.com</a>
Tom Wellborn	Vice-Chair / Program 303/933-0533 <a href="mailto:wellborns@mindspring.com">wellborns@mindspring.com</a>
Curtis Dominicak	Secretary 303/969-9416 <a href="mailto:Cldominicak@comcast.net">Cldominicak@comcast.net</a>
Craig Wildemuth	Treasurer 303/791-6307 <a href="mailto:Craig.Wildemuth@grace.com">Craig.Wildemuth@grace.com</a>
Martin Vorum	Employment Info 303/789-0848 <a href="mailto:Mvorum@chisp.net">Mvorum@chisp.net</a>
Collin Greenwell	Student Chptr. Liaison 720/497-2133 <a href="mailto:Collin.greenwell@xcelenergy.com">Collin.greenwell@xcelenergy.com</a>
Kerrie Pratt	New Mexico Liaison 505/243-3200 <a href="mailto:PrattKL@cdm.com">PrattKL@cdm.com</a>
Laura Moes	Editor 303/770-2432 <a href="mailto:Lauramoes@msn.com">Lauramoes@msn.com</a>

Rocky Mountain AIChE News is published eight times a year by the Rocky Mountain section of AIChE. Opinions expressed herein are those of the authors and are not necessarily those of AIChE nor the officers of this section.

The objectives of AIChE are to advance chemical engineering in theory and practice, to maintain a high professional standard among its members, and to serve society, particularly where chemical, engineering can contribute to the public interest.

***Solution for March Puzzler (page 2):*** After revising the piping connections at a cost of \$5,000, so that the water inlet was on the bottom of the shell side and the outlet at the top, the entire system performed at design.

## UPCOMING MEETINGS IN 2005

***April 19: Presentation: Solvent Resistant Membranes in Refinery Separations in Westminster***

***May 17: Tour of Dyno-Nobel Ammonia Plant in Cheyenne, WY***

***September 20: Tour of TDA Research and Presentation***

***October 20: Olfactory Sense Analysis***

Rocky Mountain AIChE News  
America Institute of Chemical Engineers  
1025 West Peakview Circle  
Littleton, CO 80120-3327

On the Web at:

<http://www.aiche-rm.org>

*Send your E-MAIL address to  
[mmoes@ekiconsult.com](mailto:mmoes@ekiconsult.com) to receive  
this newsletter electronically!*



**FOREIGN NATIONALS** must send their passport number, date of birth, place of birth and country of citizenship in the RSVP to Tom Wellborn at [rockyaiche@yahoo.com](mailto:rockyaiche@yahoo.com) prior to attending the meeting.

**DIRECTIONS:** From I-25, take US-36 into Boulder. Go past the Foothills Parkway/Table Mesa/South Boulder Rd exit, and take the Baseline Rd exit. Stay to the left on the exit ramp, and turn left (west) on Baseline Rd. Travel under the US-36 overpass, to the first stoplight, at 27th Way. Get in the left turn lane and follow 27th Way up the hill to Broadway (CO 93). The Boulder NIST Labs are straight ahead, directly across Broadway. Visitors must check in at the guard shack and obtain a Visitor Badge at the Visitor Center. All visitors are required to show photo identification upon arrival and must wear a visitor badge at all times.