Rocky Mountain AIChE News

April 2005 Volume 14 Number 7

April Section Meeting: Commercialization of Membrane Technology for Refining Applications

"Along the Atlantic Coast and elsewhere, a different petroleum cargo is being imported: gasoline. Instead of refining crude oil in domestic refineries, oil companies are becoming increasingly dependent on imports of finished fuels to meet the growing American thirst for gas.

The arrangement has benefited both sides of the trade. Domestic refiners can keep their overall capacity tight, secure in the knowledge that any demand spikes can be met with imported gasoline. And foreign companies can use the American market opportunistically to sell off excess gasoline production rather than store it at home.

This relationship could be in danger of breaking down. Recent changes in U.S. fuel standards may reduce the number of foreign refineries capable of serving the American market. And demand from China and India is rising fast. We may soon find ourselves more dependent than ever on a handful of nations—and fighting off foreign competitors—in the quest to meet our transportation fuel needs. [1]"

Increasingly, the news portrays a nervousness about the future of our oil and gas supplies and the story is repeated as we fill our vehicles at the gas pump. Davison Membranes pioneered many commercial membrane applications and has been a leading player in commercializing membrane-based solutions for refining applications ranging from natural gas separation to solvent recovery and gasoline sulfur reduction. The demand for membrane products and processes has been steadily growing, but the use of membrane processes within the mainstream petroleum and chemical refining

April Section Meeting

Topic: Commercialization of Membrane Technology for Refining Applications

Speaker: Craig Wildemuth
General Manager, Membranes
Davison Membranes

Date: Tuesday, April 19th

Time: 6:00 Social Hour/Lobby Bar
6:45 Dinner
7:30 Presentation

Location: Westminster Double Tree
8733 Yates Dr., Westminster

Menu: Black bean & corn salad
Tossed Garden Salad
Make-you-own fajitas beef/chicken
Refried beans
Santa Fe Rice
Sopapillas

Cost: Members: $20
Non-Members: $25
Students & Unemployed: $10

Please RSVP by **Friday, April 15th** (early RSVPs are greatly appreciated!). Indicate your name, phone number, and number of attendees by e-mailing Tom Wellborn at rockyaiche@yahoo.com. Alternatively, you may leave a voice mail for Tom at 303-933-0533.

(continued from page 1)

industries lags significantly behind other industries and has only narrowly been applied.

Although the development of the membrane itself has attracted the most attention, there is generally a large gap between the identification of a working membrane to the development of a commercially viable process. This presentation will give an overview of the steps involved in the commercialization of membrane-based processes by using successful commercial examples. For example, MaxDeWax™ for lube solvent recovery, the world's largest membrane refining applications jointly commercialized by Davison Membranes and ExxonMobil, has been in successful operation in ExxonMobil Beaumont refining since 1998. More recently, Davison has commercialized S-Brane, an innovative separation process that selectively removes sulfur-containing molecules from FCC or other naphtha streams. S-Brane technology not only significantly reduces the overall capital and operating cost for clean fuel compliance, but also provides a means for preserving octane that often occurs in hydrotreating-based technology.

Craig Wildemuth is General Manager, Gas Membranes and Director of Manufacturing for Davison's Littleton manufacturing operation. Craig received his BS in Chemical Engineering from Iowa State University and his MS in Chemical Engineering from the University of California – Berkeley. His experience in membrane ranges from hollow fibers used in medical devices to spiral elements used for industrial separations. He has held various positions in research, process development and manufacturing with Dow Chemical and Grace during his 25-year career in membrane technology.

[1] Extracted from "A case of the vapors", Jeffrey Winters, Mechanical Engineering, December 2004

JOB OPPORTUNITY FOR A CONTROL SYSTEMS ANALYST

Highly skilled individual needed to provide technical expertise for regional wastewater treatment plant's process control/automation computer systems. Duties include project management and performing analysis, design, and programming for new and existing process control/network systems.

Qualifications: B.S. degree in electrical engineering or computer science, plus five years of experience in operation and programming of real-time process control systems. Must have knowledge of process control theory and process instrumentation; experience with distributed control systems, PLC systems, client/server programming, and data communications. Desired qualifications include: specific experience with Allen Bradley PLC systems, ABB MOD-Advant DCS systems and OSI PI data archiving systems a plus. Preferred candidate will have knowledge of wastewater treatment.

Compensation/Benefits: Salary range: $50,815 - $76,232. Looking to hire at mid-range, allowing room for salary growth. Pay for Performance Program. Excellent comprehensive benefits package, including health, dental, life, and AD&D insurance; 100% employer-funded defined benefit retirement plan; optional deferred compensation program. Educational assistance, health & fitness program. Four 10-hour-day workweek available.

*Send resume or apply to Metro Wastewater Reclamation District, 6450 York St., Denver, CO 80229; (Ph. 303-286-3000). See our website at www.metrowastewater.com for details about our organization. *NOTE - A drug screening, criminal background check and MVR will be part of the selection process. Metro District is a non-smoking facility. AN EQUAL OPPORTUNITY EMPLOYER.*

NEW MEXICO CORNER

Topic: The Synergy between Productivity and Safety
Speaker: William L. Kubic, Jr.
Los Alamos National Laboratory
When: Wednesday, May 4th, 5:30 p.m.
Where: Fiesta's Mexican Restaurant and Lounge
4400 Carlisle Blvd NE

Industrial safety in the United States has improved continually since 1940. To ensure that this trend continues, it is important to understand the factors that led to these improvements. In his presentation, Dr. Kubic will argue that past improvements were driven by economic factors and not government regulations. In particular, he has found a strong link between productivity and safety. This synergy between productivity and safety exists because many actions that are taken to improve productivity also result in improvements in safety. Therefore, past improvements in industrial safety have been primarily the indirect consequences of economic pressures to improve productivity. Viewing safety and productivity as two aspects of a common problem could benefit both safety and productivity.

For more information about the New Mexico meetings, contact Kerri Pratt at PrattKL@cdm.com

April Puzzler: Can you find a solution?

***Location**: Phibro Energy USA (1992) - Texas City Refining, TX*

***Problem:** In oil refineries, alkylation is a process whereby propylene and the four isomers of butylene are combined with isobutane to create highly branched heptanes and octanes in the presence of a strong and highly concentrated acid, either sulfuric or hydrofluoric, with contactor designs that minimize polymerization. Typically, isobutane in the hydrocarbon mixture is 2-3 times the stoichiometric requirement to maximize conversion via LeChatelier's principle. The mixture is separated from the acid in a large settler vessel. Propane and butanes are next easily separated from the resulting gasoline product, called alkylate, and then from each other by fractionation. Excess isobutane is recycled as is the acid, after removal of small amounts of heavy polymer byproducts.*

The alkylate usually has a road octane of 92, a low vapor pressure, and its economics are driven by the low cost of low octane, high vapor pressure gasoline blendstocks like natural gasolines fractionated from crude oil or condensed from natural gas processing. In the summer when gasoline vapor pressure specifications are low, high vapor pressure normal butane blending is constrained. As a result, the industry typically stores butanes in specially constructed salt domes for blending in winter. Since the road octane of butane is 92, the value of road octane increases significantly in the summer and the value of low octane blendstocks is driven down. In some refining areas, primarily on the Gulf Coast, the polymerization value of propylene justifies recovery of propane and propylene and subsequent separation by distillation (100 trays!). With C3's removed (and therefore no heptanes), the C4 alkylate is generally higher octane.

There are three refineries located in Texas City, and one has a hydrofluoric alkylation unit which produced 11,000 bpd of C4 alkylate. Typical alkylate properties for this unit were 94 road octane and 6 psi Reid vapor pressure. However, in early summer, the road octane began to decline by 2-3 numbers over the course of the same number of weeks. As a result, the refinery could no longer purchase and blend inexpensive natural gasoline with an octane number of 75. Since the value of an octane point was roughly 1 cpg or $0.42/octane-barrel, this decline represented about $10-15M$/day in profit loss to the refinery. Worse, the vapor pressure of the alkylate also began to increase mysteriously. If the octane number of the alkylate declined or the vapor pressure increased further, the refinery might not be able to blend its own natural gasoline from crude oil, and would have to discount it substantially to sell it. This could easily double the economic loss.

Refinery personnel had been investigating the cause of the declining octane and increasing vapor pressure of the alkylate. Impurities in the olefin and isobutane feedstocks (which could lead to high byproduct yield due to polymerization and/or low conversion) were examined, but found to be within normal tolerances. In addition, byproduct yield had not increased. Acid purity (which could cause low conversion and declining octane) was also found to be normal. Fractionator efficiencies (which could reduce the isobutane/olefin ratio and conversion) were calculated and no decline was observed. Exchanger surveys and subsequent calculation of fouling factors showed no appreciable efficiency losses which might impact separations. Recycle and purchased isobutane purity was normal. None of the possible causes investigated explained the mysterious increase in the vapor pressure of the alkylate. Things became desperate after the alkylate vapor pressure continued to increase, low octane gasoline blendstock inventories began to build, and the planning and marketing departments were asked to consider selling them in lieu of equivalent finished gasoline.

***Diagnosis:** Detailed scrutiny of the process flow and instrument diagrams revealed that the isobutane/olefin feed mixture was preheated with the alkylate product in an exchanger prior to mixing with the hydrofluoric acid in the contactor. In addition, the pressures of the two process streams on both sides of the exchanger were roughly the same..in fact, a pressure cross-over occurred from end to end. A tube leak in this exchanger would allow alkylate into the feed mixture, thereby immediately reducing the initial acid purity in the contactor and significantly impacting conversion. Since there was a pressure cross-over, a tube split length-wise or a leak at the opposite end would also allow high vapor pressure feed mixture into the alkylate product.*

***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.*

WHAT HAVE I MISSED?

MARCH - Boulder

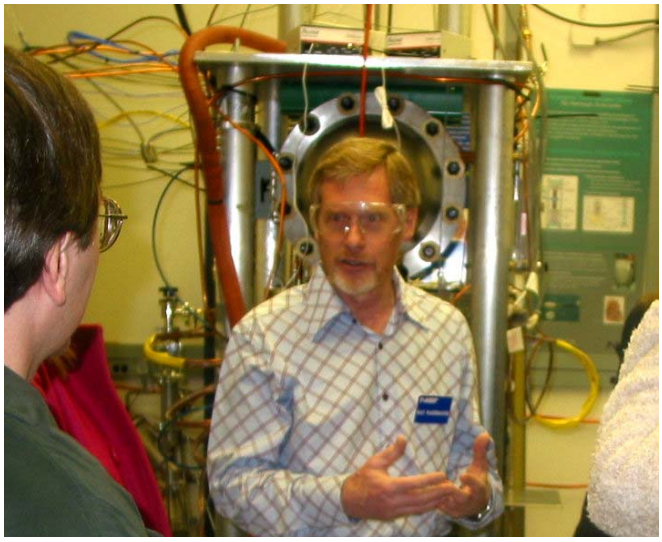
The tour of the National Institute for Standards and Technology (NIST - formerly the Bureau of Standards) was the brain-child of AIChE member Arno Laesecke, who casually mentioned at the November meeting (Solid Oxide Fuel Cells) that he might be able to ask Dr. Tom Bruno at NIST if an AIChE tour could be arranged. So, on March 15 approximately 46 AIChE members were treated to a first class cafeteria dinner prior to a choice of any four of nine tour stops. After the meal in the cafeteria, two short overview presentations were made, discussing the purpose of NIST in its role with the Department of Commerce and, within NIST, (and dear to the AIChE heart...perhaps), Physical and Chemical Properties Division.

Fundamentally, NIST fulfills the Federal Government's constitutional obligation to "promote the general welfare", by engaging many of America's finest scientists to establish, maintain, and refine standards by which goods and services may be gauged for public benefit. This turns out to be no insignificant task, as the rapid development of new technologies forces the development of new standards and refinement of old ones, pushing the measurement envelope to literally new dimensions. As a result, NIST is involved in activities from improving the purity of elements and compounds for properties determination by more accurate instruments to development of emerging technologies required for a human landing on Mars and to protect people from terrorism. Unlike most government entities (excepting the IRS), NIST's specialized expertise in the area of measurements allows it to not only justify, but quantify the value of, its existence to the OMB.

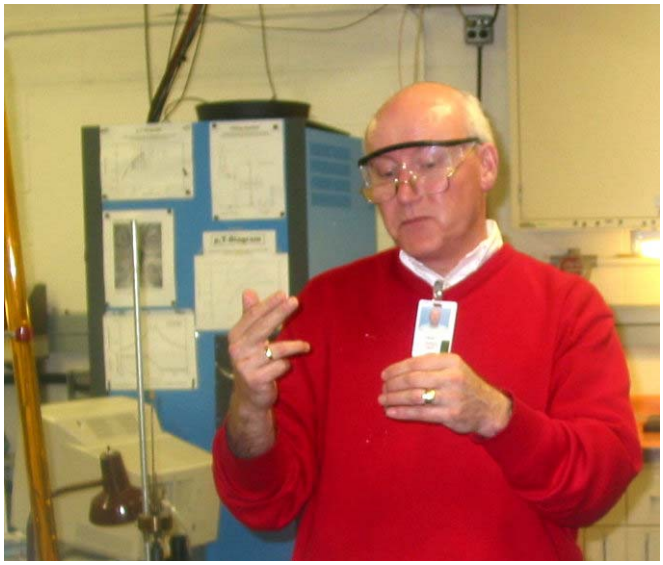
The tour stops included: Atomic Clock, Superconducting Magnets, Infrastructure Safety, Surface Energetics & Chemical Analysis, Scientific & Technical Databases, Standard Reference Densitometry, Thermal Conductivity Measurements, Viscometry, Cryogenic Technologies.

While one obviously could not see the cesium atoms in the multiple generations of atomic clocks, one could see the results displayed virtually throughout the facility, making one quite time-conscious during the tours. And indeed one was, as after any four tour stops, one was disappointed there was insufficient time for the remaining five. Hands-on demonstrations were conducted of Superconducting Magnets, while the Cryogenic demonstrator had to wear gloves to present their demonstrations. In fact, liquid nitrogen seemed to be the common denominator at many of the stops. In some areas, dynamic testing and data generation were underway while in others, instruments were displayed and measurement techniques described by the users. At the end, NIST representatives encouraged AIChE members to return again and visit the stops they missed in the future. Students and members alike marveled at what they were able to see at NIST, and as one attendee overheard during the gasps, "This isn't magic! It's science!"

Tom Bruno discussing Physical and Chemical Properties



Ray Radebaugh discussing Cryogenic Technologies



Arno Laesecke discussing Viscometry

AIChE Meetings

2005

May 2-5	Offshore Tech Houston, TX
Sept 11-14	LNG Conference Vancouver, BC
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
June	Process Develop. Symposium Palm Springs, CA
Nov 12-17	2006 Annual Mtg. San Francisco, CA

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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 April Puzzler (page 3)**: Shutting down an HF alkylation unit is particularly difficult, due to the extremely hazardous and corrosive nature of the acid and typically limited LPG storage. However, the only viable option was to shut the unit down, pull the exchanger bundle, identify the leaking tubes, plug and hydrotest, and restore the unit to service. Inspection revealed several tube leaks, including one tube split lengthwise. It took three days to accomplish the tasks, but alkylate quality returned to normal upon restart. Six weeks was required to process the inventory of C4 olefins built during the shutdown, using what little spare capacity was available. A new bundle was ordered for installation during the next turnaround.*

UPCOMING MEETINGS

***May 17**: Tour of TDA Research and Presentation*
***September 20:** Olfactory Sense Analysis*
***October 18:** Tour of Dyno-Nobel Ammonia Plant in Cheyenne*
***November 15:** Tour of BP/CU Visualizaton Center in Boulder*
***January 17, 2006:** Nanoproducts*

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On the Web at:
http://www.aiche-rm.org

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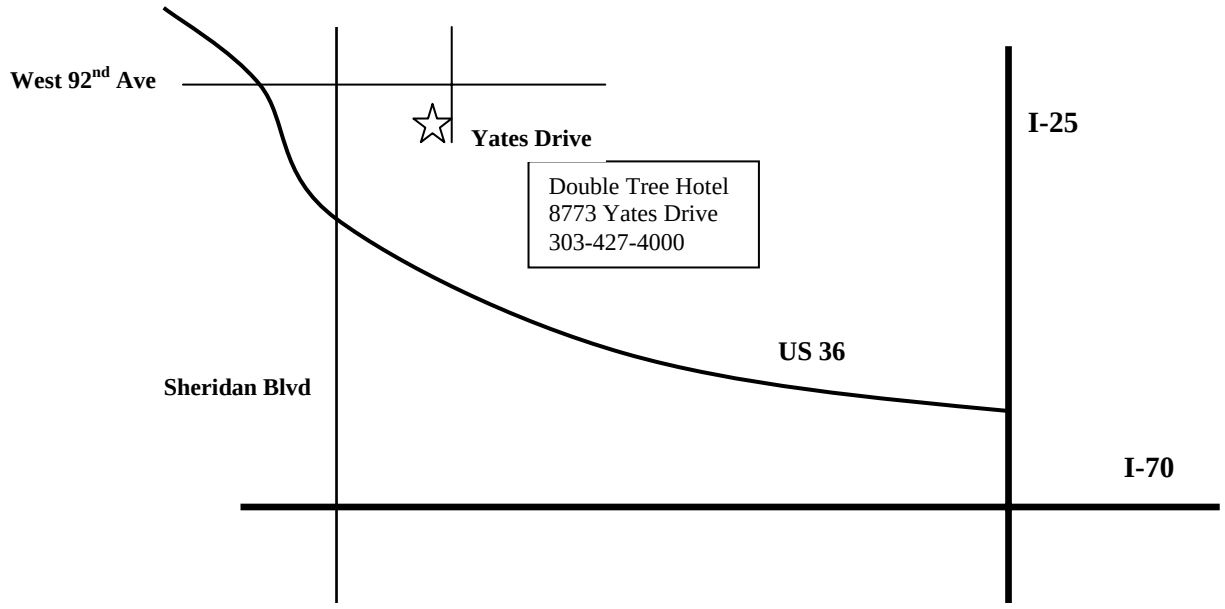

<u>DIRECTIONS</u>: Take I-25 to US 36 (Boulder Turnpike). Travel west on US 36. Exit at Sheridan Blvd and go north (to the right). Turn right at the first light which is W. 92nd Ave. Turn right at the first street which is Yates Drive. The Double Tree hotel is at the bottom of the hill on the right hand (west) side.