Welcome to the AFPM Q&A and Technology Forum, and welcome to Baltimore. This year’s theme is Refocus, Reinvent, Reimage, Reassure, so there is no more appropriate place to meet than Baltimore, a city whose history has run a similar course.

Founded in 1729, Baltimore was once a major manufacturing center and the second-lead- ing port of entry for immigrants to the US. However, with the decline in manufacturing, the city has had to refocus and reinvent itself into what is now a growing green economy.

Like Baltimore, the refining and petrochemical industries know what it means to adapt to new challenges. Today, we are facing one of our largest challenges yet: a growing movement to demonize our industries in the name of climate change. Sadly, the leaders of this movement will not face the truth—oil and natural gas are the fuels that made the air cleaner than it has been in more than 50 years. These environmental improvements are achieved through the investment of billions of dollars in research and technology. Clearly, the work that you do is instrumental in advancing our industries, which is why this conference is so important.

This year’s program was developed to focus on the issues that you have identified as critical to your operations. The Q&A sessions and the complementary Principles and Practices sessions address a wide range of critical subjects that affect your operations, and highlight the importance of developing and training future industry leaders.

Back by popular demand, and necessity, is our Cybersecurity Day. This issue continues to pose significant challenges to industries, governments and individuals. Cybersecurity is a critical component of protecting refineries and petrochemical facilities, and several standards, technologies, controls, strategies and processes to manage cyber threats have been developed. The Cybersecurity Day will tackle many issues, from legal risks to identifying risks to your control systems.

CHET THOMPSON, President, American Fuel & Petrochemical Manufacturers

Sam Lordo to receive Lifetime Service Award

Each year, the Peter G. Andrews Lifetime Service Award honors members who have made long-lasting contributions to the value and vitality of the AFPM Q&A and Technology Forum. Recipients have served in many capacities and have had significant influence on the event’s quality, emphasizing the importance of sharing knowledge in making continuous improvements.

The 2016 recipient is Sam Lordo, who has accumulated 39 years of experience in the refining and petrochemical industries with Exxon Chemical, Nalco/Eexxon Energy Chemicals and Nalco Champion. He has been a longtime AFPM member and advocate, serving in numerous capacities, including on the 2002 AFPM Q&A Panel and the AFPM Screening Committee.

Mr. Lordo serves as marketing director for Nalco Champion, North America, where he directs, coordinates and supports marketing and technology activities with major refinery sites worldwide. He is involved with desalting, antifoulant and corrosion control technical and technology developments, and has authored several papers on corrosion control, desalting and crude oil management.

In addition to his longtime participation with AFPM, Mr. Lordo has been a member of the National Association of Corrosion Engineers (NACE) for 20 years, and remains active in the Crude Oil Quality Association (COQA) as an associate board member.

“It is a great honor to receive this recognition,” Mr. Lordo says. “I have spent many years working in and for the industry through a number of direct and indirect pathways. AFPM was one of the first industry organization events I attended, and it is definitely one of the first that I got actively involved with.

“At the AFPM Q&A and the Annual Meetings, it is always great to see and visit with all of my old friends and colleagues, as well as meet new friends. AFPM is more than a technical social organization: I truly believe that through our interactions, AFPM members expand our knowledge of the industry and the opportunities ahead. I use these meetings as a chance to learn and stay up-to-date through the networking opportunities.”

Mr. Lordo believes that the refining and petrochemical industries have shown great resiliency and adaptability to the challenges that geology, governmental and environmental regulations and a challenging global economy have presented.

“Just look at what we have persevered through since 2008. With the advent and application of the technologies that help produce light tight oils, we moved from the doom and gloom of final oil to having to throttle back production to match demand,” he says. “Even with the stress of low oil prices, the industry continues to adapt with new technology.”

Echocing the sentiments of many industry professionals, Mr. Lordo marvels not only at how far technology has come recently, but also the potential effects that new technologies will have on refraining to the next level of production efficiencies.

SAM LORDO, Marketing Director for Nalco Champion, North America

“I see one of the biggest opportunities in predictive modeling that is being developed using key crude oil qualities. Both computational power and innovative data mining will bring big changes,” he says.

See SERVICE AWARD, page 3
Drawing upon the expertise of Chevron and Grace, Advanced Refining Technologies® (ART) is the leader in hydroprocessing catalysts with more than 50 years of combined experience perfecting best-in-class solutions.

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- AFPM Annual Meeting: Technical presentation by Doc Kirchgessner with Patrick Salamo of PES
- AFPM Cat Cracker: Q&A with Grace's Ann Benoit; technical presentations by Gary Cheng, Kent Turner, and Dennis Kowalczyn
- AFPM Q&A/Technology Forum: Informational exhibit and one-on-one dialogue with technical experts

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and satisfying to see the growth and others to foster. “I find it rewarding the Emerging Leaders Series that He will also support and promote crude quality and how to best process “it would be the dramatic changes in try grapple with,” Mr. Lordo says, and profitability, often through most consisting refiners to improve reliability career, and during his work with Na- "I do it because of the people I have been privileged to work with over the um/coking Q&A session and moder- sations on supply chain and optimi- plant automation as a whole.” Mr. Lordo described his plans for a and I will visit some of the hospital- sessions looking for new ideas.” As always, he will be promoting the benefits of AFPM membership. “I do it because of the people I have been privileged to work with over the years. I must thank Nalco Champion and my family for all their support that has allowed me to participate in AFPM over the years,” he says. “Be- ing recognized by my AFPM peers is one of the greatest professional high- lights of my career.”

Throughout the last 30 years of his career, and during his work with Na- lco Champion, he has been involved with process troubleshooting and as- sisting refiners to improve reliability and profitability, often through mostly unconventional methods. “If I had to identify the greatest challenge that I have seen the indus- try grapple with,” Mr. Lordo says, “it would be the dramatic changes in crude quality and how to best process those crude in the face of the chang- ing political and regulatory climate.” Some of his short-term goals in- clude continuing his involvement with the Advance Downstream University, an internal training pro- gram that Nalco Champion has de- veloped for new college graduates. He will also support and promote the Emerging Leaders Series that AFPM has allowed Steve Perry and others to foster. “I find it rewarding and satisfying to see the growth and development of the next generation of industry contributors. This is vi- tal for the future of AFPM and the industry as a whole.”

Mr. Lordo described his plans for a busy event. “In addition to attending as many of the sessions as possible, I will be assisting in the crude/vacu- um/coking Q&A session and moder- ating the associated open forum ses- sion, which is a new dimension that promotes increased audience discuss- ion. Steve Perry and I will co-chair the Emerging Leaders P&S session, and I will visit some of the hospital- ity suites looking for new ideas.”

As always, he will be promoting the benefits of AFPM membership. “I do it because of the people I have been privileged to work with over the years. I must thank Nalco Champion and my family for all their support that has allowed me to participate in AFPM over the years,” he says. “Be- ing recognized by my AFPM peers is one of the greatest professional high- lights of my career.”

SCHEDULE OF SESSIONS
AND SPECIAL EVENTS

SUNDAY, SEPT. 25, 2016

3–6:30 p.m. Registration and badge pickup
5–5:30 p.m. Emerging Leaders networking event
5:30–6:30 p.m. Q&A kickoff networking event

MONDAY, SEPT. 26, 2016

7 a.m.–6:30 p.m. Registration
8–8:55 a.m. General session
• Presentation of the Lifetime Service Award: Sam Lordo, Nalco Champion • keynote address: Jim Makowski, Koch Industries
10–10:15 a.m. Coffee Break
12–2 p.m. Lunch in Exhibit Hall
5:15–6:30 p.m. Q&A: Hydroprocessing Panelists: Subhash Bhattacharyya, Chevron Lummus Global LLC; Patrick Grigal, Criterion Catalysts & Technologies; Andrew Layton, KBC Advanced Technologies Inc.; Jeffery Mustier. Marathon Petroleum Corp.; Chad Perrott, ExxonMobil Chemical Company; Joseph Rydberg, DTG Petroleum Corp.
3:30–3:45 p.m. Refreshment break
3:45–5:15 p.m. Plant Automation: Software Applications • Eliminating Difficult to Control Processes with Procedural Automation: Darwin Logerstor, Prosys Inc. • The Cloud is Here for Smart Manufacturing: Pete Sharpe, Emerson Process Management; Larry Menges, Precour Inc. • Big Data Analytics Applied to Real-World Control Systems—From Instruments to Advanced Controls: George Buckbee, Metso
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5:15–6:30 p.m. Reception in Exhibit Hall

PRESIDENT’S WELCOME, continued from page 1

Plant Automation sessions will focus on alarm philosophy and man- agement to help keep your facilities operating successfully and producing products. We will also have conversa- tions on supply chain and optimi- zation. Gasoline processing, includ- ing exploring solutions for producing higher-octane gases, is an increasingly important topic as the Obama adminis- tration, and possibly the next adminis- tration, looks to increase fuel efficien- cy standards. Every session addresses the fundamentals of good operations and the foundational principles for technologies that are commonly used. This forum is created each year to give everyone the opportunity to listen and share information. Through your participation, we continue to work to- gether to make our industries among the safest and most innovative in the country. I hope the program and your fellow conference attendees provide new perspectives and information to take back and utilize in your operations. In addition to participating in this year’s event, I hope you have an op- portunity while you are here to appre- ciate some of the city’s great offerings, including its rich history, the scenic harbor and, of course, the famous Maryland crabs.

Thank you for joining us here in Baltimore, and thank you for support- ing AFPM.
Rainer Bass, HollyFrontier, is a senior economic and planning engineer in Dallas, Texas. He is responsible for strategic capital projects and MS degrees at all of the company’s locations, as well as strategy around specific threats and opportunities affecting commercial operations. Mr. Bass holds a BS degree in chemical engineering from Kansas State University and has been with HollyFrontier for nine years at various locations.

Subhas Bhattacharya, Chevron Lummus Global, is a Richmond, California-based consulting engineer in hydroprocessing and downstream technology. He has 27 years of industry experience and has worked extensively in process design, plant commissioning, technology services and technology development. Mr. Bhattacharya has presented several papers on distillation and residue hydrocracking, catalytic dewaxing and hydrogenfinishing technologies at national and international conferences. He is the author of the chapter on lubricant base oil hydroprocessing in the latest edition of the Handbook of Petroleum Refining Processes, and has three patents. He earned an MS degree in chemical engineering from the Indian Institute of Technology in Kanpur, India.

Zach Bezon, United Refining, is a process engineer based in Warren, Pennsylvania. He assists in the advancement and improvement of the refinery’s processing facilities, including the implementation of heat exchangers, distillation towers, vessels, pumps, tanks and new piping systems. Mr. Bezon holds a BS degree in chemical engineering from the University at Buffalo and has five years of experience in the oil refining industry.

Jeffrey Mueller, Marathon Petroleum

Phillip Niccum, KP Engineering, is senior vice president of process engineering. With 35 years of engineering and management experience, Mr. Niccum has been granted 15 US patents and authored dozens of publications for major industry conferences and trade journals. Prior to joining KPE, he served as a senior refining process engineer manager at KBR, as well as chief technology engineer and director of FCC technology at KBR, where he spent the last 26 years of his career. Mr. Niccum began his engineering career with Texaco, where he performed technical service and design work on Texaco-FCC units. He earned a BS degree in chemical engineering from California State Polytechnic University.

Chad Perrot, ExxonMobil Chemical

Steven Philoon, UOP LLC—A Honeywell Company, is a principal platforming technology specialist. His current responsibilities include providing direct support to a set of globally distributed customers, participating in technology development projects and bringing commercial perspectives to those efforts, contributing to engineering review meetings for new units and revamps, and conducting onsite troubleshooting and unit performance assessments. During his 35 years with UOP, Mr. Philoon has held positions in R&D, technical service, information technology and engineering services. He earned a BS degree in chemical engineering from the University of Wisconsin–Madison.

Andrew Layton, KBC Advanced Technologies, is a principal consultant with 44 years in the refining industry in all regions of the world, as well as in R&D and engineering and design offices. His experience includes refinery technical, supervisory and operations positions, major project startup leadership, and regional technology leads for reforming and hydroprocessing. He is involved in numerous reliability and profit studies, and also provides a wide range of capabilities that includes frequent turnaround and startup technical support to several global refiners.

Joseph Rydberg, CITGO Petroleum, has over 15 years of experience in the refining industry. He is a process technologist at the Lemont Refinery in Lockport, Indiana, where he is responsible for technical support for daily refinery operations and project process development. His experience is primarily in hydroprocessing technical support, optimization and troubleshooting. Mr. Rydberg holds a BS degree in chemical engineering from the University of Illinois at Champagne-Urbana.

Pete Sharpe, Emerson Process Management, is the director of industry solutions development, and has 37 years of experience in the process control industry in both technical and management roles, specializing in automation in refineries and petrochemical plants. He is responsible for managing the engineering and development of Emerson’s industry-specific solutions, including advanced control, optimization, reliability and energy management technologies. Mr. Sharpe has been Emerson’s representative on...
the Smart Manufacturing Leadership Coalition (SMLC) since its inception. He has also been instrumental on the platform committee, working with Prairix and the SMLC team to establish real-time communications between plant systems and cloud-based applications. He holds a BS degree in chemical engineering from the University of Colorado, and an MBA degree from the University of Houston.

Maji Shyama, Essar Oil, heads the operations function of the company’s refinery in Jamnagar, India. He is responsible for operations of refinery process units, utilities and associated facilities. He has experience in some of the major Indian refineries and the Mombasa Refinery in Kenya. Mr. Shyama holds a chemical engineering degree from Jadavpur University and has 33 years of experience in operations, process and health, safety and environment (HSE) functions, including process safety.

Jay Steiner, MERRICK & Company, is a senior process engineer for the company based in Greenwood Village, Colorado, and serves as the technical leader for the process engineering team. His duties include management of team resources, proposal review and development, process design and technology evaluation. He has 15 years of petroleum refinery experience, with 12 years at the Phillips 66 Billings, Montana refinery, including five years as the crude/vacuum unit engineer. Mr. Steiner holds a BS degree in chemical engineering from Montana State University-Bozeman.

Eric Thraen, Flint Hills Resources, is the system technical lead at the Pine Bend, Minnesota refinery. He is responsible for process technical support of refinery operations and capital projects, and his 35 years of experience in the refining industry includes project engineering, operations and capital projects in the areas of FCC, alklylation, crude/vacuum distillation, delayed coking and gasolene blending. Mr. Thraen has provided engineering and operations support on large grassroots construction and major revamps in these areas. He earned a BS degree in chemical engineering from the University of Michigan.

Lee Wells, LyondellBasell, is the SME engineer responsible for the FCCU at the company’s Houston refinery. In this capacity, he leads the process design work for turnaround projects, mentors the FCCU operation support engineers and assists in process optimization. Since joining LyondellBasell 23 years ago, he has supported the FCCU as a process engineer and engineering team lead. He also served for six years as the refinery’s energy coordinator. Mr. Wells began his career at Gtgo in Lake Charles, Louisiana, supporting the FCCUs and alkyl unit, among others, and serving in positions in economics and production planning. His career continued at Amoco in Texas City, Texas, where he did project work, supported the alkyl units and performed PSY studies. He has 32 years of experience in the refining industry, and holds a BS degree in chemical engineering from Texas A&M University.

Bruce Wright, Baker Hughes, works as a senior engineer in the industrial technology group in Sugar Land, Texas, specializing in applications within the hydrocarbon process industry. He has 38 years of industry experience and is involved in the technical support and troubleshooting of refinery fouling problems, and foam control. Mr. Wright has experience in product development and environment, health and safety (EHS) compliance. He is an inventor or co-inventor on eight US patents and has published 11 technical papers. Mr. Wright earned a BS degree in chemical engineering from the Rensselaer Polytechnic Institute in Troy, New York, and holds an MBA degree from the University of Houston. He is a registered professional engineer in the state of Texas, and is a member of the American Institute of Chemical Engineers.

George Yaluris, Albenmarle, manages the Americas FCC technical services team for the solutions business unit. He has two decades of FCC experience, providing technical support for the application of FCC catalysts, commercializing new catalysts, developing novel FCC catalyst and additive technologies, and researching the chemistry of catalytic cracking processes. Dr. Yaluris holds a diploma in chemical engineering from the Aristotlean University of Thessaloniki in Greece, and a PhD in chemical engineering from the University of Wisconsin–Madison. He is a co-inventor on 16 patents and has published more than 25 papers.
Improve crude diet flexibility and increase profits

Crude diet flexibility is one of a refinery’s primary means of improving profitability. The ability to process discounted crudes, from light shale oil to heavy Canadian crudes, opens up a window of opportunity for refiners. However, it also comes with an array of challenges and risks. With so many unknown factors about crude oil makeup and characteristics, uncertainty in processing is higher than ever.

Poor desalting efficiency, uncontrollable emulsions and other desalting challenges are common when processing lower-priced opportunity crude oils, and will further impact downstream operations such as heat exchanger fouling and wastewater plant upsets. A comprehensive Crude Oil Management approach, shown in FIG. 1, helps refiners minimize risk by proactively gaining insight into crude blend processing challenges, combining technical expertise with technological innovations to provide the best possible feedstock preparation and desalting performance.

Assessing operational impact. Baker Hughes takes a holistic approach to desalting, beginning with a comprehensive risk assessment to understand how a crude blend may impact refinery operations, including:
- Recognizing upstream recovery operations and how previous chemical treatments might affect downstream processing
- Evaluating how crude is received—whether by truck, rail, pipeline or ship—to gain perspective on storage, handling and blending activities before it reaches the crude unit
- Understanding how refinery equipment and processes are configured
- Identifying and addressing potential processing limitations that may arise from different crude blends.

Case History. A US Gulf Coast refiner was processing heavy, high-solids opportunity crudes that were negatively impacting key performance indicators.

FIG. 1. Baker Hughes’ Crude Oil Management approach comprises an extensive portfolio of chemical treatments, modeling platforms and mechanical service programs to ensure reliable and profitable refinery operations.

Counter Seasonal Performance Issues

You no longer need to live with process constraints associated with high temperatures. On short notice, Aggreko designs and installs temporary engineered solutions, offsetting the effects of seasonal limitations. This is accomplished with in-house process engineers and a wide-range of readily-available equipment.

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Introducing FFC Plus, the next generation of FIBER FILM Contactor technology. Merichem Company’s advanced FIBER FILM technology with an integrated coalescer and treater pushes the boundaries of extractive technologies. With this latest advancement to Merichem’s proven technology, hydrocarbon treating rates can be increased by up to 150% through increased mercaptan extraction efficiency. The integrated coalescing and treating device offers a simple installation, reduced chemical use, and reduced service and maintenance complexity. FFC Plus truly is mercaptan treating made better.

**Improved Treating Rates**

The FFC Plus technology from Merichem delivers increased capacity and more efficient sulfur extraction treating of hydrocarbons. This technology enables higher through-put within smaller equipment and better turndown at no additional cost. Process changes and upsets are also handled more effectively without affecting product quality.

**Reduced Carryover**

Merichem’s advanced FIBER FILM technology provides enhanced coalescing of both liquid phases that improves separation efficiency and reduces contaminant carryover. These features protect downstream equipment and catalysts.

**Reduced Plot Space**

The higher capacity and efficiency of FFC Plus translates into reduced equipment sizes and plot space. This reduces project capital and lowers plant operating costs.

Existing Merichem or other treating units can be easily retrofitted with FFC Plus, providing up to 150% additional capacity. This capacity increase will not affect the existing turndown range of Merichem units and will improve the turndown of other units. The new contactor is a direct “drop-in” replacement that can be added or switched with minimal modifications within a short shutdown period.
Fugitive emissions, the unintended release of gases or vapors from pressurized plant components, are a key concern for regulators and operators of oil and gas, chemical and petrochemical plants. Fugitive emissions can be hazardous, contribute to atmospheric pollution, and can represent an economic loss for the plant. Since the number of potential leak sources at large industrial facilities are numerous and difficult to identify, controlling fugitive emissions is vital.

Valves present a challenging possible source of fugitive emissions. In particular, the bolted and threaded components and features that constitute pressure relief valve (PRV) designs suffer the same fate. Unlike manual valves, PRVs are not designed with packing (or stuffing boxes) to minimize or control emissions. Additionally, an industry-wide standard for testing PRVs for fugitive emissions has yet to be established and adopted.

Pentair Valves & Controls teamed with a leading oil and gas producer and a third-party testing laboratory to conduct an innovative fugitive emissions testing program for its PRVs. The company’s Anderson Greenwood Series 400 pilot-operated modulating PRVs by Pentair was part of an extensive fugitive emissions testing program.

**Testing criteria.** The testing criteria were formulated by the joint experience of the oil and gas producer and Pentair as the valve manufacturer, and designed to meet the most stringent requirements of the global oil and gas industry. The valves were subjected to pressures up to 6,000 psig. Depending on the rating of the valve, the temperature was cycled from ambient temperature down to –320°F, up to 1,000°F, and then back down to ambient temperature. Helium gas was selected as the pressurizing test medium, as helium is the smallest atom and therefore the hardest to contain and prevent leakage.

After pressurizing each valve, all potential leak paths (e.g., gaskets, flanges, fittings, etc.) were checked multiple times during the temperature cycle and after the valve was cooled back to ambient temperature. Leak rate was checked using a calibrated mass spectrometer leak detector and a “sniffing” probe with a sensitivity of at least 1.0 x 10^-10 Pa·m³/sec. The valves were considered Class A if the leak was below 1.78 x 10^-10 Pa·m³/sec for every millimeter of gasket length, and the valves where the leak was below 1.78 x 10^-9 Pa·m³/sec for every millimeter of gasket length were considered Class B. Both classes are acceptable, with Class A reserved for the most severe applications, e.g., lethal service. Leakage in excess of the Class B limit is considered a failure.

Valve performance in such a test program depends on several factors. During design, leak paths must be minimized and attention should be given to sealing mechanisms and components, including surface finish, gasket materials and areas, O-ring compression and bolt torques. The manufacturing workmanship and assembly inspection must ensure that all parts are constructed to specification and properly assembled.

**Results and benefits.** The independent laboratory testing showed that all Pentair tested valves successfully passed the strict fugitive emissions containment requirements while withstanding high pressure and both high and low-temperature applications. Maintaining low emissions allows the valve to be safely used in applications with harmful fluids, including volatile organic compounds (VOC), and flammable, lethal and greenhouse gases. Limiting harmful emissions is the driving force behind several regulations, such as the US Environmental Protection Agency’s (EPA) Clean Air Act in North America, and the TA Luft regulation in Europe. The benefits of oil and gas, fuel, chemical and petrochemical producers in utilizing PRVs that are proven to reduce fugitive emissions are numerous:

- **Safety.** Limits direct personnel exposure to harmful products
- **Economic.** Saves more of the process fluids and assures shareholders that production processes are conducted efficiently
- **Environmental.** Minimizes the greenhouse effect and curtails global warming
- **Legal.** Avoids fines from local and federal regulators

These new tests provide an industry benchmark for the continued development and promotion of process and standards improvements to control the amount of released emissions. To address this global issue, embracing new fugitive emissions testing standards can help make significant strides for cleaner processes.

**LYONDELLBASELL TO ADD HDPE PLANT IN TEXAS**

LyondellBasell has selected its La Porte, Texas, manufacturing complex as the site for a new 550-Mtpy high-density polyethylene (HDPE) plant. The plant will be the first commercial plant to employ LyondellBasell’s new proprietary Hyperzone PE technology. Construction is scheduled to begin in early 2017, with startup planned for 2019.

Located on the south shore of the Houston Ship Channel, LyondellBasell’s La Porte complex spans 540 acres and produces ethylene, propylene, linear low-density polyethylene (LLDPE) and low-density polyethylene (LDPE). The La Porte complex is also the primary location for LyondellBasell’s acetyls business, with an integrated chain of manufacturing units producing methanol, acetic acid and vinyl acetate monomer (VAM).

HDPE resins produced using LyondellBasell’s new proprietary Hyperzone PE technology will exhibit enhanced properties, such as improved stress crack resistance and balance between stiffness and impact strength. In certain applications, Hyperzone PE resins may allow customers to use less PE resin per unit produced, resulting in improved resource efficiency and savings.

The Hyperzone PE project is part of LyondellBasell’s ongoing growth plan. Recently, the company completed work on ethylene expansion projects at the La Porte and Channelview sites in Texas. A third ethylene expansion project is currently underway in Corpus Christi, Texas. Additionally, development of a world scale propylene oxide and tertiary butyl alcohol (PO/TBA) plant at the company’s Channelview site is progressing.
How will we produce tomorrow’s propylene?

BART DE GRAAF and MARTIN EVANS, Johnson Matthey Process Technologies

High crude oil prices formed a dark cloud over the refinery landscape until late 2014, promising large profits for alternative propylene manufacturing technologies, whether the feedstocks derived from coal, natural gas or agricultural crops.

At the same time, the US shale gas boom provided steam crackers with a new and cheap feed source: natural gas plant liquids (NGPL). This feed is high in ethane and LPG. Both of these developments led to lighter feeds being run in US steam crackers. Product selectivities from these light feeds are heavily shifted toward ethylene, and this caused a decrease in propylene, butadiene and benzene supply. While the fluid catalytic cracking (FCC) process has made up much of the shortfall, alternative routes for propylene production, such as propane dehydrogenation (PDH) and methanol-to-olefins (MTO), shown in FIG. 1, have been actively considered by many companies. For example, Flint Hills Resources’ Petrollogistics Houston PDH plant produces propylene directly, rather than as a small byproduct of cracking for ethylene or gasoline (FIG. 2).

To break even, these technologies typically require crude oil prices that exceed $40/bbl-$50/bbl. In northeast Asia, FCC remains the cheapest propylene source, even at $60/bbl (FIG. 3). Economic drivers have shifted significantly since November 2014, when Saudi Arabia decided to change strategy and compete for market share rather than support high oil prices, causing crude oil prices to fall dramatically. In late 2015, the US Congress voted to overturn a 40-year ban on the export of oil, and this opportunity was immediately seized by several companies. Sunoco began exports of Marcellus Shale ethane via the Marcus Hook terminal, and the first ethane exports from Houston were scheduled for early August 2016. Although it is still in its early stages, the sale of NGPL outside the US is expected to result in higher prices for these liquids.

While these pricing changes were taking place, worldwide propylene demand has fallen due to slower than expected economic growth in China. Europe and the US have failed to counter this decreased demand. By the end of 2015, production rates of existing MTO units in China were being reduced, and the commissioning of several MTO projects has been postponed or delayed. Indeed, utilization forecasts of available MTO/methanol-to-propylene (MTP) capacity show over 50% of available capacity remaining unused in 2016, with four out of five MTP plants idled due to negative margins. The forecasted plant utilization remains close to 50% out to 2018.

Following the startup of the Dow PDH project, it is expected that only one of the 12 announced PDH propylene projects (the facility under construction by Enterprise Products in Mont Belvieu, Texas) will actually come online.

Increasing FCC yield. Approximately 55% of all propylene is derived from steam cracking, with FCC accounting for 35% of propylene supply. This leaves just 10% of supply from alternative sources. In the average FCCU, approximately 5% by weight of FCC feed is converted into propylene. However, this number can be substantially higher depending on the feed, catalyst, unit design and operating strategy.

Most major process licensors now offer FCC or FCC-like technologies that obtain maximum propylene production through a combination of catalyst changes, operating conditions and hardware design. Novel technologies include changes in reactor orientation (upflow vs. downflow reactors), contact time, contact temperature, multiple risers, etc.

Most FCCUs are capable of increasing propylene yield by 1 wt%-2 wt% without hardware changes. While this is a fairly insignificant increase in a single unit, if many units adopted this operating strategy, it would have a pronounced effect on propylene supply. Such a change is achievable by using ZSM-5 additives with little or no investment.

Varied reasons exist for adopting such a strategy. The imminent introduction of Tier 3 gasoline specifications will mandate a substantial reduction in gasoline sulfur levels, requiring the use of treatment techniques. This legislation is being phased in over several years through the use of built-up credits, so the effects will be gradual.

Many refiners are opting for either FCC feed pretreatment or post-treatment of gasoline, both of which have a negative effect on gasoline octane. The most common method of compensating for octane loss is the use of ZSM-5 additives: the octane number of the gasoline leaving the FCCU is directly increased, as is the production of butylenes, which are a primary feed for alkylation units.

The evolving role of FCC in fuel supply. A further incentive for ZSM-5 use is expected in 2025, when new fuel efficiency standards for cars will require 54.5 mi/gal. This standard is anticipated to reduce oil consumption by 2 MMbpd. As gasoline is the prime FCC product, a large effect on FCC throughput and operation will be seen. It is unlikely that this fuel efficiency goal will be achieved with today’s gasoline quality. Higher efficiency engines will require large (possibly even “stop out”) increases in gasoline octane, altering the role of FCC in fuel supply. ZSM-5 additives are part of the solution to the 2025 octane puzzle, and process licensors will undoubtedly play an important role by changing operating strategy, hardware and reactor design.

The FCCU offers noteworthy potential for increasing propylene supply without requiring investments of $500 MM or more. While experts expect “on purpose” propylene production to grow in the coming decades, the FCCU will continue to play a prominent role in this market, achieving higher octane, low-sulfur gasoline, and bridging the shortfall in propylene with some help from ZSM-5 additives.

For more information on Johnson Matthey’s products and services, visit the team at booths 40 and 41, or stop by their hospitality suite.

Product selectivities of the lighter feeds being run in US steam crackers are heavily shifted toward ethylene, and this has caused a decrease in propylene, butadiene and benzene supply. While the FCC process has made up much of the shortfall, alternative routes for propylene production are being actively considered.


FIG. 2. Flint Hills Resources’ Petrollogistics Houston PDH plant is strategically located on the Houston Ship Channel and has direct or indirect access to approximately half of US propylene consumption. The facility produces propylene directly, rather than as a small byproduct of cracking for ethylene or gasoline, and has an annual capacity of 1.45 Bbl. Source: plasticsengineeringblog.com.

FIG. 3. 2015 NE Asian propylene cost comparison at $60/bbl.
When Advanced Refining Technologies (ART) acquired exclusive rights to sell the ICR line of hydrocrack-
ing catalysts from Chevron Lummus Global (CLG), its activity in global hydro-
cracking catalyst sales, R&D and product commercialization increased.

At that time, one of ART’s newest customers was starting up a load of hydrocracking catalyst in North America. The single-stage recycle design unit had been operating with a competitor’s catalyst system and was using a VGO/AGO-blend feed. Operating objectives included maximizing unit operating cycle with higher endpoint feed and selectivity toward jet, and minimizing LPG and light gas yield.

For the unit’s first operating cycle, the proposed catalysts were two of ART’s newest, ICR 183 and ICR 214. ICR 183. A high-activity catalyst de-
signed to maximize jet yield at the ex-
 pense of light gas production, resulting in maximum C5+ liquid yields, ICR 183 exhibits low deactivation rate, even while operating at high conver-
sions. The catalyst also provides high-
nitrogen tolerance in case of increased nitrogen slip from the hydrotreating section. An advanced metals deposi-
tion method during manufacture re-
sults in uniform dispersion over the entire catalyst surface, improved hy-
drocracking activity, optimal product prop-
erties, high-organonitrogen tolerance and added stability.

ICR 214. As a component of this cata-
lyst system, ICR 214 offers an activity advantage over ICR 183, while giving up only a modest yield of jet gas to light and heavy naphtha. Similar to ICR 183, ICR 214 yields very little light gas, maximizing liquid products. The customer pilot plant testing confirmed that the jet selectivity is only slightly less for ICR 214 compared to ICR 183.

Testing results. The proposed ART cata-
ylist system and several catalyst ven-
dors were tested at a third-party labora-
tory to show side-by-side performance comparisons in activity, selectivity and product quality at conditions similar to the customer’s commercial operating conditions. ART was selected based on this testing and its technical support package and commercial offering.

The catalyst is meeting all expec-
tations, and the cracking catalysts’ nor-
malized average bed temperature (ABT) is yielding a low deactivation rate. The improved performance of the ART catalyst system over previous catalyst systems is shown in FIG. 1.

The improved start-of-run activity and catalyst stability have enabled the customer to increase the feed endpoint fully 50°F higher than the previous two cycles, with a significantly lower feed API gravity.

Despite the higher feed endpoint and lower feed API gravity, conversion has been maintained at 97 vol% without compromising the overall operation. The same conversion would appear to indicate the same severity in these three most recent cycles. Upon closer inspection, as a result of a higher aver-
age feed rate and fixed recycle oil rate, the conversion per pass is significantly higher than before these cycles. This increased severity is somewhat understated, since, with the higher end-
point and lower API gravity feed, the cycle has less product material in the feed than the previous two cycles, resulting in a higher net conversion.

The customer has utilized the im-
proved performance of the ICR 214/ ICR 183 catalyst system to their ad-
vantage in processing higher feed rates and heavier feed, at increased operating severity. However, the jet yield at 400 days was the same as the previous two cycles. Improved perfor-
ance is also evident in the total C5+ liquid yield, which is stable and com-
pares favorably despite the increased operational severity.

Repeated selection and improved performance. The customer made its catalyst suppliers to bid for the next re-
load using a higher endpoint and lower API gravity feed. Third-party testing was again conducted to explore all op-
tions. ART proposed a catalyst blend with an optimized stacked loading containing a higher ratio of ICR 214 to ICR 183 compared to the current load-
ing, increasing cracking catalyst sys-
tem activity and positioning the unit for a longer cycle length. Based on rig-
orous testing against several compet-
sing suppliers, and confidence in ART’s ongoing technical service, ART was again chosen to supply the next load.

The customer experienced an im-
provement in unit profitability by en-
abling the processing of more feed, and more difficult feed, without com-
promise.

For more info, visit Advanced Refining Technologies at booth 37.

**Got Jet?**

**DAN TORCHIA and NEIL HOWARD, Advanced Refining Technologies**

**FIG. 1.** The ART catalyst system is yielding improved performance over previous systems, including a low ABT deactivation rate.

**BAKER HUGHES, continued from page 6**

(KP6) at the desalter and the waste-
treatment plant. A small amount (as little as 13%) of heavy Canadian crude was included in the feedstock blend, but a consistent solids-stabi-
zed emulsion was observed through-
out the desalter, resulting in brine oil and grease > 5,000 ppm. Cleaning the brine through mudwashing proved unsuccessful due to improper oil-wa-
ter separation in the desalter. During mudwashes, the large, oily emulsion band was being agitated out of the bottom of the vessel.

High amounts of solids were inter-
mittently carried over with the emul-
sion, contributing to downstream heat exchanger and furnace fouling. With limited control over desalter perfor-
mance and the resulting reliability challenges, the discounted Canadian crude was removed from the feed.

Baker Hughes was brought in to discuss potential options and perform a full system survey and the requested testing. The team recommended the implementation of a crude pretreat-
ment program with its XERC 7021 heavy oil demulsifier, and a primary demulsifier at the desalter.

Crude pretreatment allows for max-
imum oil-demulsifier residence time and mixing, increasing water coales-
cence and emulsion resolution at the desalter. It was decided that all exist-
ing adjunct chemistries, such as stabi-
izers and wash-water polymers, could be discontinued. Within 24 hr of start-
up, a significant improvement in brine quality and a reduction in the emulsion layer were noticed. Following imple-
mentation of the pretreatment program with the heavy oil demulsifier, the brine oil and grease content reduced to 200 ppm, while the amount of pro-
cessed high-solids Canadian crude had increased to > 35%.

After Baker Hughes implemented its program, the refiner was able to pro-
ce as much as 50% heavy Canadian crude and achieve a full desalter.

The crude pretreatment program deliv-
dered improvements that enabled the re-
finer to achieve an additional $325,500/ day profit. For more information, visit bakerhughes.com/COM.
If raising the alky feed and distillate from your FCC unit is a top priority, you’ve come to the right place.

That’s because with its continuing record of success, Albemarle’s ACTION is the only commercially proven FCC catalyst to maximize distillate, butylenes, and octane with minimal gasoline loss. Utilizing its unique zeolite and matrix technologies, ACTION has been successful cracking all types of feeds, from tight oil to heavy resid. Your success is too important to risk with unproven alternatives.

Achieve satisfaction and success with the undisputed leader...demand ACTION.

For more information on Albemarle ACTION catalyst or our exceptional portfolio of products and services, call (281) 480-4747 or visit www.albemarle.com
A recent survey of manufacturing executives indicates that many respondents (67%) are pressing ahead with plans to invest in data analytics even as they pare back spending in other areas to combat tough business conditions.

How are executives justifying these expenditures? Many say that they view data analytics—a key component of the Industrial Internet of Things (IIoT)—as a viable solution to a cycle of problems that lead to downtime and lost revenue.

More than 200 North American manufacturing executives took part in the survey, titled “Data’s Big Impact on Manufacturing: A Study of Executives,” which was jointly conducted by Honeywell Process Solutions (HPS) and KRC Research Inc., from May 23 to June 8, 2016.

“Executives need to keep their businesses running smoothly and safely, and they are banking on IIoT technologies to help navigate challenges, even during cash-strapped times,” said Andrew Hird, vice president and general manager of HPS Digital Transformation.

“For more than 40 years, Honeywell has provided leading automation technologies that help manufacturers meet those goals. The IIoT by Honeywell is the next step in that evolution.”

Among other key findings of the survey:

- Some companies are feeling pressure to continue working under the threats of unscheduled downtime and equipment breakdowns, which are viewed as the most detrimental to maximizing revenue.
- The majority of companies say they are already investing in data analytics technology.
- More than a quarter said they do not plan to invest in data analytics in the coming year—of that group, not understanding the benefits of data analytics and inadequate resources are among the most-cited reasons for this lack of investment.

The vicious cycle of downtime. Unscheduled downtime was ranked as the top threat to maximizing revenue, but 42% of respondents admitted to operating equipment harder than they should. When asked how often their companies experienced a list of issues in recent years, 71% of respondents said they experienced equipment breakdowns at least occasionally, while 64% said the same for unscheduled downtime.

“Running plant equipment harder than appropriate presents a host of issues, ranging from equipment breakdowns to potential safety incidents,” Mr. Hird said. “Those issues inevitably lead to more downtime, which leads back to lost revenue. It is easy to see how many companies feel that they are caught in a vicious cycle. Predictive analytics achieved through an effective IIoT by Honeywell solution can help companies break out of this cycle.”

Of the surveyed executives, 40% ranked unscheduled downtime as the biggest threat to maximizing revenue. Other threats included:

- Supply chain management issues (39%)
- Inadequate staffing (37%)
- Off-spec products (36%)
- Equipment breakdowns (32%).

Data analytics as a viable solution. For manufacturers, data analytics is a key component of successful IIoT implementation (Fig. 1). Most respondents had favorable views of the benefits of data analytics as a solution, and they agreed that big data analytics can reduce the occurrences of:

- Equipment breakdowns (70%)
- Unscheduled downtime (68%)
- Unscheduled maintenance (64%)
- Supply chain management issues (60%).

Respondents believe that data can enable well-informed decisions in real time (63%), limit waste (57%) and predict the risk of downtime (54%).

“It is easy to put that puzzle together. These executives correctly believe that data analytics can help them combat the biggest threat they see to business: unscheduled downtime,” Mr. Hird said. “This is why they think that it makes sense to continue investing.”

Additionally, more than two-thirds of respondents (68%) said they are currently investing in data analytics, 50% said they believe their companies are right on track in their use of data analytics, and 15% said that they believe their companies are ahead of the curve as it relates to data analytics usage.

Not everyone is sold. While the majority of respondents said that they are already investing and/or planning to increase their investments in data analytics in the coming year, 32% said they are not presently investing in data analytics. Meanwhile, 33% said that their companies are not planning to invest in data analytics in the next 12 months, or are unaware of any plans to do so.

Of those who have no plans to invest:

- 61% believe that their organizations already have systems in place to ensure safety, yield and success
- 45% said that their companies have seen some growth without data analytics
- 42% said that they do not fully understand the benefits of big data
- 35% believe that people are overstating the benefits of big data.

Approximately 63% of respondents who said that they have no investment plans indicated that they just do not have the resources to appropriately do so, while 39% said that they do not have the right personnel to make the most of data analytics.

“For some companies, hurdles remain before the IIoT can be fully adopted,” explained Mr. Hird. “Some do not believe that they need it, while others say that they lack the resources to do it correctly. The good news is that the IIoT is something that does not require a wholesale change. It can be phased and scaled depending on an individual company’s circumstances. This is precisely why Honeywell says that the IIoT represents an evolution, not a revolution.”

To speak to a member of the HPS team, visit booth 17 or the Essex B suite on Sunday, Monday and Tuesday days. To connect with representatives of Honeywell UOP, visit booth 16 or the Essex A suite on Sunday, Monday and Tuesday nights.
Baltimore welcomes you to one of the most historically significant cities in the country. More than a century after Captain John Smith (yes, that Captain John Smith) first sailed into the uppermost Chesapeake Bay, the city of Baltimore was founded in July 1729. As the port is one of the best naturally protected harbors in the world, it became the nation’s second-largest point of entry for immigrants.

Baltimore grew swiftly in the 18th century as a granary for sugar-producing Caribbean colonies and a major trade hub for goods such as tobacco. The first US Post Office system was inaugurated in 1774, and Lexington Market, founded in 1782, continues to be known as one of the oldest continuously operating public markets in the US. The city played an important role in the American Revolution, joining the fight against British taxes and refusing British trade. The Second Continental Congress met in the Henry Fite House from December 1776 to February 1777, effectively making the city the capital of the US during this period.

The city’s role in the War of 1812 is perhaps the most famous period in its history. After burning Washington, D.C., the British turned their attention to what they called “a nest of pirates,” attacking the staunchly anti-British city in the Battle of Baltimore. While viewing the failed British assault on Fort McHenry (FIG. 1) from a British ship, Francis Scott Key penned the poem, “Defense of Fort McHenry” that would later become our national anthem, “The Star-Spangled Banner.”

Baltimore was the first US city to light its streets with hydrogen gas, and the construction of the Baltimore and Ohio (B&O) railroad made the city a major shipping and manufacturing center to Midwest markets.

**Attractions.** There is so much to see in Baltimore (FIG. 2), including the first architectural monument in honor of George Washington; the Baltimore Basilica, the first church constructed in the US following the adoption of the new Constitution; the Baltimore World Trade Center, which is the world’s tallest equilateral, five-sided building; boat tours throughout the historic harbor; Johns Hopkins University and Medical Center, one of the largest and most-respected hospital and research complexes in the world; the Pimlico Race Course, the site of the second leg of the Triple Crown of thoroughbred racing, the Preakness Stakes; Hanoverplace, a modern urban retail and restaurant complex; the National Aquarium; several world-class museums; and the ships, shops and restaurants of the Inner Harbor, to name just a few.

The city also boasts the most public monuments per capita in the US, and more than 65,000 properties, or roughly one in three buildings, are listed on the National Register.

**Cuisine.** From crab to cocktails, our city offers something to please every palate. We are particularly proud of our Chesapeake seafood—lobster, rockfish, scallops, mussels, clams, shrimp and crab (FIG. 3). Try our cured and smoked pork, meats and salmon; coddies (small fried cakes of cod and potatoes topped with mustard and a saltine); and pit beef (grilled and served on a Kaiser roll with horseradish).

Be sure to get out into the city for inventive libations, lively entertainment and great local music. We welcome you to Baltimore!
ALBEMARLE REINFORCES HYDROPROCESSING COMMITMENT

Albemarle is reinforcing its business strategy in hydroprocessing and becoming even more focused on technology development and catalyst performance. With recent volatility in oil prices, the refining industry’s biggest challenge is to maximize the profitability of unit operations. The company is positioned to optimize its customers’ hydroprocessing unit operations. By not being tied to any specific license agreements, Albemarle’s unique STAX portfolio and Nebula bulk catalyst can maximize profitability for refiners.

Nebula is Albemarle’s bulk metal catalyst technology, developed jointly by Albemarle and ExxonMobil. It is the highest activity hydrocracking catalyst available for many hydroprocessing applications and offers at least twice the activity of traditional catalysts, leading to increased HDS, HDN and HDA activity. Nebula is ideal as a drop-in solution in existing HPC units utilizing Albemarle’s STAX technology.

Today, more than 60 refineries are employing Nebula with over 130 successful unit cycles. In a proprietary STAX combination with STARS catalyst, the Nebula catalyst unleashes performance and boosts profit margins of both hydrocrackers and distillate hydroprocessing units around the globe.

Albemarle’s STARS hydrocracking catalyst product line was recently expanded to three new grades: PF 870 STARS for hydrocracking pretreat applications; PF 880 STARS for medium- to high-pressure middle distillate hydrocracking; and PF 780 STARS, the newest all-around catalyst for low- to medium-pressure hydrocracking applications.

PF 780 is a high-activity desulfurization catalyst with an extremely high metals efficiency. This step-out feature was achieved via improved metals dispersion and tailored distribution of active sites coupled with better pore accessibility. The PF 780 is applicable as both a standalone catalyst and in various STAX configurations, utilizing Albemarle’s reactor loading technology.

To reinforce this business strategy, Albemarle is ending its alliance with Honeywell UOP. The company is committed to working with its customers to maximize unit operations, while also completing projects initiated under the Honeywell UOP alliance.

To learn more, speak with the Albemarle team at booth 15, or visit their hospitality suite on Monday night in Dover A.

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March 19-21, San Antonio, TX

International Petrochemical Conference
March 26-28, San Antonio, TX

International Base Oils & Waxes Conference
March 27, San Antonio, TX

Security Conference
April 24-26, San Antonio, TX

Labor Relations / Human Resources Conference
April 27-28, San Antonio, TX

National Occupational & Process Safety Conference
May 16-17, New Orleans, LA

Reliability & Maintenance Conference
May 23-26, New Orleans, LA

Q&A and Technology Forum
October 2-4, Austin, TX

Environmental Conference
October 15-17, Denver, CO

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