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Epstein challenges US fossil fuels industry to adopt 'human' approach

BEN DUBOSE, *Hydrocarbon Processing*

The US oil and gas industry is facing what many believe is the most important energy election in a generation, but the framework of the industry's message may need to change to gain more traction with the voting public.

Alex Epstein, author of the *New York Times* best-selling book, "The Moral Case for Fossil Fuels," and an expert on energy and industrial policy, delivered his philosophy-based message as Monday's keynote speaker at the 2016 Annual Meeting.

"The fundamental mistake the industry makes is thinking they're in a debate over conflicting facts, when it's really a debate over conflicting philosophical frameworks," he said.

Epstein said the two words he would use to describe how the fossil fuels industry responds to its attackers are "reactive" and "overwhelmed."

"We have one side that is reactive and overwhelmed, while the other side is proactive and overwhelming," Epstein said, citing recent Democratic Party presidential debates as examples of prominent candidates holding anti-fracking positions.

Epstein believes those opposed to continuing fossil fuel development—fracking being one example—do so based on one fundamental argument.

"That argument is that we're morally obligated to replace our addiction to fossil fuels and replace it with 'green' energy," Epstein said. "No matter what the issue is, that's always coming up. Even if you refute some of the facts, they always have that."

"If one side controls the moral argument, then they get to constantly say that every policy they advocate is heading in the right direction," he



ALEX EPSTEIN'S humanist view encourages a proactive approach to changing the perception of the energy industry and its benefits.

► See **KEYNOTE**, page 13

Analysts see Clinton as presidential favorite, but do not count out Trump

BEN DUBOSE, *Hydrocarbon Processing*

Monday's keynote speaker, Alex Epstein, painted Democratic presidential frontrunner Hillary Clinton as an example of someone who he believes could work against the development of fossil fuels.

But the pair of US political analysts that followed Epstein's address seemed to believe that Clinton is the favorite to win the November election.

"The electoral college strength of the Democrats is pronounced," said Mark Halperin, who spoke alongside colleague John Heilemann at Monday's general session. Halperin and Heilemann are the managing editors of *Bloomberg Politics* and co-hosts of *With All Due Respect*, a daily news and analysis program on *Bloomberg TV* and *MSNBC*.

"Democrats are now the presidential party," Halperin added. "Republicans need to not just tread water with how

they've done the last two cycles, but do substantially better. They've done nothing but go backward with the groups they need, such as younger people and single women.

"I think that whomever the two parties nominate, Hillary Clinton, if she's the [Democratic] nominee, will have the advantage."

Halperin said he believes Donald Trump is "overwhelmingly likely" to be the nominee from the Republican side, whether or not he has the binding majority of delegates before the party's convention. He pointed out the party's relative distaste for Ted Cruz, who is currently running second behind Trump, as a reason not to expect Trump's delegate lead to be overridden at the summer convention.

"Cruz doesn't have the support of the establishment," Halperin said.

However, given the heated rhetoric and divisive nature of many of Trump's campaign rallies of late, Heilemann believes that Trump could have a major challenge in a general election setting.

"Can he really pull back from all this and become a unifying figure to bring both the party and the country together?" Heilemann asked. "I'd never say never, but it is going to be a huge challenge just to knit his own party back together."

Nonetheless, Clinton is not without potential vulnerabilities. Halperin noted that she does not have the campaigning skills of the last three US presidents—Barack Obama, George W. Bush and Bill Clinton—and the modest challenge within her own party's primary from Senator



JOHN HEILEMANN (left) and colleague **MARK HALPERIN** agree that this year's presidential race is the most unpredictable in recent memory.

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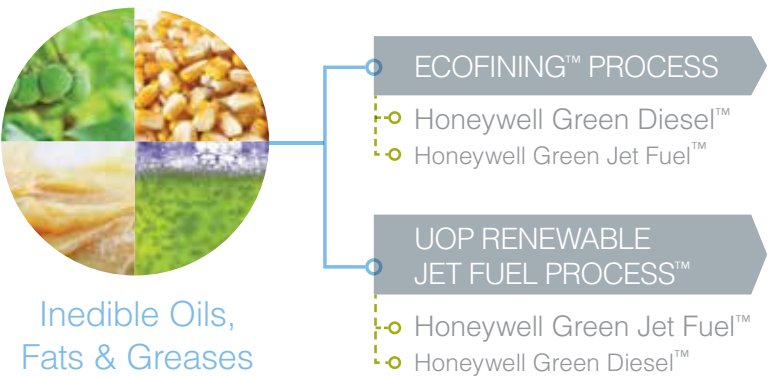
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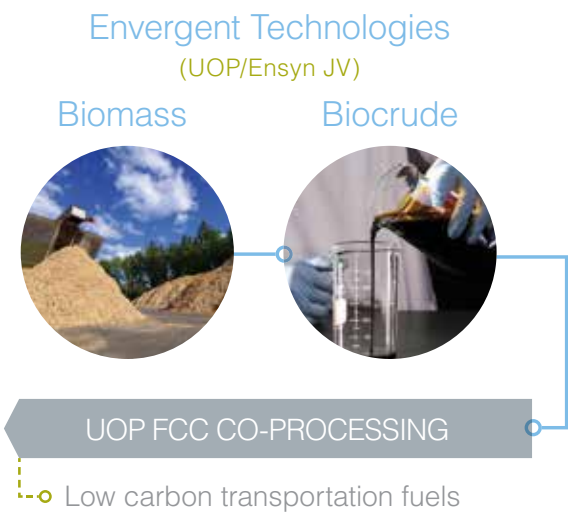
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Onsite testing of crude oil at refineries

On Monday at the AFPM Annual Meeting, GE introduced new predictive analytics software and laboratory equipment for the onsite testing of crude oil to determine how the oil might affect a refinery before processing even begins. GE's CrudePLUS significantly reduces the analysis time of crude oil and can lead to streamlined operations, less fouling and increased energy efficiency.

GE's new digital solution is a fast and comprehensive method to test crude oil and blends of various oil sources at the refinery, using predictive analytics to improve operation and reduce carbon dioxide emissions and costs. Data captured with CrudePLUS can lead to improved blending and desalter operations that result in reduced oil to the refinery's wastewater treatment plant, which can reduce upsets and lower

potential environmental impact. Using CrudePLUS to analyze oils and blends can improve margins by mitigating processing issues while increasing discounted crude intake, expand a refiner's operating envelope to process more at a lower cost, minimize heat transfer loss and maximize throughput in preheat trains and furnaces, and reduce maintenance expense by implementing an effective fouling mitigation strategy.

GE also introduced TrueSense, an online continuous monitoring system designed to improve corrosion protection in oil refineries. GE's upgraded TrueSense for Process—Crude Overhead Monitoring System (COMS) reduces corrosion and fouling, increasing refinery operations efficiency.

TrueSense for Process COMS provides real-time, continuous onstream measurements reliable enough to con-

sistently control chemical injections. It was developed to improve corrosion protection of crude unit overhead systems by providing online continuous measurement of critical parameters such as pH, chlorides and corrosion probes. The digital system also automates chemical injection control in response to these measurements.

Upgrades to the TrueSense platform include automated chloride measurement testing and corrosion probe readings, which previously were only available manually. In addition to increasing the frequency of the readings, now chloride and corrosion probe measurements are continuously uploaded to GE's InSight knowledge management solution.

When used in conjunction with GE's cloud-based LoSALT ionic equilibrium model, refineries can obtain greater quantification of system performance by automating system salt and dew point temperature calculations.

The LoSALT online and onsite amine speciation technology enables testing of critical amine contaminants, and provides automated and instant analysis, which speeds the delivery of data that calculates critical parameters related to crude unit salting. Refineries implementing the digital tool can use the data to reduce system corrosion and fouling. Avoiding corrosion also prevents the unexpected release of hydrocarbons into the atmosphere and environment. ●

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NEW TEXAS PDH PLANT PASSES PERFORMANCE TESTING

Dow Chemical's new world-scale propane dehydrogenation unit (PDH), located at the company's Oyster Creek site in Freeport, Texas, successfully completed the performance test. The passing of the test certifies that the unit is operating at full capacity and is meeting the Honeywell UOP Oleflex performance guarantee.

The new 750-Mtpy (thousand tons per year) facility began commercial operations in December 2015 and completed the performance test in less than two months.

The company says these milestones represent progress on its comprehensive investment plan to further connect its US operations with cost-advantaged feedstocks from increasing supplies of US shale gas and deliver a long-term competitive advantage for its performance materials, consumer and infrastructure solutions businesses.

Dow said it also continues to make significant progress on its world-scale ethylene unit, supporting infrastructure and the derivative investments aligned to the company's performance plastics franchise, located at Dow sites across the US Gulf Coast. The completion of the performance plastics derivative investments will be synchronized with the new ethylene unit.

PHILLIPS 66 REPORTS EMISSIONS, REFINERY PLANT REPAIRS

Phillips 66 has begun a month-long emissions event related to maintenance repairs at its 146-Mbpd refinery Borger refinery in the Texas panhandle, about 50 miles northeast of Amarillo. The line going to Unit 34's sulfur recovery unit (SRU) incinerator is partially plugged with sulfur, and sections of that line will be heated in an effort to melt out the sulfur. During the heating of the line, the company acknowledged that there may be visible emissions. ●



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SCHEDULE OF SESSIONS AND SPECIAL EVENTS

TUESDAY, MARCH 15, 2016

7 a.m.–12 p.m.	Registration
7:30–9 a.m.	Industry Leadership Breakfast featuring*: Joseph W. Gorder , Chairman, President and CEO, Valero Energy Corporation *Open to registered member attendees only
9–11:30 a.m.	Breakout sessions: Petrochemicals, Reliability, Environmental, Operations and Turnaround, Strategic Issues
12–2 p.m.	Annual Luncheon featuring*: General Colin Powell , USA (Ret.) is one of the most admired and respected leaders in America today. A four-star general, General Powell's numerous awards include two Presidential Medals of Freedom. He is the author of his best-selling autobiography, <i>My American Journey</i> , and his second book, <i>It Worked For Me</i> . *Open to registered member attendees only
2–4:30 p.m.	Breakout sessions: Plant Automation, Margin Improvement, Crude Oil Supply, Water Issues, Regulatory and Legislative Issues

US gasoline demand could peak in 2016 as fuel efficiency improvements loom

BEN DUBOSE, *Hydrocarbon Processing*

The recent upswing in US gasoline demand is likely to reverse course by 2017, a leading industry analyst believes, driven by improvements in the fuel efficiency of light vehicles.

“Despite low fuel prices and the recent upward trend, we see this as a temporary recovery in demand,” said Linda Giesecke, director of research for the Americas refining industry at consultancy Wood Mackenzie. She spoke at Monday afternoon’s technical session on gasoline processes.

In her presentation, “How real is the peak in US gasoline demand?” Giesecke noted that demand for US gasoline has recovered to levels not seen since the recession of late 2008.

Demand in the US is back up to more than 9 MMbpd (million barrels per day) and continues to account for nearly half of total domestic fuels demand, making the outlook pivotal to refiners.

“Barring a major weakening in the economy, gasoline demand will likely match its 2007 peak in 2016, even if demand growth slows from last year,” she said in her presentation at the AFPM Annual Meeting. “The question is whether positive growth will be sustained over the medium term, or whether 2016 will mark a renewed peak in demand for gasoline.”



LINDA GIESECKE, director of research for the Americas refining industry at consultancy Wood Mackenzie

In the present upward cycle, the gasoline recovery gained strong momentum in late 2014 with the plunge in fuel prices. As a result, gasoline was a key component behind the surge in total US demand in 2015, resulting in the US accounting for nearly one fifth of total global oil demand growth, she said.

Nonetheless, Wood Mackenzie still views the recovery as temporary.

“This outlook is based on a moderation in growth of vehicle miles traveled (VMT) and, more importantly, accelerating fuel efficiency improvements of light vehicles,” she said.

In addition to falling prices, Giesecke said that improvements in the US labor market have also played a role in gasoline’s recovery. Over two million more Americans are working now than a year ago. Assuming that the majority commute to work and travel 12 miles each way, the increase in commuting alone would be over 50,000 bpd, or 0.5%, she said. Moreover, that figure does not include the impact that having a job has on travel for other purposes.

A look at 4Q 2015, however, showed a moderation in those gasoline gains. Although still positive, year-on-year growth in gasoline demand slowed to an estimated 150,000 bpd in the fourth quarter. Early estimates for January suggest even lower demand, she said.

“The moderation in growth in 4Q 2015 ties closely to our outlook for 2016,” Giesecke said. “In general, gasoline’s positive growth should continue in 2016, but at a slowing rate. Growth in [VMT] is expected to average a more moderate 2% for the year, still supported by low retail gasoline prices and an improving labor market. Fuel efficiency should improve, but not enough to counter the effect of rising miles.”

By 2017, however, Wood Mackenzie expects the growth in gasoline demand to shift into decline, she said, based on an outlook for further moderation in VMT, along with the effect of sluggish gross domestic product (GDP) growth and rising fuel prices.

“More importantly, this is coupled with accelerating fuel efficiency improvements in response to government standards,” she said.

From there, Giesecke expects the beginning of a long-term downward trend for US gasoline demand. In her presentation, she noted that last year’s rate of

growth in VMT was well above historical levels, adding that the general long-term historic trend has shown slowing growth since the late 1990s.

Over the medium and longer terms, she notes that VMT growth is expected to slow due to an economic slowdown expected in 2018 (owing to a worsening trade deficit), and because of a more gradual increase in the working-age population.

Additionally, aggressive government mandates, such as the Corporate Average Fuel Economy (CAFE) standards, are likely to dictate further improvements in the fuel efficiency of light vehicles. She noted that the 2025 CAFE target, which is not yet final, is equivalent to an “on-road” fuel economy of about 40 miles per gallon (MPG). To put that into perspective, the current average fuel efficiency of the vehicle stock is about 22 MPG.

Overall, Giesecke expects the fuel efficiency of vehicles to rise by 2% per year over the long term.

“Automakers will rely on a more rapid adoption of advanced gasoline technology and the use of lighter materials to meet these targets,” she said.

That being said, the overall volume of vehicles will still grow, and gasoline will remain the dominant fuel, Giesecke said, adding that she does not expect electric vehicles and plug-in hybrids to be cost-effective enough to significantly replace conventional gasoline vehicles through 2025. However, the increased efficiency of those gasoline vehicles could lead to lower production needs, Giesecke said.

“After stabilizing at over 9 MMbpd in 2016, and thereby marking a renewed peak, we see gasoline demand slipping under 8 MMbpd by 2025,” she predicted.

One way gasoline demand could surprise to the upside is if consumers continue to shift from cars to light trucks, which has been seen in recent years as fuel prices declined.

“Consumer preference is an upside risk to demand, but we do not expect it to be strong enough to undo the overall declining trend, especially given our forecast for rising crude and gasoline prices.”

As a result, the focus for refiners could shift from overall production volumes to advancements in technology.

“In our view, the peak in gasoline demand is real,” Giesecke concluded. ●

ANALYSTS, continued from page 1

Bernie Sanders has forced her to modify some of her stated policy positions on issues, such as trade.

“She’s moved further to the left to avoid [Sanders] beating her, and that’ll give her some vulnerability,” Halperin said.

Additionally, the FBI investigation into Clinton’s emails as Secretary of State is ongoing, and there

remains some chance that it could become a larger issue down the road. However, Halperin does not see that scenario as likely.

The larger issue could be Trump’s message and unique coalition of voting. To illustrate this point, Halperin asked AFPM attendees if they could recite the campaign slogan for either Clinton or Republican contender Marco Rubio, and the reaction from the crowd was relatively quiet. When asked the same question of Trump, though, the “Make America great again” refrain was shouted by the audience, albeit in a largely sarcastic tone.

“With Trump, you have a candidate who performs well on television, has a clear message and has shown he’ll bring up anything and everything in Clinton’s history,” Halperin said. “I’ve said before that I would bet on the Democrat no matter who the nominees are. But if it’s Trump against Clinton, it’s an unpredictable thing.”

Heilemann largely echoed this assessment, noting that Trump has a “very diverse coalition of support” in terms of ideology, potentially allowing him to challenge in states that aren’t in the usual Republican footprint.

“A general election between Trump and Clinton would be an extraordinary thing to see,” Heilemann said.

Heilemann said he recently spoke with David Plouffe, the renowned campaign manager from President Obama’s successful 2008 race.

“He told me, as a campaign manager, that he wants predictability from the opponent,” Heilemann said. “In other words, if they attack him this way, they want to know that this is what he’ll say. They want to know what his electoral map is.”

“In both cases, David Plouffe—one of the smartest guys I know in politics—said Trump is a wild card. ‘That scares the hell out of me,’ Plouffe told me.”

Nonetheless, Clinton remains the odds-on favorite, and Halperin noted that she is also using many of Obama’s top advisors.

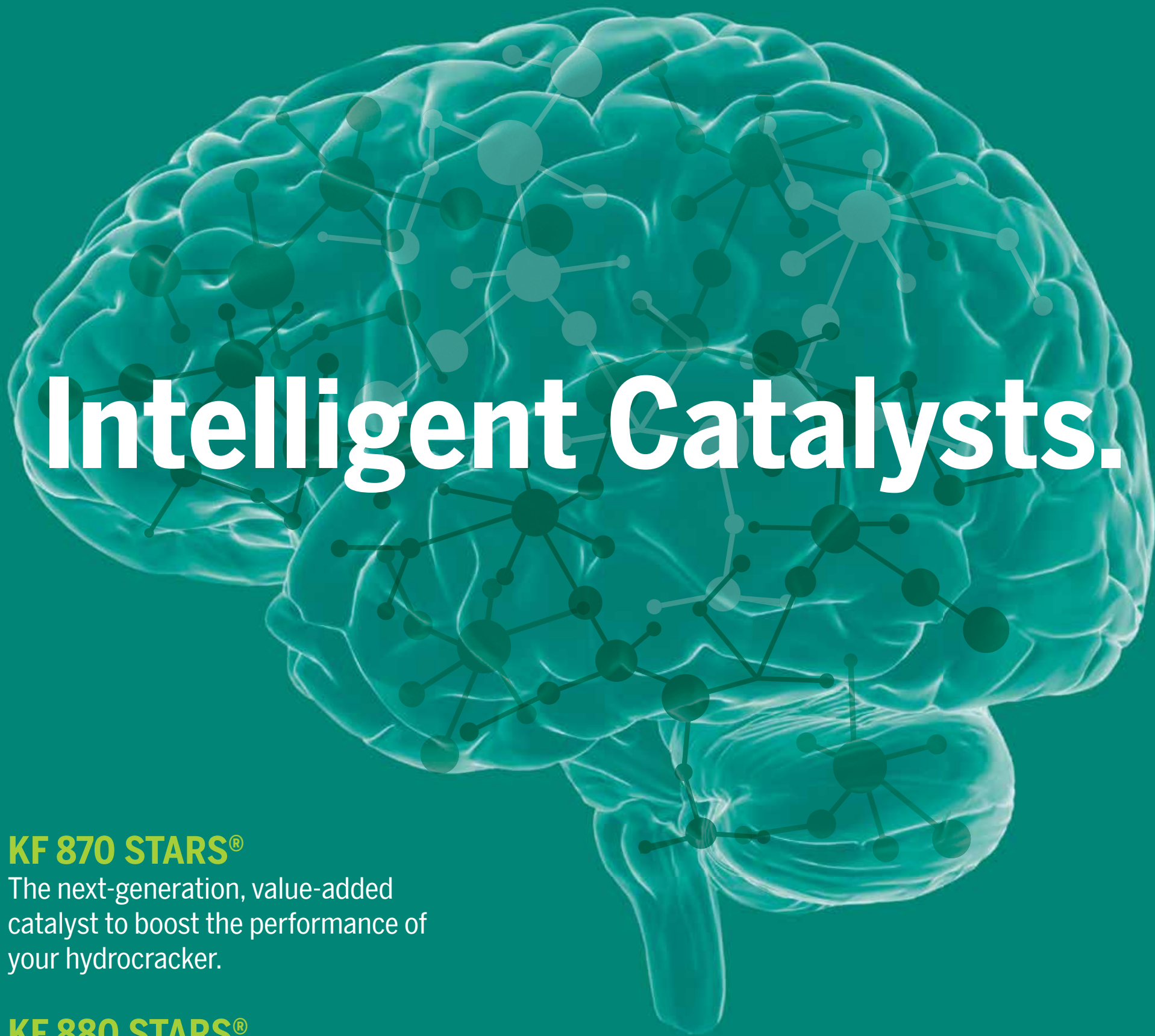
“She has an understanding of how to win this election,” Halperin said. “The challenge for her could be holding onto states like Florida, North Carolina and those in the Rocky Mountains [won by Obama] against the right Republican running the right campaign.”

Is Trump that candidate? It might seem doubtful, but Heilemann pointed out that the common belief in 2015 was that Trump would fade by the time the Republican race got serious in the spring, and that clearly has yet to occur.

“[Trump] would go into the general election as an underdog, but he’d scramble the general election much like he scrambled the Republican race,” Heilemann said. “You can’t count him out.” ●

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Exceptional next generation catalyst stability

AMIT KELKAR, Criterion Catalysts and Technologies

Catalyst technology has developed by leaps and bounds in the last two decades, driven by the switch to ultra-low-sulfur diesel (ULSD) in the mid-2000s, increases in required fluid catalytic cracker pre-treat (FCCPT) performance due to Tier 2 and now Tier 3, and in hydrocracking pre-treat (HCPT) with the increasing demand for distillate yield.

Criterion has introduced a new family of catalysts every four to five years, moving from CENTINEL, to CENTINEL GOLD, ASCENT and now to CENTERA. Each step has resulted in improvement in hydrosulfurization (HDS), hydrogentrification (HDN), and hydrogenation activity. The company has also made noteworthy progress in catalyst stability against metals and coking deactivation.

Unplanned downtime is the most critical factor impacting refinery profitability, and increased stability minimizes the risk of an early outage. Refiners can take advantage of the increased stability and activity by processing heavier, more value-add feedstocks or increasing unit severity without significant cycle life debit.

These following commercial examples highlight the performance and benefits of Criterion catalysts across all applications.

CENTERA resiliency with more cracked feed and increased severity. An FCCPT unit switched from ASCENT DN-3551 to CENTERA DN-3651 and processed 10% higher feed rate with higher feed sulfur nitrogen (TABLE 1). The percentage of cracked stock in the feed almost doubled, resulting in a two-number drop in feed API. The deactivation rate is slightly lower than the previous cycle.

To take advantage of this stability, the operating mode was switched from HDS to maximum saturation by increasing the temperature by 20°F–30°F. The net result was 8% lower product nitrogen and higher API shift (0.8 numbers), leading to significant yield and conversion benefit at the downstream FCCU. The hydrogenation activity of CENTERA minimizes coking so that the deactivation rate continues to be low at the higher temperature. The refinery is now evaluating an additional increase in severity to target ULSD and minimize reprocessing (FIG. 1).

Stability with increased operating severity. A similar performance was observed in a Gulf Coast FCCPT unit loaded with a stack of ASCENT DN-3551 and CENTERA DN-3651.

Volume swell and hydrogen (H₂) consumption were key value drivers; the operating mode was switched from HDS toward maximum aromatic saturation (Asat) after eight months. Average delta API in AS mode was one number higher than HDS mode, indicating increased H₂ consumption and volume swell. Product sulfur also reduced significantly. Despite the increased severity, there was no change in the deactivation rate, which remained stable at 1°F/month. The higher hydrogenation activity of the catalyst system minimizes coking-related deactivation, even at the higher temperature.

Stable performance with heavier feed. A medium-pressure ULSD unit switched from CENTINEL GOLD DN-3330 to CENTERA DN-3630 and maintained a 15°F–20°F activity benefit throughout the entire cycle. This improved stability enabled the refinery to increase straight-run diesel and light coker gas oil end-point. The average feed was substantially heavier with higher sulfur and nitrogen (TABLE 2), but the deactivation rate was unchanged, and the unit achieved target cycle life at a significantly higher margin (FIG. 2).

Hydrocracker pretreat—Improved activity and stability with heavier HCGO. A hydrocracker switched from a combination of CENTERA DN-3620 and Z-503 in the pretreat reactor to CENTERA DN-3621 and Z-HD11 (FIG. 3). The current catalyst system has proven to be 8°F–10°F higher in HDN activity at start of run (SOR), and the deactivation rate is estimated to be 40% lower despite the heavier feed. In particular, the current heavy coker gasoil (HCGO) is heavier with an end point 20°F–40°F higher than the last cycle. The total exotherm of the pre-treat reactor is 20% higher at similar nitrogen slip. The higher exotherm is a sign of increased hydrogenation, which is a key factor in stable performance.

CENTERA stacked system. The run length of this high-pressure FCCPT unit was increased from 18 months to 36 months by implementing a stacked system using CENTERA NiMo DN-3651 and CoMo DC-2650, and an improved OptiTrap grading design. This resolved activity loss and chronic delta P growth. The catalyst system delivered better

► See CRITERION, page 8

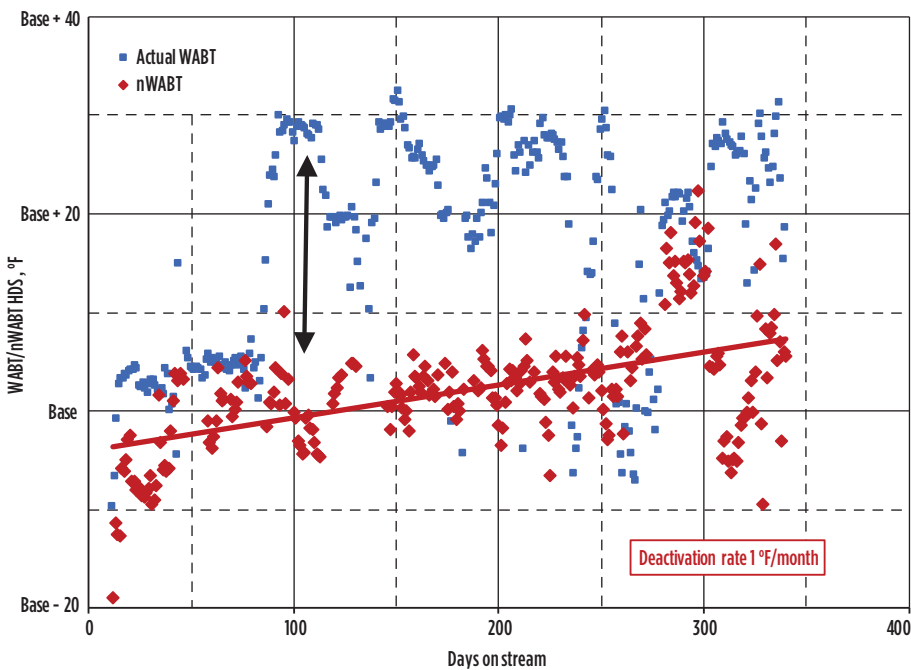


FIG. 1. Continued stability with increased operating severity.

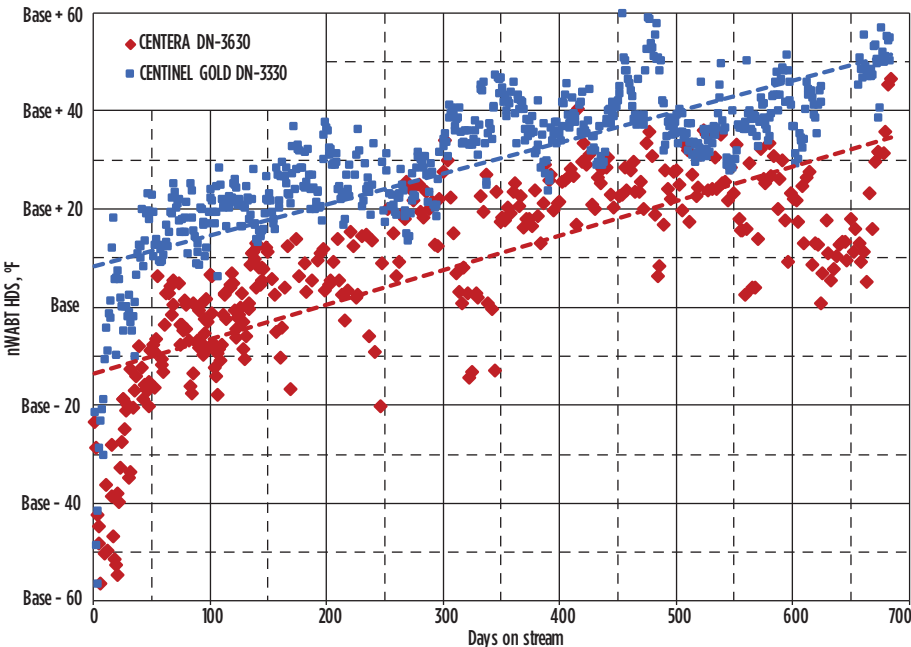


FIG. 2. Benefits of CENTERA DN-3630 over CENTINEL GOLD DN-3330.

TABLE 1. Feed conditions

	ASCENT DN-3551	CENTERA DN-3651
Feed rate, KBPD	BASE	10%
% cracked	28%	51%
Feed API	BASE	–1.9
Feed sulfur, wt%	BASE	22%
Feed nitrogen, ppm	BASE	26%
Feed T95, °F	BASE	BASE
Deactivation rate, °F/m	1.2	1

TABLE 2. Feed conditions

	CENTINEL GOLD DN-3330	CENTERA DN-3630
Feed rate, KBPD	BASE	3%
Feed sulfur, wt%	BASE	175%
Feed nitrogen, ppm	BASE	22%
Feed T90/FBP, °F	BASE/BASE	+ 22/+ 27°F

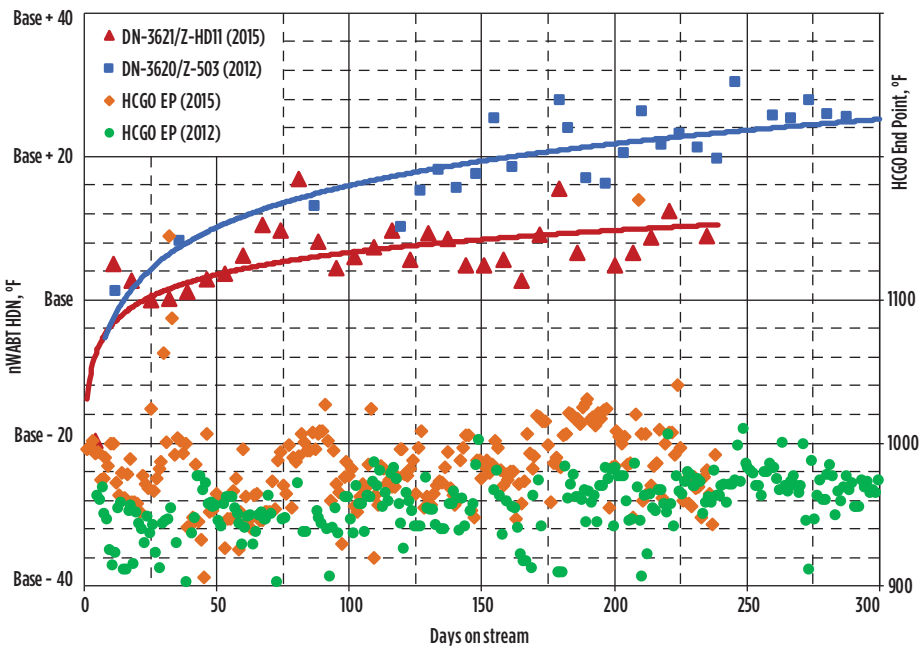


FIG. 3. Enhanced stability with new generation CENTERA DN-3621 and Z-HD11.



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Monday, March 14 • 6:00 to 11:00 pm

KBC's Chief Economist Stephen George will present
Market Insights on Monday at 7 and 9 pm.

Entertainment provided by Ned Boynton Jazz Trio

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Adapting Petrochemical Processes for Enhancing Tier 3 Gasoline Blending Options

Presented by Mel Larson, Tuesday, March 15 at 10:30 am

Application of Operational Excellence Principles to Achieve Maximum Hydrocracker Utilization

Presented by Robert Ohmes, Tuesday, March 15 at 3:30 pm

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Putting expertise to work on H₂ plants

Air Products is launching a global hydrogen (H₂) services offering as part of its customer plant support (CPS) business. The company is a leading global third-party provider of H₂, producing 3 Bscfd and operating more steam methane reformers (SMRs) than a majority of refiners. Air Products focuses on the provision of H₂, an essential molecule in the production of cleaner burning transportation fuels, so refiners can focus on their area of expertise, producing fuels upon which much of the global population depends.

By owning and operating over 100 H₂ plants, Air Products has the operational expertise with

which to solve issues and offer services for refiner-owned plants (FIG. 1). Recent H₂ services customer inquiries range from requests for help producing more or less H₂ from SMRs, to assistance planning SMR turnarounds, to solving mechanical integrity issues, feedstock changes, pressure swing adsorber (PSA) revamps, and ways to improve energy efficiency.

For example, Air Products was contacted by a US refiner that was experiencing operating issues with its SMR and wanted to increase throughput and improve energy efficiency. Through a detailed plant assessment, operational changes performed

onsite and a performance test, Air Products helped the customer increase H₂ capacity by 20% and improved the net H₂ plant efficiency by over 10%.

In Southeast Asia, a customer requested an additional 50% of H₂. A new plant was not cost effective, nor feasible due to time constraints. The company developed a cost-effective plant expansion scheme with a shortened schedule. The existing H₂ plant reforming capacity and final H₂ product purification sections were creatively debottlenecked and integrated without requiring an extended revamp of the reformer furnace or pressure swing adsorption unit. ●

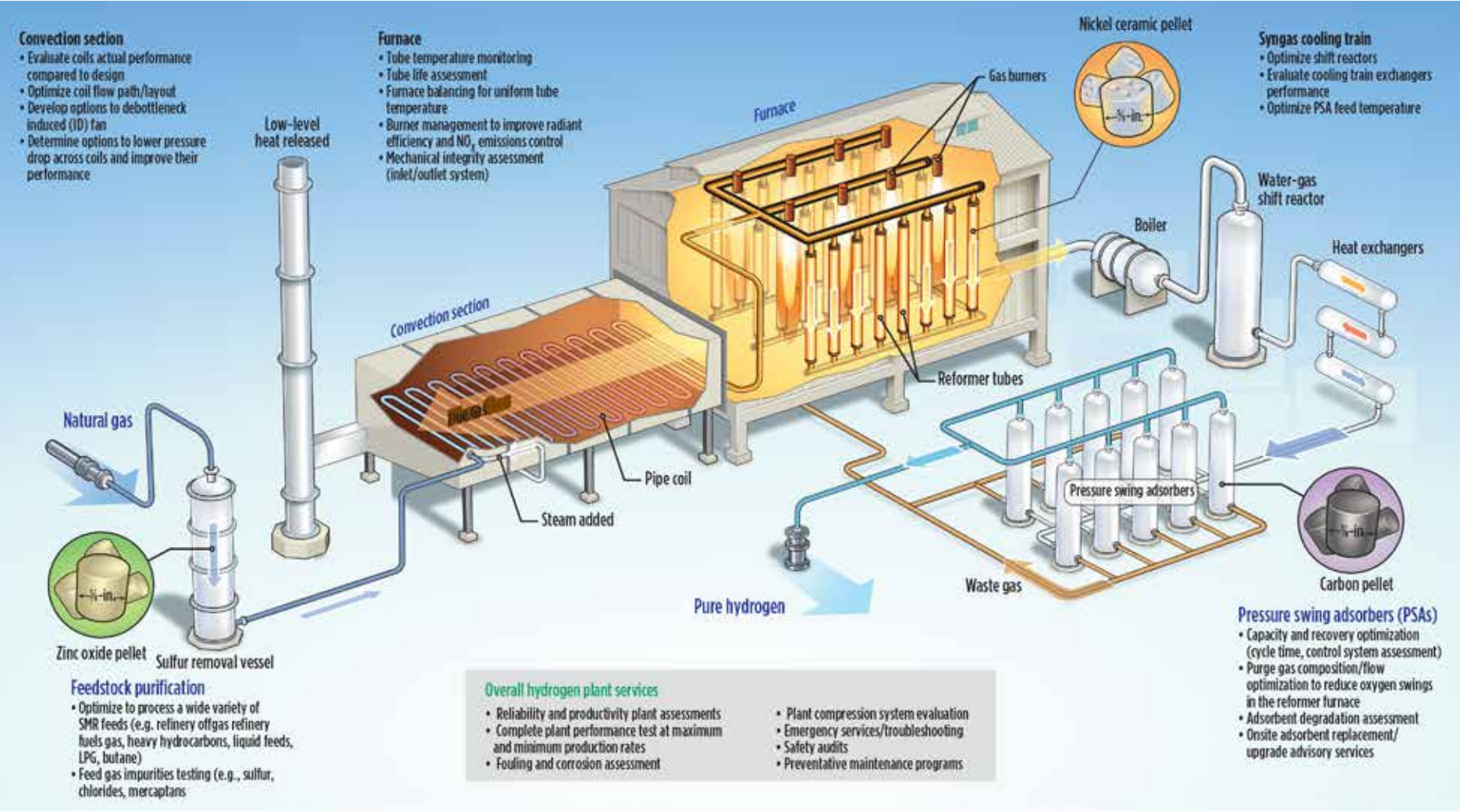


FIG. 1. From feedstock optimization through the furnace to the PSAs, Air Products offers services that create value throughout an H₂ plant.

SIEMENS TO ACQUIRE SIMULATION SOFTWARE SUPPLIER CD-ADAPCO

Siemens and CD-adapco have entered into a stock purchase agreement for the acquisition of CD-adapco by Siemens. The purchase price is \$970 MM. CD-adapco's software solutions cover a wide range of engineering disciplines, including computational fluid dynamics (CFD), computational solid mechanics (CSM), heat transfer, particle dynamics, reactant flow, electrochemistry, acoustics and rheology.

In 2015, CD-adapco had over 900 employees and revenue of close to \$200 MM. On average, CD-adapco increased its revenue at constant currencies by more than 12% annually over the past three fiscal years. Siemens expects this strong growth to continue.

CD-adapco will be integrated into the PLM software business of Siemens' Digital Factory (DF) division, a provider of automation technology and product lifecycle management (PLM) software. ●

CRITERION, continued from page 6

than expected improvements in activity, SOR temperature was on target, and stability proved to be better than previous cycles with competitors' catalyst. Delta P increased rapidly in beds 1 and 2, which needed to be skimmed halfway through the cycle. A number of changes were made to the grading scheme in the top beds (loading filter tray cartridges with smaller size grading, increasing grading depth and adding additional size layers), which have greatly reduced the rate of dP increase.

Stability leads to increased diesel yields. Another FCCPT unit that processes 100% cracked stock enjoyed huge improvement in diesel yield after switching to a NiMo/CoMo stack of CENTERA DN-3651 and DC-2650. This unit has historically experienced a steady decline of ULSD yield in the last six to 12 months of the cycle. The higher activity and stability of the CENTERA system enabled a 10°F increase in diesel T95, while also providing higher H₂ consumption, thus increasing volume

swell. The diesel yield was maintained above 50% for the entire cycle. The combination of higher feed-rate and increased diesel yield positively impacted refinery distillate production and margin. The unit was able to process more difficult feed (higher nitrogen, increased LCO and lower API) while maintaining yield stability throughout the cycle (TABLE 3).

Proven stability in multiple applications. Catalyst stability is a key performance indicator to ensure units meet turnaround timing and minimize unplanned downtime. Criterion offers a number of solutions in multiple applications for achieving exceptional stability and extending cycle life. The highlighted examples are commercial experiences of Criterion catalysts that are enhancing the stability of numerous units across all services. Catalyst stability is best illustrated in commercial operation. Our ultra-stable CENTERA catalysts combined with Shell Global Solutions HDTrays and FilterTrays have been helping refiners maximize value for decades. ●

CENTERA, ASCENT and CENTINEL GOLD are a trademark of Criterion Catalysts & Technologies.

TABLE 3. Comparison of feed conditions

	ASCENT DN-3551/ CENTERA DC-2650	CENTERA DN-3651/ DC-2650
Feed rate	BASE	+4%
LCO rate	BASE	+37%
Feed API	BASE	-1
Feed sulfur	BASE	BASE
Feed nitrogen	BASE	+9%
H ₂ consumption	BASE	+11%
Diesel yield, % of fresh feed	47%	52%
Diesel T95	BASE	+10°F

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Dynamic studies pay dividends for refiners

JEFFREY FENG and BHARAT BANSAL, KBR Inc.

As process plants of all types become more complex, the need for robust and versatile simulation services becomes even more crucial.

Optimize relief header and flare system. Stepped up regulatory, emissions and safety requirements have refiners taking a closer look at their relief header and flare systems. These systems are also a key consideration when evaluating the costs and impact of refinery modernization, upgrade and expansion projects.

A dynamic flare study (FIG. 1) can accurately identify plant bottlenecks and flare-related safety concerns to determine the most economical way to expand and protect the refinery using existing assets. KBR's refinery and automation and process technologies (APT) teams use advanced simulation tools and in-depth process know-how to:

- Validate relief system design
- Accurately predict the impact of rerouting relief to an existing flare system
- Predict performance of existing flare system when new process units are added
- Address hazard and operability (HAZOP) study findings
- Evaluate the potential for flare load reduction.

Increase fuel gas system reliability. A stable, reliable fuel gas system delivers the flexibility and expandability

refiners need to adapt to changing operating conditions and feed variations. Poorly defined fuel gas control strategies can impact plant profitability and the safety of fired equipment. KBR recommends dynamic simulation studies to optimize the configuration of these complex systems.

A comprehensive fuel gas study can help increase onstream factor and improve the safety of fired equipment. Dynamic simulation tools, combined with process expertise, allow KBR to:

- Validate control systems
- Quickly evaluate the impact of new operating conditions
- Authenticate fuel gas heating values
- Predict and monitor the rate of change of fuel gas properties
- Identify make-up fuel gas specifications
- Predict and respond to process changes.

Benefits that last the lifetime of the plant. Steam systems represent a significant component of refinery investments. That is why many operators rely on dynamic simulation studies to right-size package boiler design and optimize day-to-day operations of refinery steam systems.

When used in the design phase, a dynamic steam study can minimize over-design of package boilers, reduce the number of letdown stations and decrease the potential for steam venting and energy losses. Dynamic

studies at existing sites strive to stabilize steam system performance, efficiency and reliability. Advanced tools and analysis:

- Validate steam system design conditions
- Identify opportunities for steam system energy savings
- Analyze and predict boiler ramp-up rates (FIG. 2)
- Isolate and improve operating processes
- Deliver critical insight into usage, demand and other bottlenecks.

Ensure reactor safety. How can plant managers ensure the safety of their high-pressure reactors? With so much at risk, more and more refiners rely on the rigorous analysis of a dynamic study of their de-pressuring systems, reducing plant commissioning time by precisely sizing the system during the design phase. A detailed study can:

- Accurately predict de-pressuring rate and time
- Validate equipment design limits under a range of depressuring scenarios
- Properly size the system to meet regulatory and owner requirements.

Advantage over steady-state analysis. On a flare system, dynamic analysis (FIG. 3) can accurately predict the timing of relief from different units, and reduce the peak flare load with capital savings of up to several millions of dollars for a new refinery. This allows

an existing refinery to expand without modifying the flare system.

Within a fuel gas system, issues associated with the rate of change of fuel gas and the specifications of make-up fuel gas cannot be addressed in steady state with the benefit of reducing the shutdown of fuel gas system, which may lead to a shutdown of the entire refinery. Each shutdown can result in lost revenue of several million dollars each day.

Package boilers in a steam system must be able to ramp up quickly to maintain stable steam supply to the refinery. The ramp-up rate of a boiler must be determined by dynamic analysis. Shutdown of the steam system will lead to a shutdown of the entire refinery. Each shutdown can result in significant lost revenue. A stable steam system will increase plant availability.

Steady-state analysis of a reactor depressurizing loop is incapable of predicting depressuring time; a dynamic analysis is required. These studies could help with sizing the system's valves to ensure safety and smooth transient operations in plants.

Advanced simulation services for refineries can provide dynamic simulation; advanced process simulation and modeling support; computational fluid dynamics; heat and mass integration (pinch) studies; logistic and material movement; and liquid transient analysis.

For more information about KBR services, please visit the KBR hospitality suite on Monday evening (5–10 p.m.). •

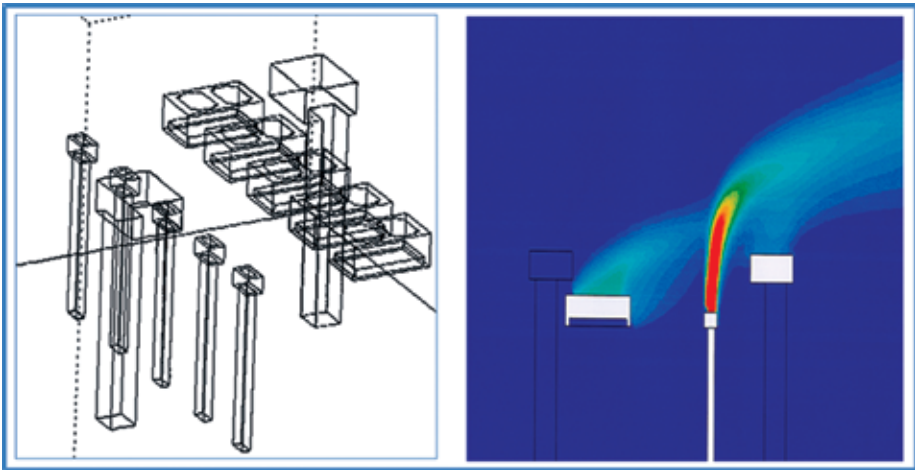


FIG. 1. Model of a flare heat distribution on an operator crane cabin and air-cooled heat exchangers for temperature operation safety requirements.

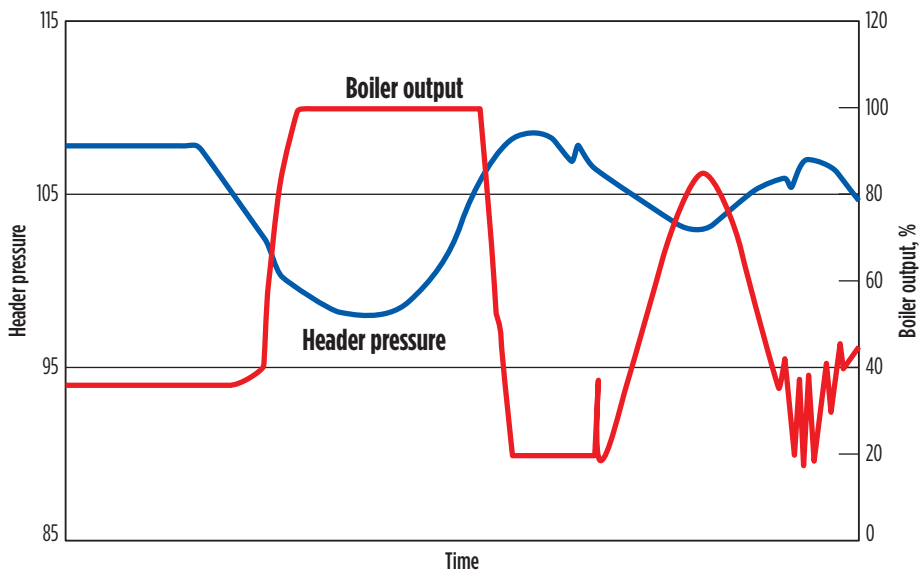


FIG. 2. Boiler ramp-up rate required for steady steam header pressure.

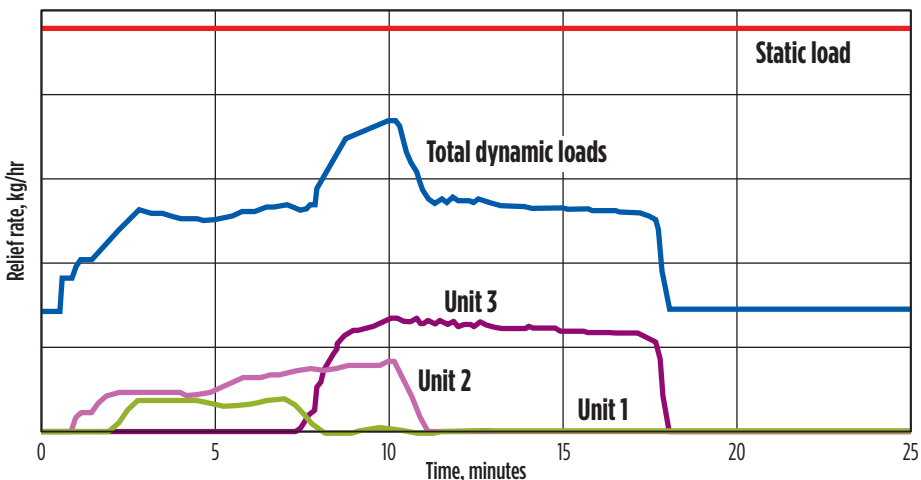


FIG. 3. Accurately predicting relief timing and reducing the peak flare load through dynamic analysis allows a refinery to expand without modifying the flare system.

CHANGING THE CARBON MONOXIDE MARKET LANDSCAPE

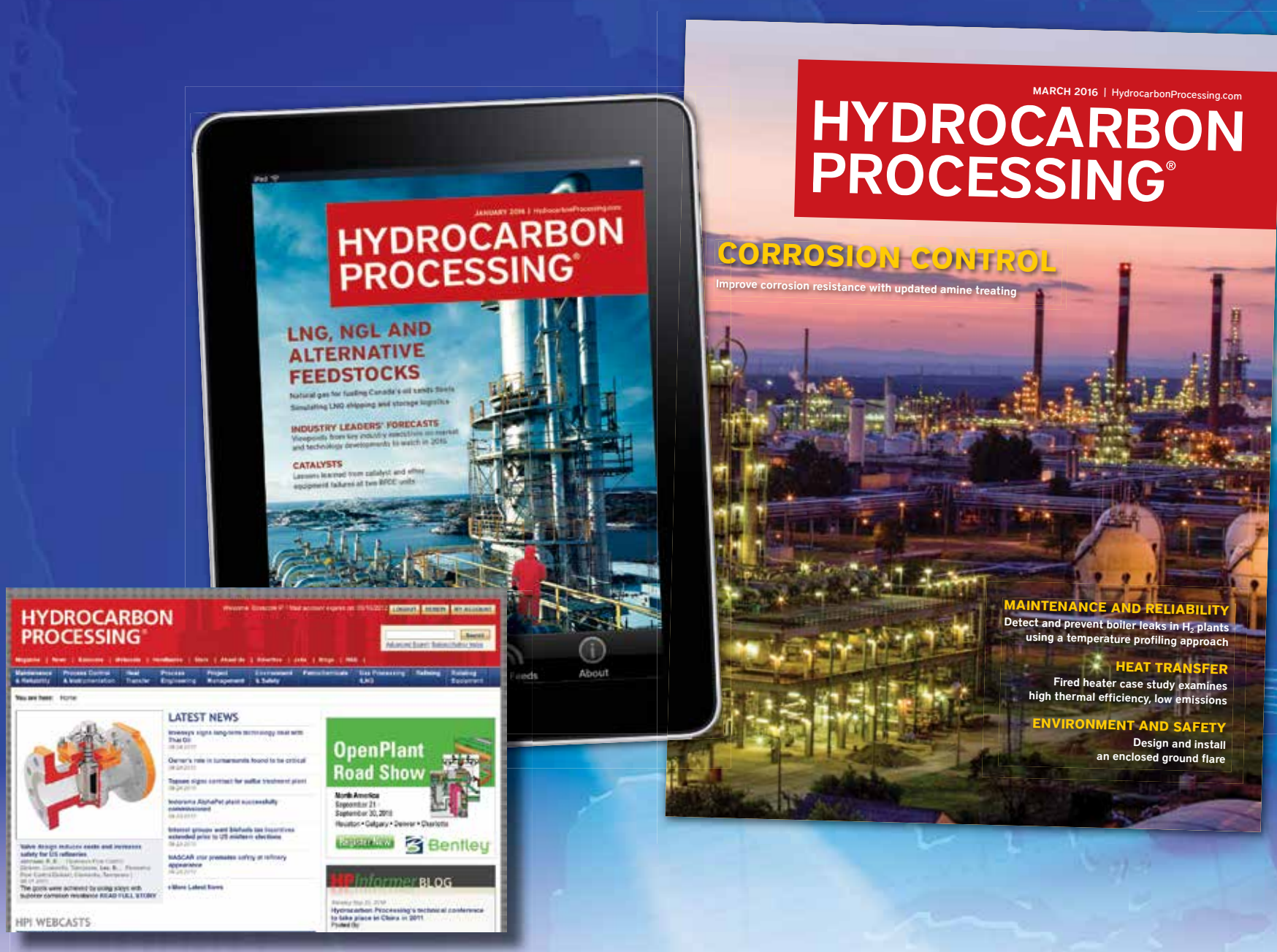
La Porte, Texas-based Gas Innovations has unveiled eCOs, a fuel cell technology that will allow the safe and efficient production of carbon monoxide (CO) directly at the site of facilities where the gas is needed. Developed by Denmark-based Haldor Topsoe, the CO-generation device will use feedstock carbon dioxide and electrical power to produce CO in quantities ideal for most operations.

The development is significant to the chemical, medical, pharmaceutical and electronics and industries, which require CO in their processes. The technology will also provide higher levels of purity, producing CO at 99.5% assay with minimal contaminants, with customization options that can produce gas with 99.999% purity.

Gas Innovations, a leading supplier of high-purity hydrocarbons, propylene, propane and specialty gases, now has an eCOs unit in operation at its Texas facility. In 1Q 2016, the company will begin leasing out the eCOs modules, making it possible for larger-scale operations to produce their own CO onsite on an as-needed basis. Both solutions drastically reduce costs related to transportation, storage, rentals and connections. •

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A holistic scrubbing solution for the refining industry

YVES HERSENS and SCOTT EAGLESON, DuPont Clean Technologies

The US Environmental Protection Agency (EPA) is proposing a new Clean Air Act targeting the emissions of hazardous air pollutants from petroleum refineries. The suggested new rule, RIN 2060-AQ75, would revise emissions control requirements for flares, storage tanks and coking units at oil refineries, as well as eliminate emissions limit exemptions during startup, shutdown and malfunction (SSM) periods. Refiners around the world are facing similar requirements from national or regional bodies.

In the drive to continue satisfying market demand, the industry has also had to increase production from unconventional oil fields with heavy oil fractions. That has resulted in products with higher sulfur content, increasing the need for desulfurization technologies.

Addressing a triple challenge. Refiners, therefore, now have to face a multi-faceted task: process increasingly sour crude while simultaneously reducing emissions and increasing

output. That is not an easy task, particularly in the current market.

To tackle this challenge, DuPont Clean Technologies offers two complementary, proven scrubbing systems as a solution for refiners who need to cut sulfur dioxide (SO_2) emissions, and/or need to control particulate emissions efficiently. Common sources of airborne pollutants in a refinery are:

- Fluid catalytic cracking unit (FCCU) regenerators, sulfur oxides (SO_x), nitrogen oxides (NO_x) and particulate
- Claus plants, with or without tail gas treatment unit (TGTU), hydrogen sulfide (H_2S) and SO_x
- Sulfuric acid regeneration units, SO_x
- Fluid cokers, SO_x , NO_x and particulate
- Fired heaters, SO_x , NO_x and particulate
- H_2S flares
- Power plants and boilers burning heavy fuel oil (HFO), coal, petroleum coke, SO_x , NO_x and particulate.

Many refiners struggle to control emissions effectively and efficiently. By reducing atmospheric emissions of H_2S , SO_x , NO_x and particulate from major refinery sources, the BELCO EDV scrubbing and the MECS DynaWave scrubbing systems make air pollution control easier and more reliable. Refiners that have installed such scrubbing systems have handled the liquid and solid byproducts of scrubbing with their existing onsite facilities and practices.

Continuous emissions control for critical refinery processes. An unscheduled shutdown of a major refinery process unit is not an option for the majority of refiners. Process units are expected to operate 24/7, 365 days a year for multi-year operating campaigns. Whatever the scenario, emissions must be minimized while product is generated and sold to the market. The BELCO EDV wet scrubbing technology is robust and widely used for treating flue gas from FCCU regenerators, fluid cokers, fired heaters and boilers. With over 100 FCCU installations worldwide and additional systems on other major refinery processes (fluid cokers, fired heaters and boilers), this low-energy wet scrubbing system supports FCCU operating campaigns of typically three–five years or more, providing continuous emissions controls with no maintenance shutdowns. This allows refiners to keep the FCCU running at all times, while controlling flue gas emissions and keeping emissions control costs as low as possible, so they can focus on production.

Flexibility in use for SRUs. As a result of the new regulations, oil refiners

will not only have to meet air emissions requirements for sulfur plants during normal operations, but now also during startup, shutdown and maintenance periods. They must operate under these constraints while meeting production goals. In many regions, that includes operating the facility continuously and reliably for a minimum four to five-year cycle and generating products that meet the market's quality expectations in an economically viable way. This has led a large number of refiners to consider parallel trains to assure continuous reliability. However, is this cost really a necessity?

The MECS DynaWave wet scrubbing technology is a Claus tail gas treatment unit (TGTU) supplement or, in some cases, an alternative to the Claus TGTU. The wet gas scrubber technology makes it possible to fully bypass the Claus unit, or the Claus TGTU, directly to the incinerator and still meet emissions limits at the stack (**FIG. 1**). It is also widely used in sulfuric acid regeneration units and well-suited to treat H_2S flares.

The DuPont technology is >99% efficient in removing SO_2 , which can bring emissions down to ultra-low levels under any given circumstances at the upstream sulfur plant, and combines gas quench, SO_2 removal, particulate elimination and sulfite oxidation all in one vessel, making it appropriate for some of the most demanding applications. The high onstream reliability is proven in more than 400 installations in various industries worldwide. Two dozen of these installations were specifically designed for sulfur removal tail gas treatment applications within refineries. Recently, the DynaWave technology was integrated in an existing Claus unit design for a facility in the Middle East. Here, acid gas flaring in all possible operating scenarios, including SSM, will not lead to an increase of SO_2 emissions. Other operating examples like this exist in regions like East Asia and North America.

New refineries in Africa and Asia are currently being designed to include both DuPont Clean Technologies wet scrubbing technologies to meet environmental requirements under any given circumstance and to achieve continuous and reliable operation.

Emissions control technologies must support refining production goals, and refineries must operate continuously and reliably to meet market demand for quality and cost, without generating emissions that violate regulations. By treating the main sources of SO_2 in the refinery segment with BELCO and DynaWave wet scrubbing technologies, DuPont offers an integrated technical solution to SO_2 emissions control for both new and existing global refineries. ●

Refineries must operate continuously and reliably to meet market demand for quality and cost, without generating emissions that violate increasingly stringent regulations. Integrated emissions control technologies must support refining production goals.



FIG. 1. The DynaWave wet scrubbing technology is a Claus tail gas treatment unit (TGTU) supplement that makes it possible to fully bypass the unit directly to the incinerator and still meet emissions limits at the stack.

KEYNOTE, continued from page 1

continued. “If you say you want to set up a new petrochemical plant, they can say this is wrong because it continues the addiction to fossil fuels, and that we should be moving toward green energy and not away from it.”

Epstein likened the fossil fuel industry’s challenge to the hydra, a mythical creature from ancient Greece with multiple heads, each with the ability to attack.

“If you try and fight the hydra by cutting off one head at a time, two more grow back,” Epstein said in making his analogy. “Is this the kind of issue that you can fight one at a time, or is there a way to cut out the heart of the hydra, and thus deal with all the different heads?”

To make this argument, Epstein suggests that the industry adopt a “humanist” perspective.

“With the ‘green’ side, there’s an underlying view of human nature that human beings are polluter-parasites,” he said. “On the other hand, I believe that human beings are improver-producers.

“If we weren’t, cavemen would’ve been awash with all the health benefits and good things we have today,” Epstein added. “If you have a fundamental framework to your argument where human beings are improver-producers, it changes the way you and others think about it. In every discussion, you can always frame it as, what are we after? Whenever they bring up fracking, oil spills, policy—if I’m a

humanist, my starting point is, let’s talk about what’s best for human life.”

Epstein disputes the ‘green’ environmentalist movement because he rejects the philosophical framework behind it, referring to it as a fallacy.

“The ideal is not a dehumanized planet,” Epstein said. “I decided when I was 18 years old that the ‘green’ movement was evil, because it’s anti-human.”

Epstein concluded his remarks by pointing out that the upcoming presidential election is the most important energy election of this century, in his view. For the oil industry to get the results it desires and change the hearts and minds of some voters, it must overcome the philosophical problems that are plaguing its current messaging system.

“We have a fundamental self-esteem issue, and the oil industry has it worse than anyone,” Epstein said. “This is the core of human goodness, to take a world that’s not as good and make it better.”

In the context of the upcoming election cycle and dealing with controversial issues such as climate change, this means taking a much more proactive approach.

“The key is not just to fend off the attacks, but to get people really excited about energy,” Epstein said. “We need to frame it in human terms and not simply go on the defensive.

“People respect you if you’re proud of what you do,” he added. “With ev-

ery issue you deal with, you need to frame it in a human way and be proud of the ingenuity and technology that goes with it.”

Epstein said the recent shale revolution and the technology that accompanies it is a classic case of the industry not taking the correct approach.

“The oil industry could have taken the track that this is a great development for human life, but the industry said nothing exciting or positive about shale technology,” Epstein said. “They waited to be defined by someone else.

“The industry doesn’t think it’s about philosophy,” he added. “They think it’s about facts. But it’s about more than rhetoric. That’s not enough.”

Epstein believes his proposed solution can help.

“Everyone thinks fossil fuels are bad, so no one is concerned about exaggerations or distortions,” Epstein said. “What we need to do is change the framework. Rather than people viewing it as a self-destructing addiction, they need to view it as a life-changing good. That changes everything.

“The upside is so, so amazing, given the nature of influence now. I think everyone in this room can change the minds of dozens of people, and some can change tens of thousands. It just depends on your level of motivation. If you view it in the human way of thinking about things, it will come naturally, and you can be more persuasive than you ever thought.” ●



Amec Foster Wheeler’s **RICHARD CONTICELLO** spoke in the resid conversion technical session about new developments in US coking units.



PHILLIP NICCUM of KP Engineering broke down fluid catalytic cracking (FCC) standpipe equations during a technical session on FCC operations.

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Residuum conversion to high yields of clean distillate products

BRUCE REYNOLDS and JULIE CHABOT, Chevron Lummus Global

With increasingly stringent refinery product specifications and heavier crude oils, refiners are seeking more advanced and reliable refining technologies to maximize yields of valuable distillate products, while minimizing undesirable heavy low-value streams. LC-SLURRY is the latest addition to the Chevron Lummus Global (CLG) residuum hydroprocessing technology portfolio. It builds on the commercial reliability and perfor-

mance of LC-FINING to extend residuum hydrocracking to near complete vacuum residue (VR) conversion and significantly heavier feeds (FIG. 1). Benefitting from dedicated R&D, this technology brings residuum conversion to nearly 100%—even with the most difficult feeds—maximizing the production of clean high-value distillate products while eliminating undesirable poor-quality pitch like bottom residue. LC-SLURRY, in combination

with CLG integrated hydrotreating and aromatics saturation technologies, provides a way to produce attractive yields of hydrotreated naphtha, Euro 5/6 diesel (60 vol%–75 vol%) and high-quality hydrotreated vacuum gasoil (VGO). FIG. 2 shows that the upgraded bottom oil can be routed to conventional refinery processes to yield additional valuable liquid products.

Converting heavy residue to clean products. LC-SLURRY relies on thermally induced hydrocracking in LC-FINING-type liquid recirculation reactors, and a high-activity molybdenum nickel slurry catalyst (ISOSLURRY) to convert heavy residue to clean products. This slurry catalyst upgrades the most difficult portion of the residue while suppressing coke formation, so that the reactor system and downstream equipment remain clean. The true measure of heavy-residue upgrading is the efficient conversion of the heaviest portion of the feed (the carbon residue) in proportion to the overall VR conversion, as shown in FIG. 3. Efficient catalytic upgrading of the heaviest oil fraction also yields stable low asphaltenes bottom oil, minimizing sediments-related fouling and operability risks while providing refiners with additional options to maximize the value and use of this stream. Stable bottom oil was demonstrated at a

very high cracking conversion, even on high asphaltene feeds, and challenging high sediment-making feeds known to typically limit cracking conversion, such as Urals VR. One advantage of LC-SLURRY is the incorporation of a used catalyst solids recovery process. This catalyst recovery section (CRS) produces solids-free bottom oil and used catalyst solids for subsequent metals recovery. The ability to produce a solids-free bottom stream is critical to further processing this stream in downstream refinery processes to maximize the production of valuable liquid products. A metals recovery process specifically tailored to the LC-SLURRY technology was also developed to minimize the overall costs of catalyst usage. Existing metals reclamation facilities can be upgraded using this ecofriendly technology to gain value from the catalyst metals and the deposited vanadium and nickel. The high recovery of the catalyst metals almost eliminates the need for additional makeup metals for making the fresh slurry catalyst. The high efficiency of the metals recovery recycle to the fresh catalyst synthesis process, combined with the LC-SLURRY internal used catalyst recycle, is key to the strong economic viability of the LC-SLURRY process for producing high-value products, even on the most challenging feeds (FIG. 4).

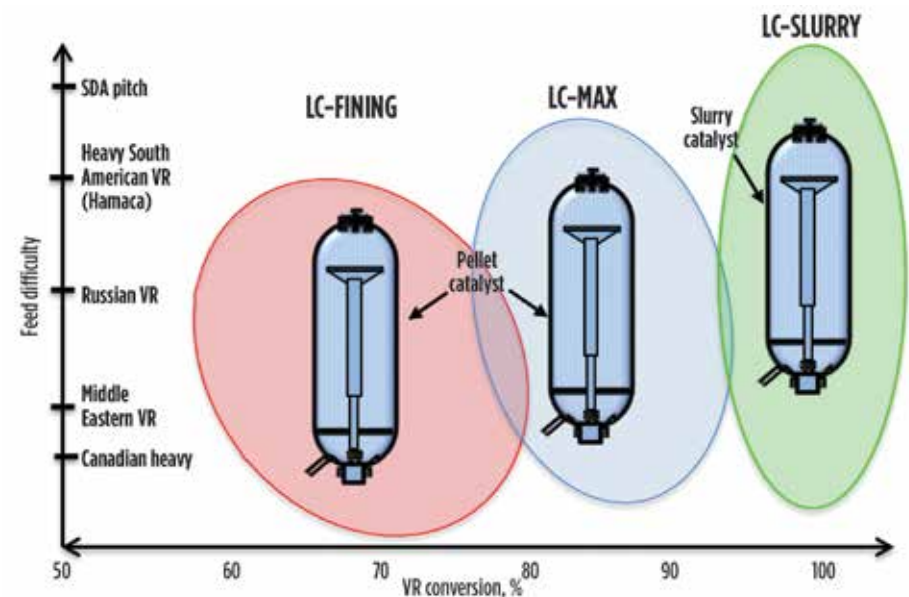


FIG. 1. The CLG advanced residuum hydroprocessing technology portfolio.



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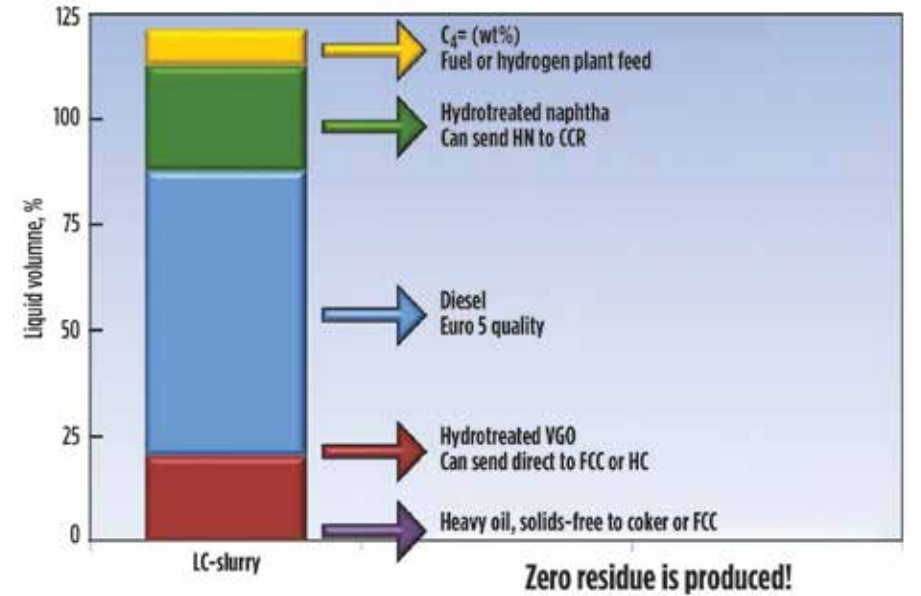


FIG. 2. Typical LC-SLURRY product yields.

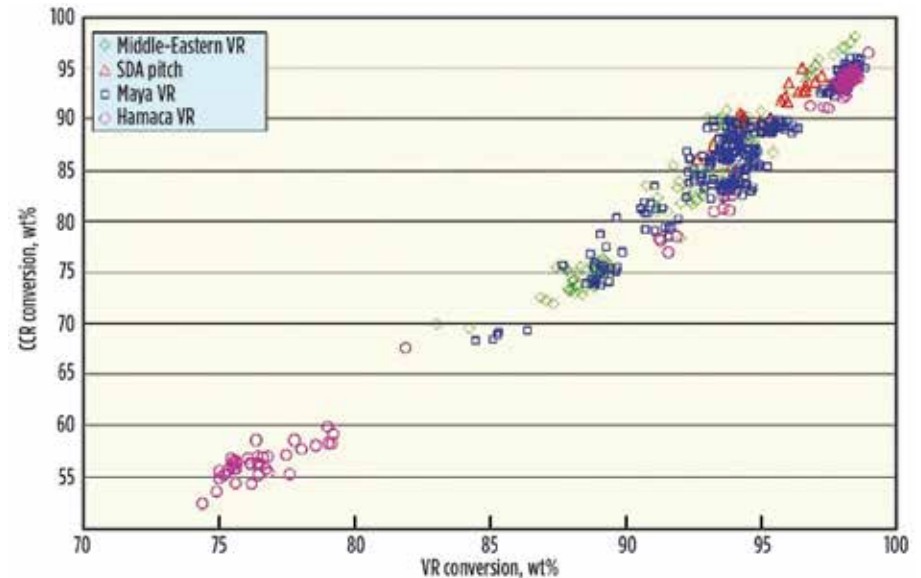


FIG. 3. LC-SLURRY Conradson carbon residue (CCR) conversion vs. cracking VR conversion.

Mitigating CAPEX and operational risks. Building on CLG's residuum hydroprocessing experience, the LC-SLURRY process was streamlined to mitigate capital expenditures (CAPEX) and operability risks. The bottom oil slurry recovered from the hot high-pressure separator is routed to the CRS via a heavy oil stripper, eliminating the need for an atmospheric and/or a vacuum fractionation column in heavy oil slurry service. The distillate products recovered from the hot high-pressure separator and bottom oil stripper are routed to the fixed bed hydrotreater, which is integrated within the main slurry hydrocracker pressure loop. Depending on the refiner's needs, other low-value refinery streams, such as coker gasoils and FCC cycle oils, could also be routed to the integrated hydrotreater to generate additional finished products. Based on CLG's commercial design, the recovered vapor stream is purified and compressed, and the resulting hydrogen-rich (H₂) stream is recycled back to the main slurry hydrocracking section.

LC-SLURRY is based on the LC-FINING liquid recirculation reactor platform (FIG. 5). Extending and adapting a proven residuum hydroprocessing reactor platform to slurry service significantly reduces scale-up risks relative to scaling up a new and much less-proven type of complex multiphase reactor, such as a slurry bubble column reactor. Liquid recirculation-type reactors also offer significant additional benefits relative to other multiphase reactors, including a lower and stable gas holdup, which results in smaller required reaction volume. The high-liquid velocity induced in these reactors provides for

improved heat and mass transfer, resulting in stable temperature control, optimum flow regime and enhanced catalytic activity. This type of reactor also favors improved slurry catalyst transport, mixing and dispersion, leading to improved catalyst utilization, flow and recovery.

Extensive technology testing. The product was tested utilizing a broad range of very heavy feeds to ensure reliable operational and economic performance. This testing program provided assurance that the technology can achieve target onstream availability, feed rate, yields and product properties on the design heavy feed of interest. The testing included multi-month operation campaigns in a large-scale 1-bpd research unit equipped with liquid recirculation reactors and an integrated hydrotreater. This research unit was precalibrated in LC-FINING service against a known commercial LC-FINING operation to verify the reactor hydrodynamics fundamentals and key scale-up parameters.

Testing confirmed the strong affinity of liquid recirculation reactor for slurry service, and stable reactor hydrodynamics and thermometry were achieved and sustained over months of operation. In combination with the active ISOSLURRY catalyst, LC-SLURRY also demonstrated in this testing program to offer flexibility in handling the typical feed changes occurring in most refineries.

CLG is offering the residuum hydrocracking for licensing. LC-SLURRY offers nearly 100% residuum conversion to high yields of clean distillate products while eliminating problematic low-value, pitch-like products. •

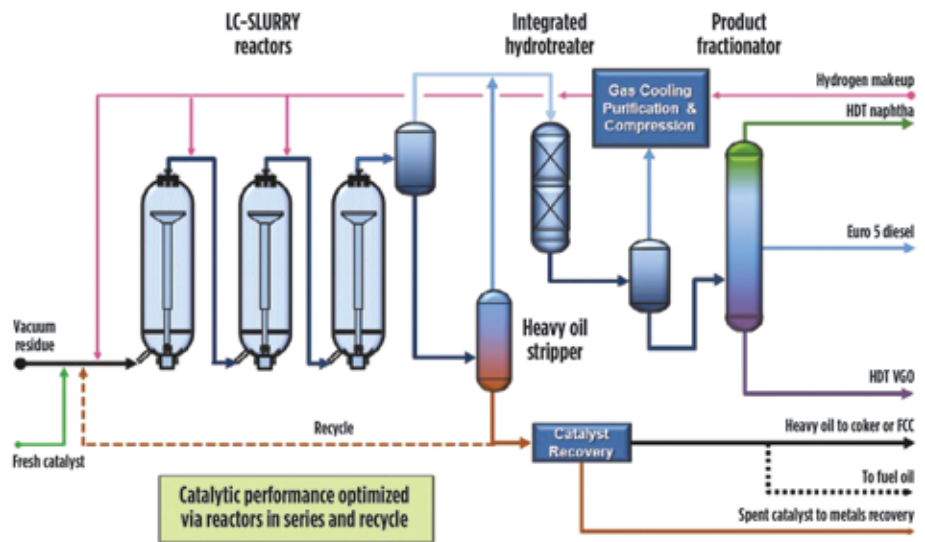


FIG. 4. The optimum LC-SLURRY flow scheme.

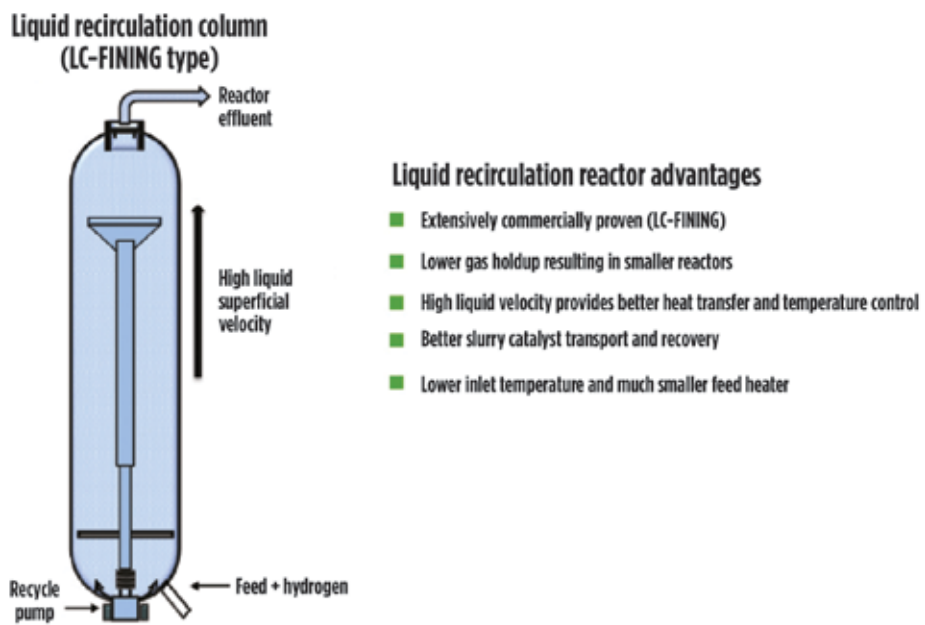


FIG. 5. Key benefits of the liquid recirculation reactor.



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The new liquid gold

KATHLEEN BEREK, BRIAN FOY and SEAN O'MARA, Burns & McDonnell

Managing water use in the production of oil, gas and petrochemicals is becoming an increasingly critical issue in the industry. Water is easily on the verge of becoming the new liquid gold. Growing populations, agriculture and industries dependent on the availability and quality of water for survival are all driving up the value of this resource. Concurrently, regions across the globe face water stress with greater frequency and duration than ever recorded.

The world's 7 B people rely on just 3% of the total volume of water on earth. By 2050, the US Census Bureau predicts the world population will surpass 9 B, yet will rely on that same 3%. A growing population requires more food, more energy and more industry, all competing for the same resources. Industrial water demand (FIG. 1) must be managed to provide for the increased population.

By 2050, global water demand is expected to grow by 55%, largely due to growth in manufacturing, thermal electricity and domestic use. Manufacturing alone can expect to increase water demand by as much as 400%, due to emerging economies and developing countries. As the oil, gas and petrochemical industries adapt to this changing landscape, the water supply will require the same consideration as the crude supply.

Managing the increasing competition for water resources. The oil and gas industry relies on secure and stable supply chains; water supply is one of the most crucial and is especially susceptible to changes in climate. The Columbia Water Center identified California, the Southwest and Midwestern plains states as drought-prone zones (FIG. 2). While water is a renewable resource, it requires increasing energy and cost to manage and treat. Competition for water resources will only continue to grow. As demand for energy goes up, so will the demand for water.

In late 2014, FMI Management Consulting projected that the combined water and wastewater construction market will grow 2.5% annually through 2020 to \$40.3 B. While forecasted expansion is steady, the rate of projected growth is tempered by uncertainty surrounding access to necessary funding. The average age of US refineries is 40 years old, and many facilities are reaching the end of their useful life. Water quality is degrading, so water process and treatment improvements will be necessary to provide reliable service.

Water quality, quantity and efficiency are topics that deserve attention. Long-term water planning is needed for the oil, gas and petrochemical in-

dustries to remain successful. Water and energy have long been managed and regulated separately. Recent regulations on water and wastewater in the power industry show how companies may need to adapt to new regulations quickly. The US Environmental Protection Agency (EPA) is conducting a detailed study to consider revisions to the Petroleum Refining Effluent Guidelines and Standards, which were last updated in 1985. As the environmental and regulatory arenas change, it is imperative that companies are proactive and pursue best practices to stay ahead of the curve.

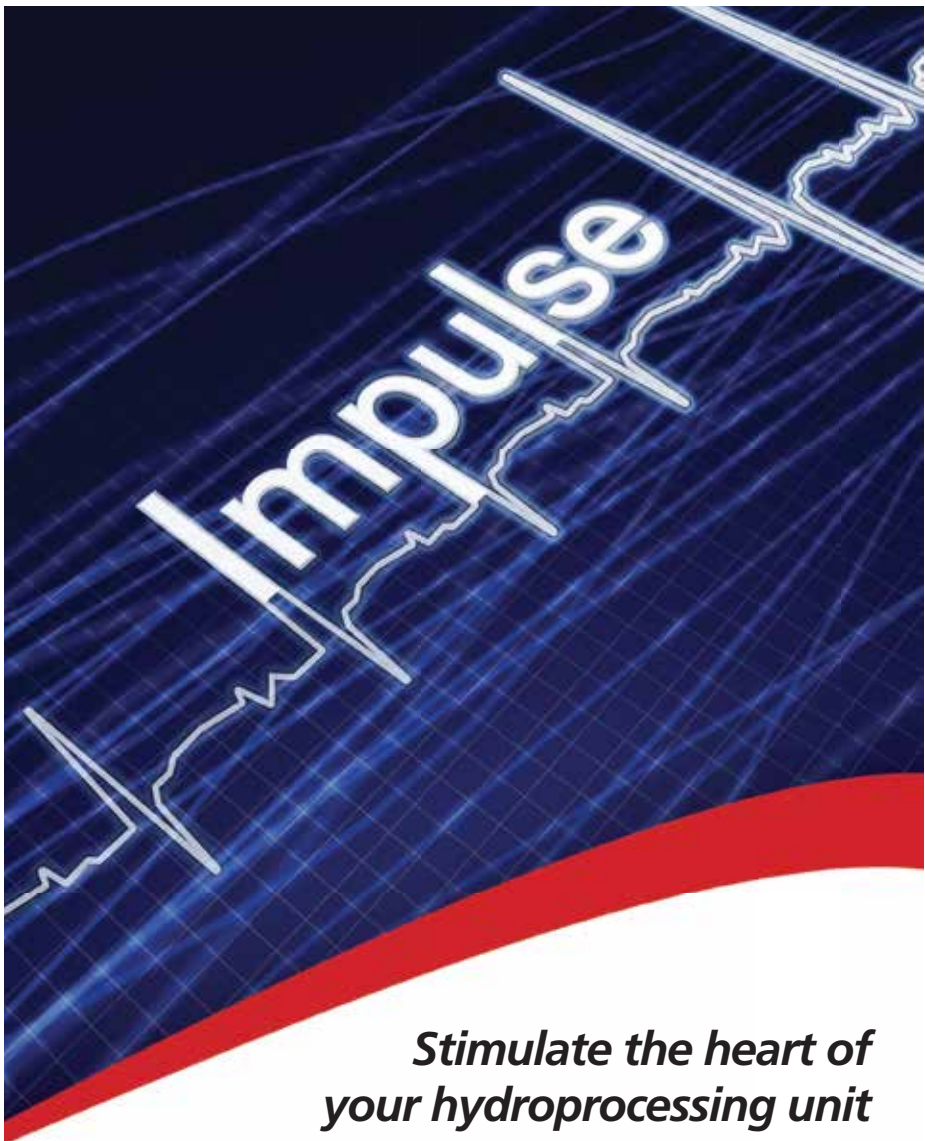
Applications in action. Industry leaders have already taken actions to achieve greater efficiencies. The West Basin Municipal Water District in California has a wastewater recycling plant capable of recycling 45 MMgpd (million gallons per day) of water. Since opening in the 1990s, the plant has processed more than 150 B gallons of total recycled water. Chevron, ExxonMobil, Tesoro refineries, Toyota and Honda corporate headquarters, city parks, golf courses and other landscapes are all customers that are using the recycled water provided by this plant.

In water-scarce or stressed areas, companies like DuPont, BASF

and Shell are establishing sustainable water management practices to promote water stewardship by 2020. DuPont reduced total water consumption by 4% between 2013 and 2014, and Valero has reduced water discharges and refinery spills to water by 75% since 2005. In the last three years, BP has reduced its total reported volume of freshwater withdrawal from 347 MMcm to 280 MMcm. Refineries in the US Southwest and Midwest regions are using integrated membrane treatment plants to reuse various sources of water, significantly reducing the draw from regional aquifers.

There are many energy alternatives that are being used and will be further developed in the future. However, there is no alternative for water. The industry must navigate the complex web of available resources, population demands, advances in technology and ever-changing regulatory environments. There must be an understanding of, and action related to, the critical connection with water to ensure a successful future for the oil, gas and petrochemical industries.

For further information, attend the "More Water Restrictions Meet More Options" session by Larry Close of Burns & McDonnell, Wednesday at 2:00 p.m. ●



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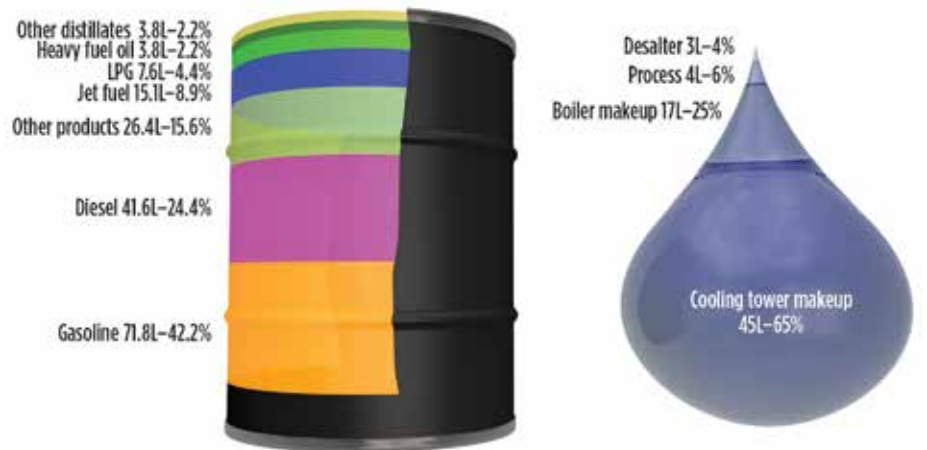


FIG. 1. Water required for refined products per barrel of crude.

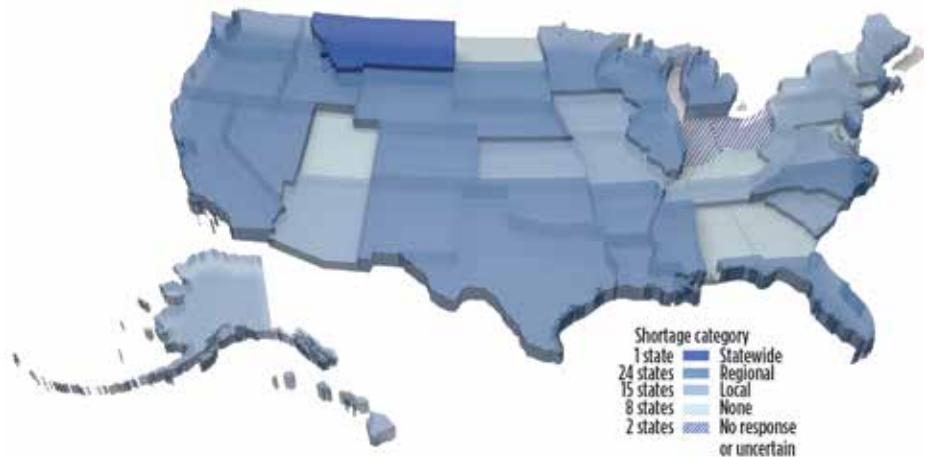


FIG. 2. Competition for water resources for the US refining and petrochemical industries will only continue to grow. Source: 2013 GAO survey.

**UPCOMING
AFPM EVENTS**
Security Conference
April 11–13, 2016
Houston, Texas

The protection of critical manufacturing sites is essential to the US manufacturing sector. The annual AFPM Security Conference presents current topics, including security issues, policies and future regulations.

Non-phosphorous corrosion inhibition protects cooling towers

MARK WIECZOREK, Baker Hughes

Corrosion in cooling towers can be a serious operational issue, leading to decreased efficiency and potential equipment failures if the corrosion is uncontrolled or the treatment is ineffective. Historically, most industrial operations have used traditional orthophosphates or other phosphorous-containing water treatment programs to control corrosion in towers. Emerging regulatory requirements, implemented amid concerns about the potential impact of phosphorous on surface water and the environment, now restrict the amount of phosphorous allowed in chemical treatment programs. These changes pose challenges for refiners and petrochemical manufacturers, who want to meet the more stringent regulatory requirements without sacrificing operational efficiency.

To address these challenges, Baker Hughes developed the LIFESHIELD non-phosphorous corrosion inhibition program to help fuel and petrochemical manufacturers meet stringent environmental regulations, while flexibly and reliably managing issues related to highly corrosive water systems. The program contains zero phosphorous, enabling it to meet Health Safety and Environmental (HSE) and legal regulations, reduce fouling downstream and protect waterways from harsh pollutants.

Increased flexibility and reliability.

Traditional phosphate-based corrosion programs require precise control to create a balance with cooling system factors, such as temperature and pH levels, and to decrease the risk of fouling and corrosion. Baker Hughes' non-phosphorous program provides the same benefits in cooling systems with a variety of water compositions and stressed cooling water conditions, including:

- High chloride environments, >1,000 ppm
- Zero to medium-water hardness levels
- A broad range of pH levels
- High biocide levels
- Temperatures in excess of 66°C (150°F).

Mitigating corrosion reduces equipment failures and improves cooling tower reliability and efficiency (FIG. 1). The ability to treat zero-hardness wa-

ter eliminates the need for additional chemical components and related costs, and improves safety, as does the ability to manage corrosion in alkaline cooling systems. LIFESHIELD programs also enable water re-use, which lowers water costs and saves energy consumption and costs.

Each inhibition program includes ongoing monitoring of treatment and dosage rates using either a handheld or online sensor to track trends and analyze performance.

Case history: Solution for Southeast Texas petrochemical manufacturer.

High levels of corrosion within the cooling water heat exchangers had negatively impacted the reliability and performance of the units, to the point where carbon steel corrosion rates averaged between 2 mpy–3 mpy (mils per year), several orders of magnitude outside the manufacturer's optimum range of < 1.0 mpy.

The manufacturer partnered with Baker Hughes to troubleshoot the system, and the team determined that three factors were raising the corrosion rates:

1. Occasional lamella solids carryover with the makeup water
2. Supplemented, unfiltered firewater being used as makeup water
3. Corrosive chloride content in the cooling tower makeup water, which negatively impacted the tower's performance.

Baker Hughes worked with the plant manager to implement a TOTAL SYSTEMS APPROACH process to help plant personnel improve oversight of the cooling tower program. The first step in the process was a cooling water basics training course for the plant operations team, with a focus on best practices for lamella management.

To address the cooling tower's out-of-spec corrosion rates, the company recommended a trial of the LIFESHIELD non-phosphorous corrosion inhibitor. The LIFESHIELD program was applied over a five-month period, replacing the existing phosphorus-based corrosion program. A custom single-drum feed system was chosen to provide a cost-effective delivery method for the new treatment to the plant.

The Baker Hughes VIVID automated smart controller with online analyzer was installed to measure the chemical levels and to provide continuous monitoring of the system, including alerts when problems arose. During the trial, the controller's active monitoring enabled the team to respond more quickly to system upsets, and also optimized response and control of the chemical treatment.

Following the LIFESHIELD inhibitor trial, carbon steel corrosion rates in the plant's cooling tower decreased to 0.75%, 25% less than the required 1 mpy spec, with readings as low as 0.5 mpy. On average, the Baker Hughes inhibitor program reduced corrosion rates by 70% compared with the plant's prior corrosion inhibition program, while ensuring compliance with environmental regulations. ●



FIG. 1. Emerging regulatory requirements are restricting the amount of orthophosphates or other phosphorous-containing water treatment programs traditionally used to control corrosion in cooling towers.

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CONTRACTS FOR LAKE CHARLES METHANOL PLANT

Gas-to-methanol group G2X Energy and strategic partner Proman Group have entered into an engineering services contract with Toyo Engineering Corp. for the detailed engineering needs on their world-scale methanol project located in Lake Charles, Louisiana.

Toyo will be providing basic engineering for offsite and utility facilities and detailed engineering of the complete methanol facility. Once complete, the G2X facility, known as Big Lake fuels methanol plant, will produce 1.4 MMtpy of commercial-grade methanol.

G2X and Proman Group have also entered into license and engineering contracts with Johnson Matthey, which will supply the technology license, basic engineering, catalyst and technical services for the project. ●

SCENES FROM THE 2016 AFPM ANNUAL MEETING



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- 1 The entire team from **Chevron Lummus Global** welcomed Annual Meeting delegates to its penthouse suite.
- 2 The cool sounds of the Ned Boynton Jazz Trio set a great environment at the **KBC Advanced Technologies** event.
- 3 A contortionist entertained the **Haldor Topsoe** hospitality suite, Cirque du Topsoe.
- 4 **Rick Ostopowicz** and **Rosann K. Schiller** from Grace Catalysts Technologies took time during Sunday night's opening session to connect with colleagues.
- 5 Emerson Process Management's **Marcelo Carugo** and **Doug White** treated guests to some of the finest wines that Napa and Sonoma Counties offer.
- 6, 7 The suite by **Dorf Ketal Chemicals** and **Solenis**, which offered one of the only balcony settings for guests to enjoy the scenic view of San Francisco, featured solutions that fit within the growing trend of crude flexibility.
- 8 **BASF** satisfied the sweet tooth of each visitor with San Francisco's unique Ghirardelli chocolates.
- 9 A local chef dished up some San Francisco cuisine: fresh beef, chicken and salmon skewers.

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March 20-22, Dallas, TX

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April 14-15, Houston, TX

National Occupational &
Process Safety Conference
May 16-18, San Antonio, TX

Reliability & Maintenance
Conference and Exhibition
May 24-27, San Antonio, TX

Cat Cracker Seminar
August 23-24, Houston, TX

Q&A and Technology Forum
September 26-28, Baltimore, MD

Environmental Conference
October 16-18, New Orleans, LA

International Lubricants
& Waxes Conference
November 10-11, Houston, TX

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- Decreasing gasoline end points at the expense of gasoline volume and octane
- Hydrogenation post treatment at the expense of octane loss
- FCC additives to reduce gasoline sulfur while enhancing octane

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