AFPM

116th American Fuel & Petrochemical Manufacturers

ANNUAL MEETING

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DAY TWO | #AFPMAM

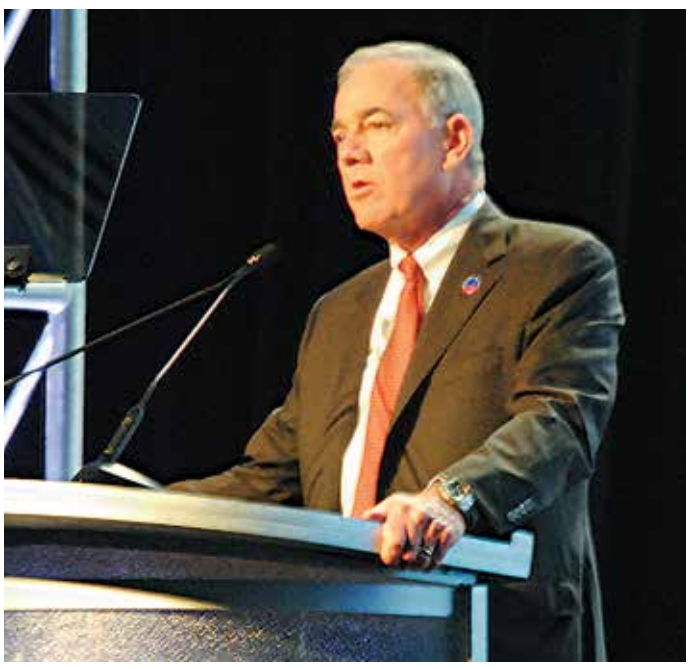
Tuesday | March 13, 2018

AFPM leaders tout industry progress, Harvey recovery efforts

ADRIENNE BLUME, *Hydrocarbon Processing*

Opening Monday morning's General Session, Valero Energy's President, Chairman and CEO, Joe Gorder, welcomed attendees to the 116th Annual Meeting.

Mr. Gorder opened by saying, "One thing this meeting allows us to do—and that we should do—is take a victory lap. Remembering the good that we do, and how much we help people … [and that] we do all of this while maintaining a strong commitment to the safety of our employees, our businesses and the environment."



JOE GORDER, President, Chairman and CEO of Valero Energy.

Overcoming Harvey. Mr. Gorder also spoke to the effects of Hurricane Harvey in August 2017, which caused massive flooding along the Gulf Coast and in southeastern Texas, notably Houston. He noted that many in the room had been impacted by the disaster, including businesses, homes and families. "And yet here we are, standing tall," he stated.

Gorder also praised the US refining and petrochemical industry for bringing capacity back online in a few short weeks after the hurricane. Approximately 25% of the country's total refining capacity and approximately 26% of its total petrochemicals capacity were shut down by the storm.

"We always hope for the best but plan for the worst," Mr. Gorder said. "But we all came together and we helped each other, and I want to thank you for what you did, and for everything that you do."

He also reminded the audience about a second general session, held on Monday afternoon, to address lessons learned from Hurricane Harvey and how the industry can improve in terms of preparedness and recovery.

In closing, the Valero chief said, "My hope is that when you leave this Annual Meeting, you'll feel good about your contribution to industry."

Policy progress. Following Mr. Gorder's remarks, AFPM President and CEO Chet Thompson addressed attendees. Thompson called the Annual Meeting's host city, New Orleans, a "shining example of resilience" after Hurricane Katrina, which devastated the city in August 2005.

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INSIDE THIS ISSUE

Technology, adaptability are key to keeping US industry on top

ADRIENNE BLUME, *Hydrocarbon Processing*

Presenting the first keynote address of the AFPM Annual Meeting was Rich Karlgaard, Editor of *Forbes,* who discussed what leading companies must do to maintain their edge in an ever-changing world.

Mr. Karlgaard likened the present state of the US economy to something that has been thrown into a centrifuge that is sorting out business models that work and those that do not. According to the Editor, several dominant megatrends can be seen in the economy.

Economic megatrends. The first megatrend, explained Mr. Karlgaard, is that "technology is not slowing down, it is speeding up," specifically digital technology produced in Silicon Valley. Shale drilling has also seen profound technological revolutions, especially over past 10 years, he noted.

The entire energy sector is poised for significant transformation between 2016 and 2030, with big impacts coming from the Internet of Things (IoT), artificial intelligence (AI), predictive analytics, big data and other advances.

Another megatrend is that extreme valuation differences create asymmetric warfare. Companies that are born digital—such as Google, Amazon, Facebook, etc.—have a high capital-to-revenue ratio. However, Mr. Karlgaard noted that "asymmetric venture capital funding leads to repeat assaults on profit models of legacy companies, which cannot get the funding to conduct multiple defenses."

Some fast-growing companies, such as Uber and Airbnb, have found ways to work around regulatory barriers. "It is pretty illuminating," the Editor added. "But sustainable advantage is becoming more and more perishable, regardless of what you do to preserve it."

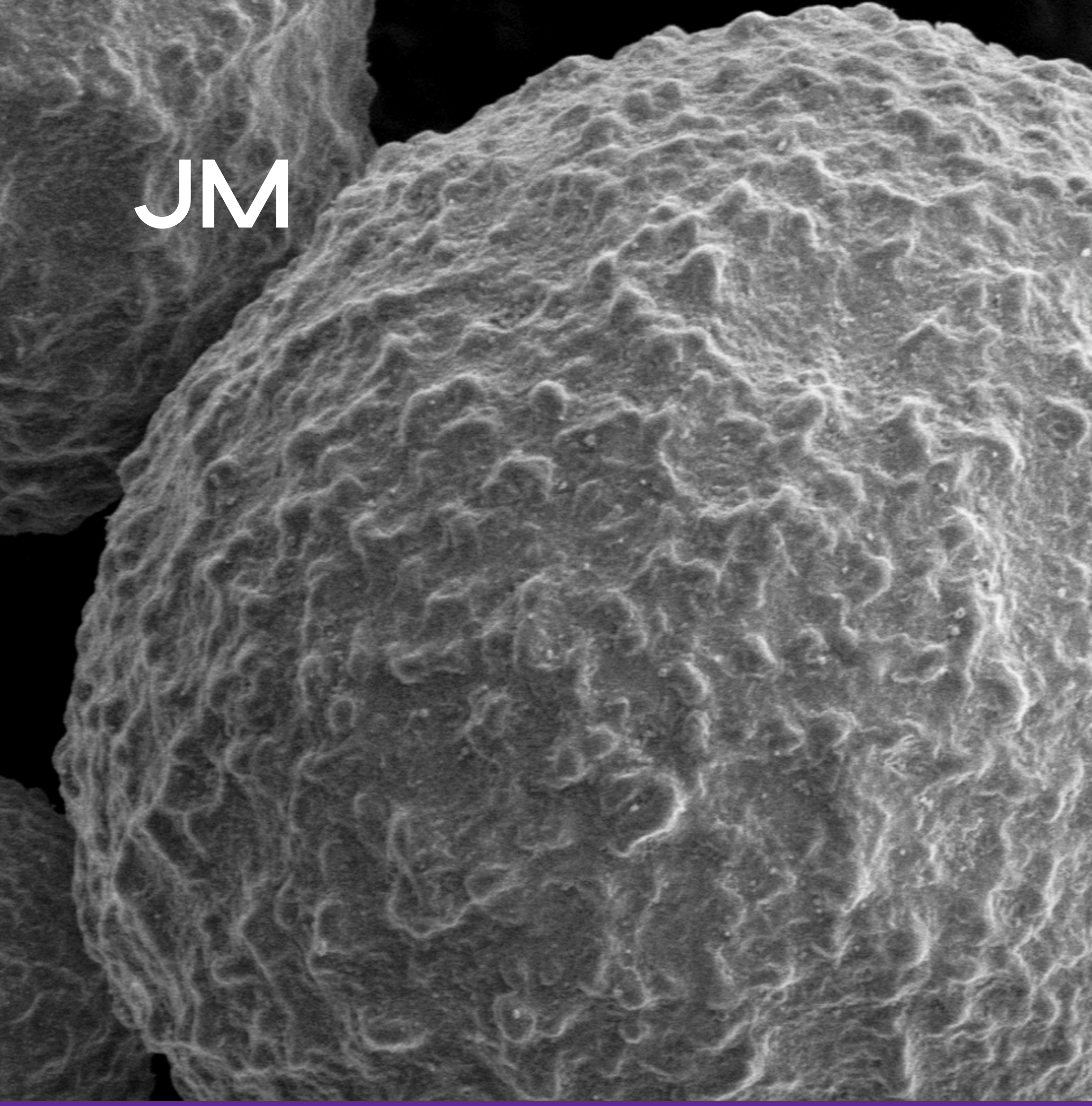
Four adaptability must-haves. Next, Mr. Karlgaard pointed out four adaptability characteristics that today's companies must adopt to not fail. The first is digital fluency. "Be in the top quartile, or perish," he warned. "How digitally fluent is your supply chain? Is it giving you information in real time? Are you able to act on it? Are you able to make tangible improvements on a regular basis?"

For AFPM member companies, digital fluency means the use of Supply Chain 2.0 (particularly if oil and gas prices remain modest), IoT, next-generation Big Data algorithms, Cloud computing power and AI's predictive power. "Being able to analyze data in real time is a huge, huge advantage," Mr. Karlgaard asserted.

Another adaptability must-have is cultural clarity. "Have a clear corporate

▶ See KEYNOTE, page 15

In Monday morning's keynote address, *Forbes* Editor **RICH KARLGAARD** cited four adaptability characteristics that today's companies must adopt to not fail.



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GENERAL SESSION, continued from page 1

"Resiliency is something our industry knows a little about, too," Mr. Thompson said. "Over the years we've evolved, we've gotten stronger, more productive, more efficient and cleaner, and we will continue to do so."

Mr. Thompson noted that in 2017, US refinery utilization was close to 90% for the third straight year. Additionally, $25 B of investment were made in the US refining and petrochemicals sector last year, and nearly $150 B of investment are in queue.

By 2020, US petrochemical exports are expected to grow by 60%, prompting the AFPM head to note, "The state of the refining and petrochemical industries is strong," despite the "unprecedented impacts" from Hurricanes Harvey and Irma. "Twenty-four refineries were shut," Thompson said. "One-fourth of production capacity was down; the whole US supply chain was affected. It had the potential to be catastrophic for our country, for our industry and for consumers, but it wasn't." As Mr. Gorder previously noted, within a few weeks, the majority of refining and petrochemicals capacity was returned to operation. "That is the definition of resiliency," Mr. Thompson said.

The AFPM head then spoke about the state of the US government's tax reform. "Last year, we thought [tax reform] was a pipe dream, but it wasn't," he said. The realized tax reform has enhanced US industry's ability to invest money in infrastructure and people. "This is where your money needs to go," Mr. Thompson urged. "Finally, we can look to the government for support, rather than resistance."

He also discussed the "eventual sunset" of Renewable Fuel Standard (RFS) regulations, which he called "bad for industry, consumers and the country." However, he noted that "productive discussions are happening" to put an eventual end to the subsidies.

The AFPM head also spoke to the need to streamline permit approvals for infrastructure projects, noting, "Reforms do not mean limiting environmental protection." He also touted AFPM's support of the North American Free Trade Agreement (NAFTA) between Canada, Mexico and the US. "The bottom line is: NAFTA is working for us," Mr. Thompson said. "We must stay in the agreement, and we must modernize the energy chapter of the agreement."

AFPM Leadership Award. Mr. Thompson also presented the first AFPM Leadership Award, given for extraordinary contributions to the advancement of the American fuel and petrochemical industries, to Congressman and Majority Whip Steve Scalise (R-LA).

Mr. Scalise, who took the podium to thank AFPM for the award, noted that EPA regulations have affected the industry's ability to grow, expand and make more jobs. He also touted the current presidential administration for reversing roadblock regulations.

"Safety is critical, but when you have regulations that make no sense, they actually do things to decrease your ability to operate safety and hire more people," Mr. Scalise said. He also noted that the recent tax reforms—the first since 1986—have lowered individual tax rates as well as corporate rates, and have also led some companies to give higher bonuses to employees.

"Tax reform has allowed companies to become competitive again," the Congressman said. "Now, we not only have a stable regulatory climate, but we also have a tax code that works for you." ●

CHET THOMPSON (left) presented the first AFPM Leadership Award, given for extraordinary contributions to the advancement of the American fuel and petrochemical industries, to Congressman and Majority Whip **STEVE SCALISE** (R-LA), second from left.

SCHEDULE OF SESSIONS AND SPECIAL EVENTS

TUESDAY, MARCH 13, 2018

7 a.m.–12 p.m.	**Registration**
7:30–9 a.m.	**Industry Leadership Breakfast*** *Open to registered attendees only
9–11:30 a.m.	**Breakout sessions:** Process Safety, Priority Regulatory Issues, Emerging Technologies
10–10:30 a.m.	**Coffee Break**
11:30 a.m.–2 p.m.	**Annual Luncheon featuring*:** Jay Leno, Comedian and Actor *Open to registered attendees only. Tickets must be purchased by March 2. No tickets or same-day seating will be available onsite.
2–4:30 p.m.	**Breakout sessions:** Economic/Commercial, Big Data, Workforce Development, Community Relations and Diversity, Innovation
3–3:30 p.m.	**Coffee Break**
5–7 p.m.	**Closing Reception** Wrap up a successful few days in the Big Easy with us at Pat O's on the River, atop the Jax Brewery. Enjoy breathtaking views of the French Quarter and the Mighty Mississippi while you unwind with friends, colleagues and a specialty cocktail! Transportation provided. Price: $75

AFPM

116TH ANNUAL MEETING CONFERENCE NEWS

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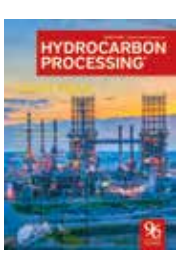


Resid conversion technology alternatives

Resid or residuum materials are high-boiling hydrocarbons that are unsuitable for transportation fuels or lubes unless they can be converted to lighter, more hydrogen (H_2)-rich hydrocarbon types. The two basic approaches to processing these feedstocks into more valuable, lighter products are referred to as H_2 addition, and carbon rejection processes.

H_2-addition processes usually operate at high pressure and depend upon catalysis and H_2 gas to achieve the desired reactions, which simultaneously crack and hydrogenate the large residuum molecules. These heavy feedstocks generally cause catalyst deactivation at a significant rate due to coking and the presence of hetero atoms and metals, requiring high fresh catalyst make-up rates. Hydrogenation is indiscriminate, and the resultant high H_2 demand can be expensive at locations where H_2 is costly. These processes also produce a bottoms stream of very low quality that is difficult to dispose of in a cost-effective manner.

Carbon rejection processes generally refer to thermal coking processes that operate at low pressure (less than 0.4 MPa-g/60psig) and utilize thermal cracking reactions to achieve the desired conversion of the high-boiling molecules. Thermal cracking reactions refer to several types of reactions, including cracking, condensation, polymerization and isomerization. This chemistry results in a redistribution of H_2 in the feed to yield lighter liquid products with higher H_2-carbon ratios, and a byproduct of solid coke with a low H_2-carbon ratio. Typical commercial coking processes include delayed coking, fluid coking and ExxonMobil's unique FLEXICOKING™ technology (FIG. 1). Solvent de-asphalting is an alternative carbon rejection process that separates carbon-rich asphaltenes by solvent extraction from a more H_2-rich, de-asphalted oil that can be processed in conventional FCCUs or hydrocrackers. The asphaltene pitch, or "rock," is typically disposed of in fuel oil blending or a coking process.

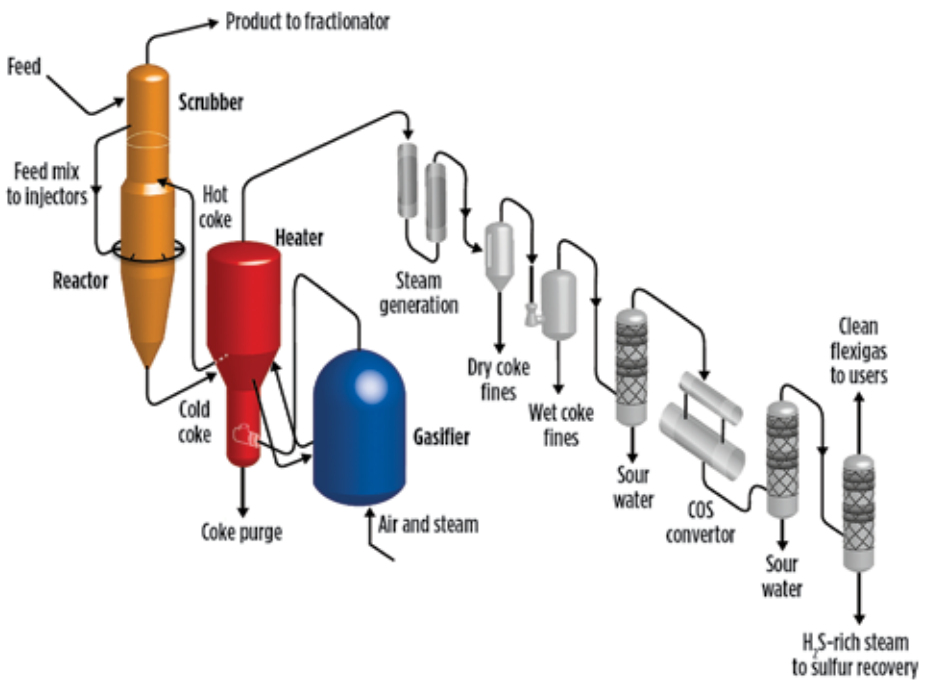


FIG. 1. Depiction of process flow resulting from FLEXICOKING™ technology implementation.

FIG. 2. ExxonMobil's FLEXICOKING™ technology unit at the Hellenic Petroleum Elefinsa refinery.

Process description. FLEXICOKING technology utilizes a low-pressure process that integrates fluid bed thermal coking with a fluid bed steam and air coke gasification. The feed is converted to high-value, full-range liquid products, conventional fuel gas and a carbon monoxide (CO)/H_2-based fuel gas, referred to as flexigas. Process heat for the thermal conversion and gasification steps is provided by partial oxidation of carbonaceous coke formed in the coking reactor. Most of the coke is gasified, and the resulting gas is desulfurized using ExxonMobil's proprietary FLEXSORB™ technology. The significant volume of clean flexigas can be used in refinery fired equipment for power generation or for other energy needs. FLEXICOKING technology has been commercially proven for more than 40 years with continuous improvements of process and operation (FIG. 2).

Flexigas benefits and utilization. Integration of coke gasification into the fluid bed coking process has multiple benefits:

- **Reduced coke handling and byproduct disposition:** Minimal coke production reduces the requirement for containing and managing the sales or disposal of large quantities of high-sulfur coke produced in the traditional delayed coking processes, or residual bottoms streams produced in hydrogenation processes.
- **Low particulate emissions:** Processing and handling the coke in a continuous closed system minimizes particulate emissions vs. typical coking operations.
- **Plot space:** Conversion of the majority of the coke within the unit reduces the plot area and refinery infrastructure required to manage coke movement and shipping.
- **Operations flexibility:** Coke gasification can be optimized to satisfy operational requirements, such as changes in feed qualities and variations in refinery fuel demand. This flexibility is a critical enabler for a site-wide zero flaring strategy.
- **Low CAPEX**: The low operating temperatures and pressures of the technology allow for the use of low-cost carbon steel with refractory vs. other gasification alternatives. Also, the management of coke transfers in a fluidized system reduces space and material handling costs. Simultaneous gasification and desulfurization reduces costs associated with desulfurization of the resid feed or coke.
- **Environmental benefits:** The flexigas produced in the gasifier burns very clean with ultra-low production of sulfur oxides (SO_x) or nitrogen oxides (NO_x) when consumed in fired heaters or boilers. The lower NO_x is the result of the nitrogen content of the flexigas, which lowers the adiabatic flame temperature during combustion and results in significantly lower NO_x production than natural gas or conventional refinery fuel gas. The sulfur contained in coke is converted to hydrogen sulfide (H_2S) in the gasification reactions. The level of H_2S in the flexigas is controlled to a low level (<10 vppm) through the removal by amine absorption within the unit battery limits.
- **Energy production:** Production of flexigas from coke provides additional energy for use in the refinery and/or to integrate with neighboring facilities, such as power plants, steel manufacturing, cement plants and others, for energy production/gas sales.
- **Economic benefits:** Depending on local market conditions, flexigas can substantially reduce refinery energy cost vs. fuel oil, natural gas or purchased power.

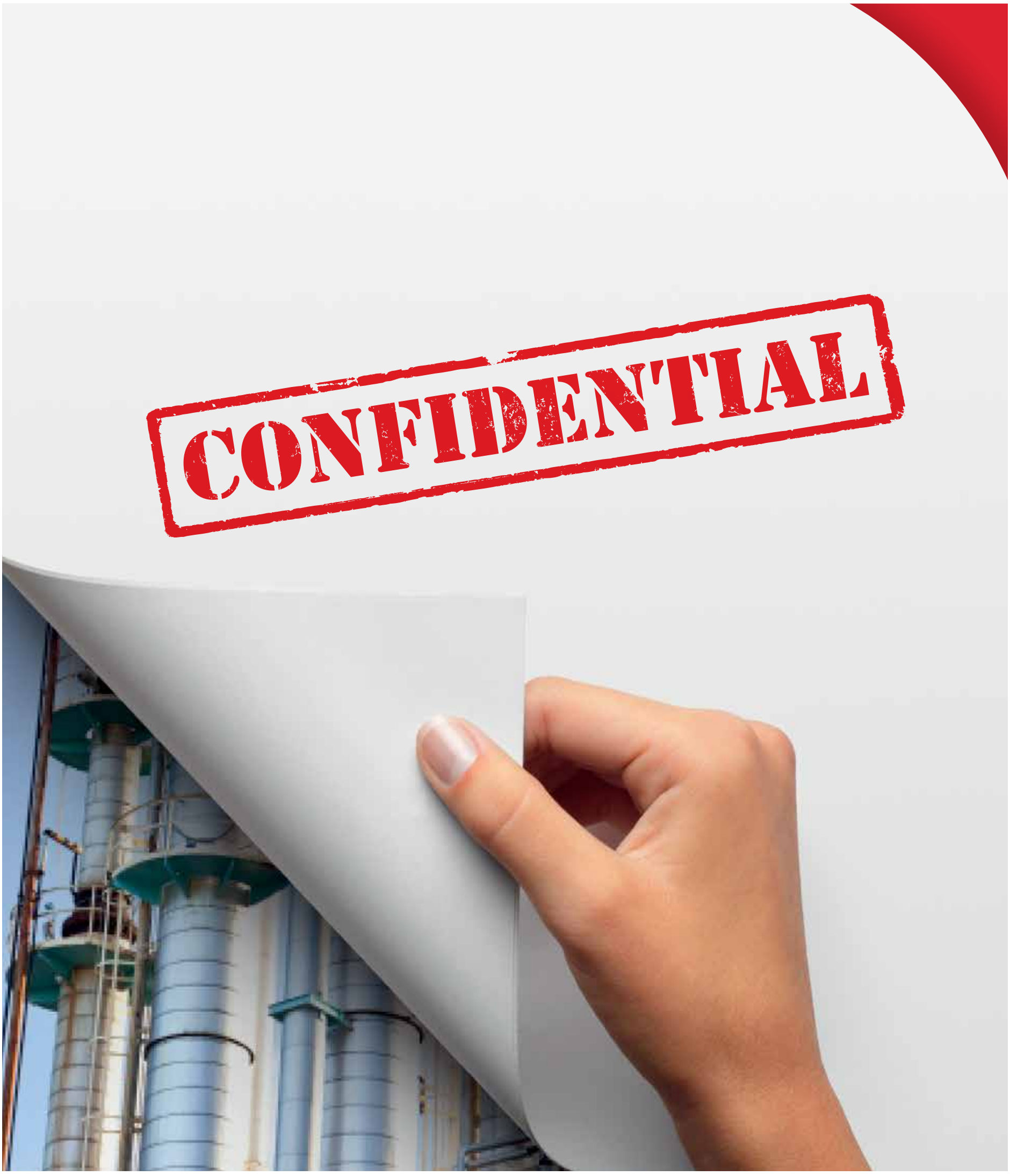
ADVANTAGED RESIDUAL HYDROPROCESSING—SLURRY HYDROTREATING AND HYDROCRACKING

Slurry hydrotreating and hydrocracking provide preferable options for refiners wanting to add heavy oil conversion to their operations. Slurry bed hydrocracking, with the advantage of back-mixing hydrodynamics, has a very high conversion rate compared to other methods of heavy oil processing, especially considering this high conversion is to light products. While many companies are actively developing these type of slurry technologies, long-term unit operability is the key issue in commercial viability.

GTC Technology's GT-SACT℠ process has demonstrated this capability in stable continuous operations. This technology features a full back-mixing slurry reactor with micro-level catalysts, which reaches nearly complete feedstock conversion (up to 98 wt%) and superior light oil yields (92 wt%–95 wt%). GT-SACT achieves this rate with the lowest CAPEX of any associated competing technology.

The one challenge with slurry hydrocracking is the erosion potential when the slurry reactor pressure lets down. The GT-SACT proprietary pressure letdown system (APRS) avoids the severe erosion problems that plague other processes, and ensures long, continuous operation. The robustness and reliability of GT-SACT is proven in commercial use, with continuous planned operation since startup. The commercial unit has shown no signs of coking or plugging in equipment, valves and pipelines, and no erosion of the pressure letdown system, which again has been an issue with other slurry hydrocracking technologies.

GT-SACT can handle a wide range of feedstock: vacuum resid, FCC decanted oil, SDA pitch, coal tar, and more. The hydrocracking process also includes hydrotreatment to ultra-low sulfur level products. This is done at a lower added investment than standalone product hydrotreatment downstream.



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Enclosed combustion equipment and technology

ANU D. VIJ, Ship & Shore Environmental Inc.

The selection of an enclosed combustion solution is a complex process that involves various environmental and operational requirements that are unique for each application. Selecting the correct equipment can produce great benefits and translate into decreased capital and operational costs by preventing the over-design or under-design of the equipment.

Enclosed flares and vapor combustor. Enclosed flares typically operate at approximately 98% destruction efficiency. The vapor combustor can maintain higher temperatures in the chamber, which allows it to maintain a destruction efficiency of up to 99.9%. Residence time is typically around 0.7 sec for these types of combustors.

THERMAL OXIDIZERS

To reach higher levels of destruction efficiency and lower emissions, we can turn to thermal oxidizers (**FIG. 1**).

Direct-fired thermal oxidizers. A direct-fired thermal oxidizer operates through the use of a burner to heat up the chamber to proper oxidation temperatures for the required destruction efficiency. If the process gas has sufficient heat content, it can be used as the fuel gas for the burner. Otherwise, supplemental fuel is required to maintain the combustion temperature.

A recuperative thermal oxidizer is a variation of a direct thermal oxidizer that incorporates heat recovery into the design. Direct-fired thermal oxidizers offer high destruction efficiencies of up to 99.99% and can provide lower emissions of nitrogen oxide (NO_x) and carbon monoxide (CO).

Catalytic thermal oxidizers. This type of oxidizer utilizes a catalytic bed to promote oxidation, lowering the temperature required to oxidize the process gas.

Regenerative thermal oxidizers. This type of system, shown in **FIG. 2,** is used for applications where the combustible concentration is below 3% of the lower explosive limit. Thermal energy is retained by the ceramic media and is then used to heat and oxidize the process gas as it enters the thermal oxidizer. Through this process, a regenerative thermal oxidizer can operate on little to no fuel and achieve 98.5% destruction efficiency and low NO_x and CO emissions.

Selection guidance. When selecting a combustion system, emissions and destruction efficiency have become the primary criteria. A simple enclosed combustor will achieve about 98% destruction efficiency. Up to 99.5% destruction efficiency can be achieved with a temperature-controlled combustor, a regenerative thermal oxidizer or a catalytic thermal oxidizer. Above that, a direct-fired thermal oxidizer or an ultra-low-emissions combustor is required.

Regenerative thermal oxidizers offer the greatest fuel efficiencies, recovering up to 98% of thermal energy. Catalytic thermal oxidizers can also operate at high thermal efficiencies by incorporating heat exchangers to pre-heat the process gas before it passes through the catalyst. Finally, a recuperative thermal oxidizer can be used to pre-heat process gas to increase fuel efficiency, or it can be used to recover heat for use in another process in the plant.

Corrosive components, such as hydrogen sulfide (H_2S) and halogenated compounds, demand systems capable of safely disposing of these components. Typically, once the concentration of any of these compounds reaches a certain level, the safest and most effective way of destroying them is through specially designed direct-fired thermal oxidizers.

With all the different factors that can influence the selection of an enclosed combustion system, it can be difficult to determine where to start. In general, the decision factors should prioritize process gas composition, followed by emissions, and finally fuel efficiency and capital costs. Proper selection requires that these factors be researched and determined in advance to ensure that the expectations for the equipment are in line with operational requirements. Armed with this information, the descriptions in this article can provide a starting point for equipment selection to ensure that the final decision achieves the requirements for the application. ●

Anu D. Vij is Chief Operating Officer (COO) of Ship & Shore Environmental Inc. Mr. Vij has more than 20 years of experience in the environmental, chemical, petrochemical and air-pollution-control industries, and has specific expertise in thermal oxidation technologies. As COO, he oversees several business units, including sales, finance, engineering, project management, procurement, production and services. Prior to joining Ship & Shore, he served as Vice President, enclosed combustion systems at Aereon, and was Director of engineering at OnQuest Inc. Mr. Vij holds a BS degree in chemical engineering from Panjab University in India, and an MS degree in chemical engineering from the University of Southern California.

FIG. 1. Thermal oxidizers are differentiated from conventional combustors because they use excess oxygen to complete oxidation reactions at a suitably high temperature.

FIG. 2. Regenerative thermal oxidizers capture the heat from oxidation, which is retained by a ceramic media and is then used to heat and oxidize the process gas.

NEXANT ESTABLISHES E&CA TEAM IN HOUSTON

Nexant, a global consultancy to the energy and petrochemical industries, has established its Energy and Chemical Advisory (E&CA) team in Houston, a global center for the process industries. The US Gulf Coast contains the greatest concentration of process and engineering companies in the world and Nexant actively works with most of these companies and financial interests, with active projects in the following areas:

- Monitoring construction and progress as independent engineers
- Engagements for multiple methanol, fertilizer, cracker and derivative facilities
- Assessments of commercial and emerging technologies for both conventional (gas processing, refining and petrochemicals) and renewables (wind, solar, bio-based, MSW conversion, etc.)
- Market analysis for all fuels and primary/derivative chemicals
- In-depth NexantThinking reports on process industry metrics and markets.

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The impact of Spectre and Meltdown on industrial, critical infrastructure

CHRIS GROVE, Indegy

Spectre and Meltdown are two newly discovered vulnerabilities that affect hardware running in the majority of the world's computing devices. Just about every machine with a modern processor is impacted, ranging from workstations and servers to phones and tablets.

This includes Microsoft Windows, Linux, Android, Google ChromeOS, Apple macOS on Intel and ARM processors. Most Intel chips manufactured after 2010 are vulnerable, while many AMD, ARM and other chipsets are also affected.

Spectre and Meltdown are different, but related. Spectre comprises two vulnerabilities: CVE-2017-5753—bounds check bypass, and CVE-2017-5715—branch target injection; while Meltdown consists of one vulnerability: CVE-2017-5754—rogue data cache load.

These vulnerabilities make systems susceptible to what are called "side-channel" attacks, which rely on physical hardware implementation and do not directly attack the logic or code. These types of attacks generally include things such as tracing electromagnetic radiation (i.e., TEMPEST), monitoring power consumption, analyzing blinking lights, cache analysis, etc.

FIG. 1. Spectre and Meltdown are two newly discovered vulnerabilities that affect hardware running in the majority of the world's computing devices. They have generated coverage in mainstream media due to the sheer number of systems they have impacted.

Since IT, IoT and IIoT devices are widely prevalent and infrequently updated, the presence of vulnerable devices may remain in production environments for generations.

The impact of the hack. These vulnerabilities do not grant access to the system; they only enable attackers to read data that should otherwise be restricted. In other words, an attacker still needs to break into the system to execute the attack.

While this might sound encouraging, it is actually a critical concern in systems with multiple users, where data from one space of memory belonging to a user should still be isolated from others.

Simply put, in shared or multi-tenant environments (virtual, cloud, etc.), strict barriers must exist between users, or any cloud customer could access data belonging to other customers sharing the same CPU.

The same compartmentalization occurs within applications, which also must be isolated from each other. For example, a web browser should not have direct access to data the Windows operating system uses to store passwords or other sensitive information.

Every operating system implements multiple levels of security to prevent this behavior from happening, including Windows UAC, SELinux and more. For that reason, the Spectre and Meltdown vulnerabilities may not be as bad as you think, particularly if you are not a cloud user.

Breaking down Spectre and Meltdown in layman's terms. Imagine, for a moment, that you have been newly bestowed with Spectre Meltdown Mindreading Capability (SMMC), which gives you the "power" to read someone else's mind, as long as you are both in the same room, and you have been granted permission to enter that room. You now have access to data, secrets, and confidential or sensitive information.

In a nutshell, Spectre and Meltdown (FIG. 1) are effective in a multi-tenant room where more than one person's/company's secrets must kept private. However, executing an attack in a room with only one owner is pointless, since technically, no secrets are present. As long as you are the only person who will ever occupy the room, your data is safe, even though you are still vulnerable to attack.

Receiving major media coverage. Spectre and Meltdown have generated coverage in mainstream media due to the sheer number of systems they have impacted. While nearly everyone owns a device that is vulnerable to attack, this does not necessarily mean that they will be impacted by the bug itself. Sometimes, as in the case of the Microsoft patch, the cure causes the pain, rather than the attack itself.

Another example is the impact of the Meltdown/Spectre patch on Rockwell FactoryTalk, which resulted in outages on FactoryTalk servers. As of now, the patch has not yet been tested by Rockwell, and is not approved for use on any FactoryTalk systems.

The mitigations are still being debated: a few have negatively impacted performance, rendering systems unusable and creating other problems that are still being resolved by various vendors and user communities. Some patches are no longer available to the public, and have yet to be re-issued.

The impact on industrial control systems (ICSs). ICS environments encompass different types of equipment, including:

- Windows workstations (engineers)
- Windows servers (DNS, AD, etc.)
- Linux servers (historians, firewalls, automation systems)
- PLCs
- HMIs
- Switches.

Almost all ICS networks are vulnerable to attack. Whether or not a specific device is at risk depends on multiple factors, such as chipset, firmware level, etc. Needless to say, substantial research and patching in the near future can be expected..

Many HMIs, panels and displays utilize the affected chips. Some PLC manufacturers are still assessing the threat. Many systems that support industrial controllers—such as automation systems, batch control systems, production control servers, printers, OPC systems, SCADA systems, peripheral devices and IIoT devices including cameras, sensors, etc.—are most likely vulnerable.

How can Indegy help mitigate these vulnerabilities? Being aware of what exists in an ICS environment is critical to securing it successfully. An automated asset inventory is essential to understanding which equipment is at risk and requires attention.

Next, having in-depth visibility into an asset inventory is vital. Without this, you are left with a list of industrial devices that must be manually examined to determine whether their specific hardware module is affected.

An automated ICS asset inventory is key to identifying vulnerable assets and tracking patching efforts. An industrial cybersecurity solution such as Indegy automatically gathers this information from industrial devices and makes it available in its asset inventory.

To exploit vulnerabilities, an attacker needs access to the network. This emphasizes the importance of having a network monitoring system that enables the identification of anyone connecting into the network, or communicating with or modifying key assets.

Patching vulnerable systems in industrial environments. Patching systems in ICS environments is by no means a trivial process, as these systems are often required for ensuring the safety and stability of industrial processes. Indegy assists organizations with the patching process in two ways:

1. **Monitoring patching progress**—Indegy enables you to see which systems have been patched, and which ones are still vulnerable. If a system is mistakenly not patched, Indegy will bring this to your attention.
2. **Monitoring personnel and systems involved in patching**—Chances are that multiple people will deploy various mitigations/patches, firmware updates, etc., on a variety of platforms, ranging from workstations to servers, PLCs, HMIs and IIoT devices. This may result in a number of individuals, in a variety of roles, from different organizations, potentially entering your production environment. How will you know what each person is working on? Can any of their activities cause disruptions to your industrial processes? What about usage of unmanaged third-party laptops that may be compromised, or cases where remote connections are opened to enable the needed work? All of these can expose industrial systems to undesired threats.

With Indegy, you can monitor ICSs safely as employees and external contractors come and leave the plant, or when they connect and disconnect from your network. The platform enables you to track all activities and get real-time alerts on any unauthorized or suspicious activities.

Indegy empowers you to confirm that your mission-critical ICSs have not been touched by any unauthorized users, and that no mistakes were made while attempting to update your systems. ●

Chris Grove is Director of industrial security at Indegy. He has more than 25 years of experience in cybersecurity. Previously, he managed large-scale data and application security projects for government and defense agencies, law enforcement and the intelligence community.

MOTION INDUSTRIES TO OPEN PACIFIC NORTHWEST DISTRIBUTION CENTER

Motion Industries Inc., a leading distributor of maintenance, repair and operation replacement parts and a wholly owned subsidiary of Genuine Parts Co., will open a new distribution center in Auburn, Washington in late spring 2018.

Enhancing the company's logistical network, the new distribution center will serve 24 area Motion Industries branch locations daily, as well as the entire Motion Industries North American footprint (500+ locations), as needed. The 62,000-ft^2 distribution center will stock and ship a broad range of industrial parts and supplies, including bearings, power transmission products, fluid power components, electrical parts, safety supplies, and more.

The new facility will complement Motion's existing, primary North American distribution centers in Birmingham, Alabama; Tracy, California; Chicago, Illinois; Baltimore, Maryland; Dallas, Texas; Edmonton, Alberta; and Lachine, Quebec. ●

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IHS Markit: Oil's eroding monopoly as transport fuel redefining refiners' future

MELISSA A. MANNING, IHS Markit

Oil's dominance as a transportation fuel will decline by 2040, as the convergence of disruptive technologies, government policies and new business models usher in a new era of multidimensional competition, according to a new research initiative by IHS Markit, a world leader in critical information, analytics and solutions.

According to the study, "Reinventing the Wheel," a new multi-client, scenarios-based research initiative by IHS Markit, the competition between the internal combustion engine (ICE) and electric vehicles; the disruptive force of "mobility-as-a-service" (MaaS), such as ride-hailing; and the much-anticipated emergence of autonomous vehicles will lead to more profound changes in personal transportation than have been seen over the past century combined.

A shift from buying cars to buying "mobility" will be a driving force of change in the automotive future, the study says. By 2040, vehicle miles traveled (VMT) will have grown to an all-time high of around 11 B mi/year (a 65% increase since 2017) in China, Europe, India and the US—the key markets examined for the study—and will keep growing. At the same time, sales growth of new light-duty vehicles will slow substantially.

"Oil's monopoly as a transport fuel will erode as a new era of multidimensional competition takes hold. However, oil will remain a major player," said Jim Burkhard, Vice President, oil markets research at IHS Markit. "Many of its advantages as a fuel, such as its high energy density, will persist. The size of today's automotive ecosystem will moderate the pace of change."

Vehicle fleets. Market share for cars primarily powered by gasoline and diesel will still account for 62% of new cars in 2040 in the four major key markets (down from 98% in 2016), with a total of 54 MM new vehicle sales in 2040, according to the study's baseline scenario. In this scenario, global oil demand still rises from 98 MMbpd today to 115 MMbpd in 2040 (the study also explores a more radical scenario in which oil demand in 2040 is less than it is today). However, gasoline and diesel fuel consumed by the light-duty vehicle (LDV) fleet declines by 2040, as indicated in **TABLE 1.**

The dominance of the full internal combustion engine will fade, the study asserts. ICE vehicles still comprise a majority of new car sales in 2040, buoyed by sales of mild to full hybrids, which still rely primarily on ICEs. However, cars powered solely by gasoline or diesel will have fallen below 50% of new cars sales by 2031.

Higher fuel economy and emissions standards, and the reduction in gasoline's share of new vehicle sales will lead to a decline in aggregate gasoline demand in key markets during the 2020s, the study says, although overall oil demand will rise.

"A great 'automotive paradox'—where more travel via car than ever, but fewer cars will be needed by individuals—will be a defining quality of the new automotive future," said Daniel Yergin, IHS Markit Vice Chairman, Pulitzer Prize winner and Project Chairman. "The shift is just beginning. By 2040, the changes in transportation will be accelerating in a way that will be visible on roads and highways around the world. The pace and degree of this dynamic shift will have significant implications for industry, for public transportation systems and for how people get to work, live their lives and spend their money on transport."

The continued emergence of MaaS providers will be among the most important and disruptive forces in the future, the study says. The MaaS industry is expected to purchase more than 10 MM cars in the study's key markets in 2040, compared to just 300,000 in 2017.

The move toward EVs. Electric vehicles (EVs)—defined as both plug-in hybrid electric vehicles and battery electric vehicles—will account for more than 30% of new cars sold in key automotive markets examined for the study by 2040, up from just 1% of new car sales in 2016. A key tipping point will be battery pack costs, which are expected to decline to a price point in the 2030s that will make EVs cost competitive with ICE vehicles, the study says.

The change in the use of liquid transportation fuels as the automotive industry moves toward EVs will also affect the chemical industry, said Anthony Palmer, Vice President, chemical consulting for IHS Markit. "As the demand for gasoline and diesel fuel used in light-duty vehicles weakens, more refinery products will be available to serve as chemical feedstocks. Such a shift will encourage investment in naphtha crackers in the growing Asian demand centers, including China and India."

The research initiative includes the industry-leading expertise of the company's energy, automotive and chemical teams to provide a first-of-its-kind, system-wide analysis of the new reality of transportation. The project focuses on the world's largest automotive markets: the US, Europe, China and India, a large and fast-growing market. For more product information about "Reinventing the Wheel," please contact Anthony Palmer at Anthony.Palmer@ihsmarkit.com. ●

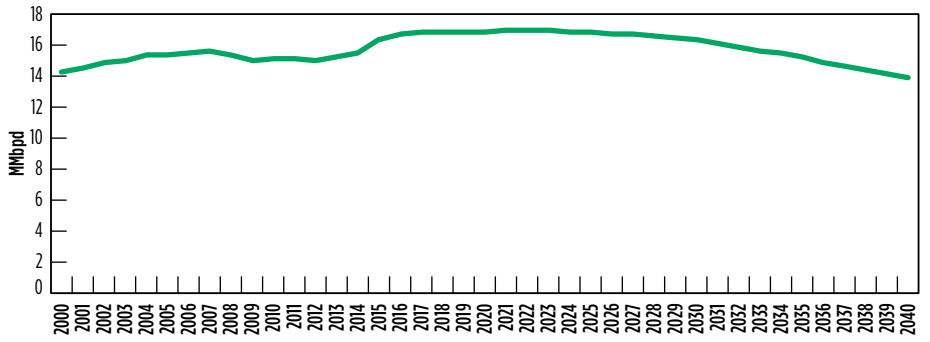

FIG. 1. Energy demand from LDVs: Gasoline, diesel, biofuels, hydrogen and electricity.

Achieve longer run lengths through increased activity and improved stability

JOHN CUNNINGHAM, Advanced Refining Technologies (ART)

Refiners demand higher activity catalysts as global sulfur specifications continue to tighten. Advanced Refining Technologies (ART) continues to expand its portfolio of ultra-high activity catalysts to meet oil refiner's needs: the DX® Catalyst Series has demonstrated superior performance in ULSD applications; 425DX and 545DX catalysts continue to excel in middle distillate after worldwide acceptance; and, responding to the need to balance feedstock flexibility, cycle length and product flexibility, ART has developed its newest catalysts, ICR 316 and 548DX. The addition of ICR 316 and 548DX allows refiners to process tougher feeds, meet tighter specifications, improve product quality and expand capacity.

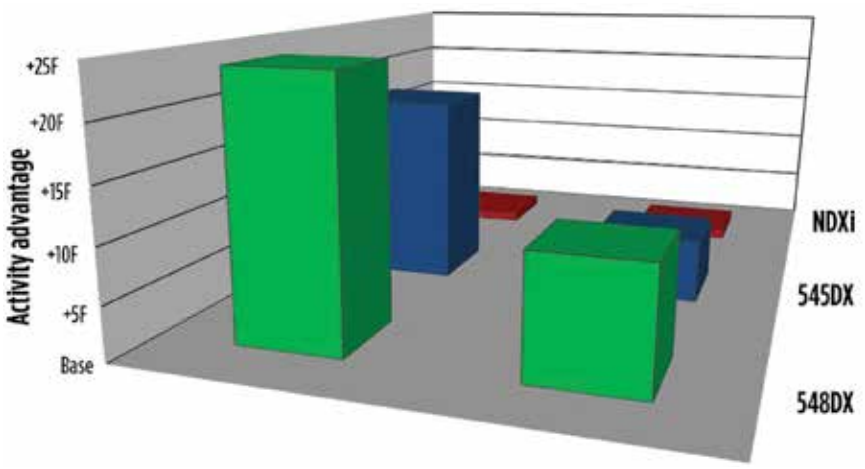

FIG. 1. 548DX offers significant advantages in HDS and HDN activity in high-pressure ULSD testing (1,000 psig).

ICR 316 and 548DX catalysts capture advancements in alumina technologies made by the ART research team. Innovations in surface chemistry and new pore structures provide a significant boost in HDS, HDN, and HDA activity, with improvements exceeding 20% in some applications. Chelate enhancements also make each catalyst more robust and forgiving for startup.

ICR 316. ICR 316 offers improvement opportunities to diesel hydrotreating units, demonstrating benefits on both straight run and cracked stocks, and at low and high operating pressures. In a comparison to its predecessor, 425DX, in a ULSD protocol using a feed containing 15% cracked stocks, ICR 316 shows a clear activity gain in both low- and high-pressure applications, enabling refiners to process more opportunity feedstocks and increase hydrotreater cycle length.

548DX. 548DX utilizes ART's newest technology in advanced chelate enhancement and alumina surface modification to provide the highest activity for HDS, HDN and HDA, making it ideal for use in both ULSD and other applications. It is commercially proven and in use in units around the world. High-pressure ULSD testing reveals a substantial improvement for both sulfur and nitrogen removal (**FIG. 1**).

▶ See **ART,** page 21

Better Adapt To Changing Conditions

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Compressor improvements turn refinery benchmarks into real savings

CHRISTIAN PRINZ, HOERBIGER

Poorly performing reciprocating compressors interrupt refinery production and drain maintenance budgets. The good news is that effective benchmarking and affordable investment can create real savings, even for decades-old compressors.

How do you translate refinery performance benchmarks into plant-level improvements that boost profits? Reciprocating compressors are a good place to start. Essential to most refineries, notably in hydrotreating and hydrocracking, recips too frequently cause wasted energy and lost production.

With new ways to benchmark and improve the performance of reciprocating compressors, it is possible to slash the costs of unplanned shutdowns, energy and maintenance.

A 2015 study showed that the effectiveness of a refinery's operation and maintenance is more or less independent of its age. The same is true of compressors. Even on old recips, the elements that define performance—valves, cylinder rings, packings, lubrication and control systems—can almost always be upgraded to the best modern standards, with payback in just a few months.

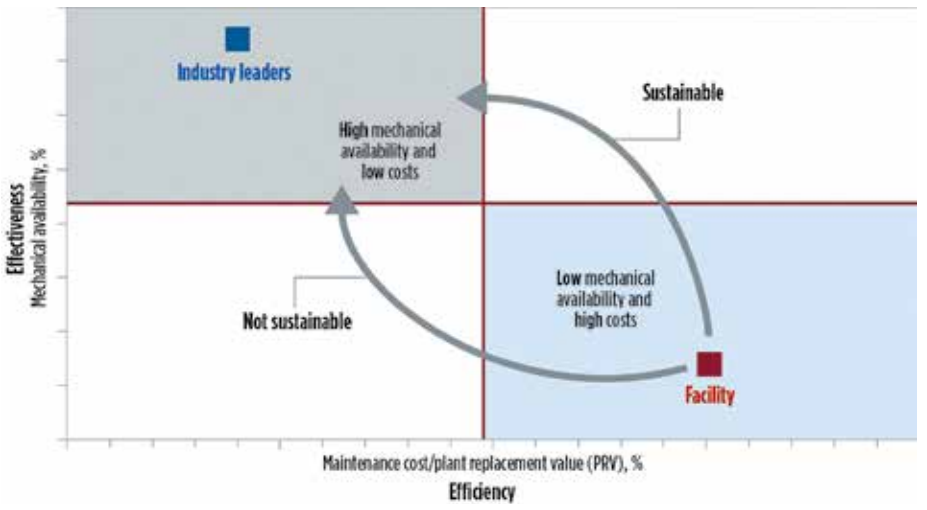

FIG. 1. Effectiveness vs. cost efficiency at the refinery level. Sustainable improvement requires boosting reliability while cutting maintenance costs. [Source: Paul Kennedy, Solomon Associates, Asian Refining Technology Conference (ARTC)]

Understanding compressor DNA. What we want from a compressor is sustainable operation: high reliability, efficiency and environmental soundness, coupled with low maintenance costs (FIG. 1).

Successful benchmarking means a detailed understanding of each compressor and its relationship to the process—its DNA. This lets us break the cycle in which the same fault recurs time and again.

The path to best performance starts from a detailed understanding of the compressor and the plant within which it operates. Without that insight, long-term performance is unlikely to improve.

HOERBIGER has developed an audit technique known as reliability, efficiency and environmental (REE) soundness that creates straightforward benchmarks to guide investment decisions.

HOERBIGER auditors assess the compressor's DNA from a complex mixture of factors including its duty, age, mechanical condition, components and maintenance routine. The auditors distill this into a numerical score for each of the three REE axes, and ultimately a single score for the whole compressor. The lower the score, the greater the potential for improvement.

From scores to savings. The next step is to predict the savings achievable through upgrades. The HOERBIGER auditors do the calculations, but return on investment (ROI) and the customer's business preferences are the deciders.

Where appropriate, HOERBIGER even offers performance contracts (PX Plan™) that pay for upgrades through performance improvements; if an upgrade does not deliver, it is HOERBIGER that loses out.

Hardest to estimate, yet potentially yielding the biggest savings by far, is a reduction in the cost of lost production (LPO) through improved compressor reliability.

With flexibility at a premium, many units are at full capacity and standby compressors may not be

available. In one example, it is assumed that losing one compressor cuts output to 70%. However, reducing the number of unexpected trips from two to one per year can save an estimated $444,000.

Beyond curtailing lost production, electricity consumption presents the next-largest opportunity. **FIG. 2** shows that fitting stepless capacity control gives by far the largest reduction in power use, though upgrading to the best modern valves, rings and packings shows increased savings, as well.

Recycling 20% of the compressor's output through a spillback valve is not uncommon, even when clearance pockets are fitted. Here, fitting a modern stepless capacity control system can save more than $218,000/year on our 2-MW compressor. **FIG. 3** shows how stepless reverse-flow control systems, such as HOERBIGER's HydroCOM and eHydroCOM, save energy by compressing only the gas that is actually needed.

Case studies. Two refinery case studies show the practical benefits of improved compressor performance. In one refinery, three hydrogen (H_2) units were upgraded with stepless capacity control. As well as the expected energy savings, overall capacity rose by 5%–10%, thanks to the ability to operate with good control right up to the rated capacity of the compressors. Process reliability has also improved.

As a result, in 2016 the refinery reported an OPEX savings of approximately $1.7 MM, thanks to stepless capacity control.

At another refinery, unexpected valve failures were halting the compressor on a continuous catalytic reforming (CCR) unit. Even with a standby unit, the unplanned shutdowns caused significant losses.

The refinery decided to change the valves to HOERBIGER's profiled plate design. This increased the average runtime between shutdowns from 2 mos to 12 mos, with valve lifetime expected to exceed 24 mos. The refinery reports annual OPEX savings of $961,000. More generally, compressor improvements following a rigorous REE audit can save some $763,000/year for a typical refinery H_2 compressor.

The savings from reduced maintenance are relatively small, yet still useful. More significant are the electricity savings from improved capacity control and reduced valve losses.

The most paramount results are found in the savings created by reducing lost production. When an upgrade can double the compressor's mean-time between failures (MTBF), the knock-on effect on the rest of the plant cannot be ignored. •

Christian Prinz earned his degree in mechanical engineering from the University of Applied Sciences in Mittweida, Germany. Beginning in June 2000 with HOERBIGER, he was responsible for project execution of compressor control and monitoring solutions for upstream and downstream applications. After two years as team leader in R&D, he moved into a global KAM role for EPCs and process licensors, and headed the marketing department of the Strategic Business Unit, Compression Technology. Since 2016, Mr. Prinz has been responsible for the global product management and sales of HOERBIGER services and solutions for reciprocating compressors.

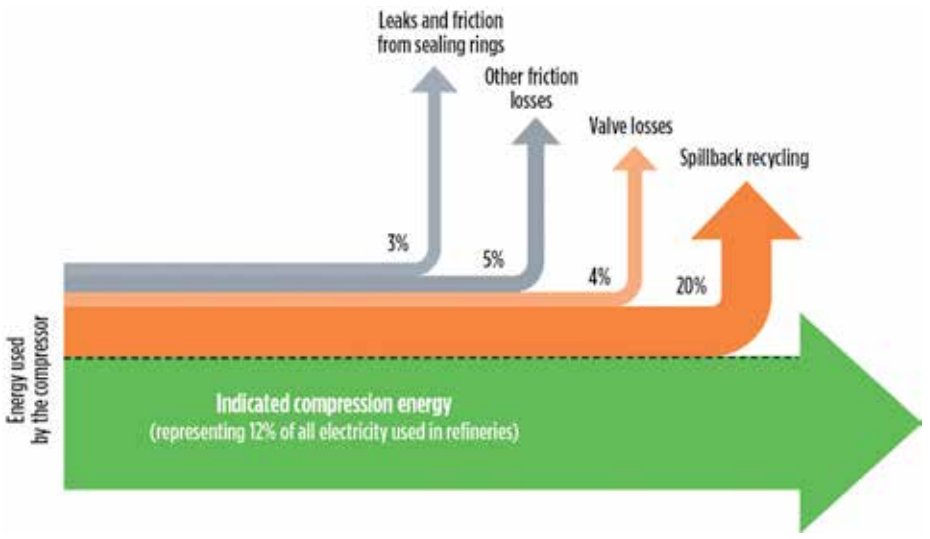

FIG. 2. Reciprocating compressors account for 12% of all electricity used in refineries. For compressors that rely on spillback valves to control capacity, the energy wasted in recycling dominates potential efficiency improvements.

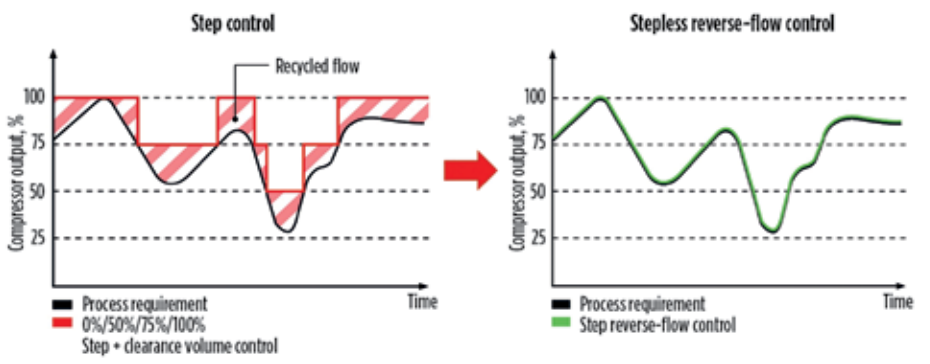

FIG. 3. Stepless reverse-flow control can save up to 25% of energy compared to conventional 0/50/75/100% step control systems. With step control, all the compression energy represented by the shaded areas is wasted.

Flare monitoring regulatory compliance requires analyzers

SCOTT EDDLEMAN, Yokogawa

In 2016, the US Environmental Protection Agency (EPA) finalized its refinery sector rule on maximum achievable control technology (MACT) regulations, and gave refineries 18 months to comply with the requirements for flare monitoring. The rule, 40 CFR 63 Subparts CC and UUU, affects any refinery with a flare used as a control device for an emissions point, and those refineries must be in compliance by January 30, 2019.

Analyzers that can be used to meet portions of the regulations include a Wobbe Index or Btu analyzer, a gas chromatograph and a mass spectrometer.

Wobbe Index analyzer. Wobbe Index (WI) or Btu analyzers are widely used in refineries to measure Btus and hydrogen (H_2) in various processes, and to analyze the quality of fuel gases. The analyzer is a calorimeter that burns a sample to measure the oxygen content in flare gas and calculate the WI, which defines the heating value of gas expressed in Btus/scf.

A Wobbe analyzer provides an instantaneous reading of Btus, so it easily meets the requirements for a 15-min. response time. However, because it measures only Btus, it can only indicate that the flare is at, above or below the limits. It does not measure any other components, so it cannot provide any information on why a problem may exist.

FIG. 1. A gas chromatograph, such as these Yokogawa GC-8000s, analyzes components in flare gas.

Gas chromatograph. Refineries use gas chromatographs (**FIG. 1**) to analyze many different process streams, so refinery personnel are quite familiar with their operation, a major advantage of this technology. Some of the leading applications include component level concentration measurements, compositional analysis of finished products, or analysis mid-process.

A gas chromatograph (GC) measures components of the flare gas via a flow-through tube, called a column. As the flare gas sample passes through the column, it reacts with a column filling, called a stationary phase, which separates the gas into various compounds. Each compound exits the column at a different time, where it is detected and identified. Measurement data can be calculated to provide Btus, critical for flare gas monitoring.

While a GC provides a great deal of information about gas composition, it can be slow to provide this data. In fact, it might not meet the 15-min. response time rule, depending on the number of components and their composition.

So, to meet the requirements for flare monitoring, a GC may need to be tuned to analyze only certain groups of components. For example, a GC might only analyze for methane (CH_4), H_2 and carbon dioxide (CO_2). After analysis, it produces a chromatogram, showing peaks and a baseline for each component.

Mass spectrometer. Refineries are not typically familiar with mass spectrometers, so a plant's engineers and technicians would have to learn this relatively new technology. A mass spectrometer has an ion source, a mass analyzer and a detector. The ionizer converts the sample into ions, which are sent to the mass analyzer and the detector. The detector calculates the value of each ion in the sample to determine the quantity of each ion present, and provides Btu data.

A mass spectrometer is an expensive, complex analyzer, but it offers two advantages: a mass spectrometer can analyze 30 components in about 12 sec, easily meeting the 15-min. response time rule; and a mass spectrometer can be configured to handle multiple streams.

Since a refinery typically has multiple flares that require monitoring, a single mass spectrometer could handle multiple flares—depending, of course, on the distance from the flares to the analyzer. A stream-switching system could direct samples from each flare to the mass spectrometer on a rotating basis.

TABLE 1 summarizes the cost and design considerations for each of the three types of measurement. ●

Scott Eddleman has 20 years of analytical experience, including three years with Measurementation as a Quality/Test Manager for analytical integration, and 16 years with Yokogawa as a Quality Control Manager, Engineering Manager and Operations Manager. His present role with Yokogawa Corporation of America is as Analytical Sales Manager for North America.

TABLE 1. A comparison of analyzers that can be used to meet portions of the EPA regulations

Parameter	Wobbe Index	Gas chromatograph	Mass spectrometer
Response time	Instantaneous	Varies, can exceed 15 min.	12 sec
Components monitored	Btu, H_2	Up to 10 (limited by response tine)	30
Approximate installed cost	$215,000	$164,000	$245,000
Refinery familiarity	High	High	Low
Reliability	High	High	Mid
Operating cost	Low	Mid	High
Calibration requirements	Low	Mid	High
Maintenance requirements	Low	Mid	Mid

KEYNOTE, continued from page 1

culture that explains what you are all about," the Editor recommended. The most adaptable cultures are organized as triangles of equally strong sides, with the lines representing strategy, execution and values. A company's most critical problems will always be execution issues, Mr. Karlgaard said, while values represent a "soft edge."

A third adaptability factor is the preservation of small working teams at an everyday working level. Mr. Karlgaard cited Jeff Bezos' rule: "Working teams should be small enough that no more than two pizzas can feed them!"

It is important to limit the number of connections and size of teams to eliminate those employees Mr. Karlgaard referred to as "slackers, assassins and those who subtract from the team rather than add." "Everyday working teams can get too big, too fast, and a company may not even realize it," he said, "So keep your team as lean as possible."

The fourth adaptability must-have is human development. Mr. Karlgaard advised attendees to hire for talent, character and culture, as a means of developing the best organization possible.

Partnerships between refiners and automakers. Following Mr. Karlgaard's keynote, Vice President of Global Propulsion Systems for General Motors (GM), Dan Nicholson, spoke about GM's perspective on the future of automobiles, particularly the internal combustion engine.

Mr. Nicholson noted the importance of talking about how the automotive and refining industries can work together to keep their relationship strong. The automotive industry, in particular, is changing at an unprecedented pace, which will require all stakeholders to be coordinated and make changes together. "Collectively, we must ensure that consumers benefit while our industries remain strong," Mr. Nicholson said.

New technologies in the automotive sector include improvements to driving safety, fuel efficiency and internal combustion engines; shared mobility services; and the electrification of vehicles. These changes, Mr. Nicholson explained, are shaping the way customers think about and interact with automobiles. He quoted GM Chairman and CEO Mary Barra, saying, "The automotive industry will change more in the next five years than it has changed in the last 50 years."

GM is working to rapidly adopt new technologies. The automaker is improving propulsion system efficiency with downsized turbocharged engines that will reduce losses without sacrificing power and torque. Also, new multispeed transmission technologies are being designed to improve fuel economy while reducing cost.

Dynamic fuel management is another technological breakthrough. New GM trucks coming out in the summer of this year will be able to run on zero to eight cylinders, in any combination, to improve fuel efficiency.

GM is also combining higher octane with new engine designs to meet fuel economy targets while providing better value to consumers and society. It is working to extend the horizon of internal combustion engines using liquid fuels, while providing consumers with vehicle affordability and performance.

Collaboration between the refining sector and the automotive sector is imperative, Mr. Nicholson said, and it must be done in a way that makes sense for consumers. It is not advantageous for industries to be working on separate efforts, as this creates confusion. The industries must be coherent in their efforts to develop new fuels enabling improved engine efficiency, customer value and environmental benefits. "The window of opportunity is open right now, and it won't stay open for long," he urged.

Mr. Nicholson also addressed the subject of vehicle electrification, saying, "There is a general assumption in the electrification movement that liquid fuels will remain how they are today, without any improvements." However, he pointed out that the EIA's 2018 *Annual Energy Outlook* forecasts that gasoline vehicles will remain the dominant vehicle type through 2050 in the reference case.

In closing, Mr. Nicholson said, "Many facets of the traditional automotive business are changing quickly, and we believe that this creates exciting new opportunities. Rather than fear this change, we at GM are leading it." ●

GM Vice President of Global Propulsion Systems, **DAN NICHOLSON,** spoke about General Motors' perspective on the future of automobiles, particularly the internal combustion engine.

Is steam system instability affecting plant performance?

NEDA FELORZABIHI and **JEFFREY FENG,** KBR

A steam dynamic study identifies and addresses the following issues: the configuration of steam control, including logics, controller setpoints and tuning constants; the size and number of letdown stations; the ramp-up rate of boilers; load-shedding strategies; the requirement of the steam management system to minimize energy consumption and to prevent cascade trips; and operational procedures for safe startup, shutdown and turndown.

Case study. A petrochemical plant experienced significant downtime due to steam system instability (FIG. 1). Minor disturbances in the steam system often led to cascade trips of multiple units. Also, the process engineering team identified that some steam disturbances occurred when starting up the plant and during upset conditions, resulting in delays and, in some cases, a complete blackout of the plant.

To understand the mechanisms causing the trips and to determine effective remedial measures, a steam dynamic study (SDS) was performed by KBR for the plant to identify and recommend modifications required in control systems, logic/tuning parameters, valves, etc., to prevent potential plant shutdowns due to upsets and trips in the steam system. Additionally, operator intervention was further minimized to accomplish the safe and steady operation of the whole plant, and to determine if any further improvements could be made to reduce the instances of these plant/steam disturbances. A steam dynamic study typically takes 2 mos–4 mos, depending on the complexity of the system.

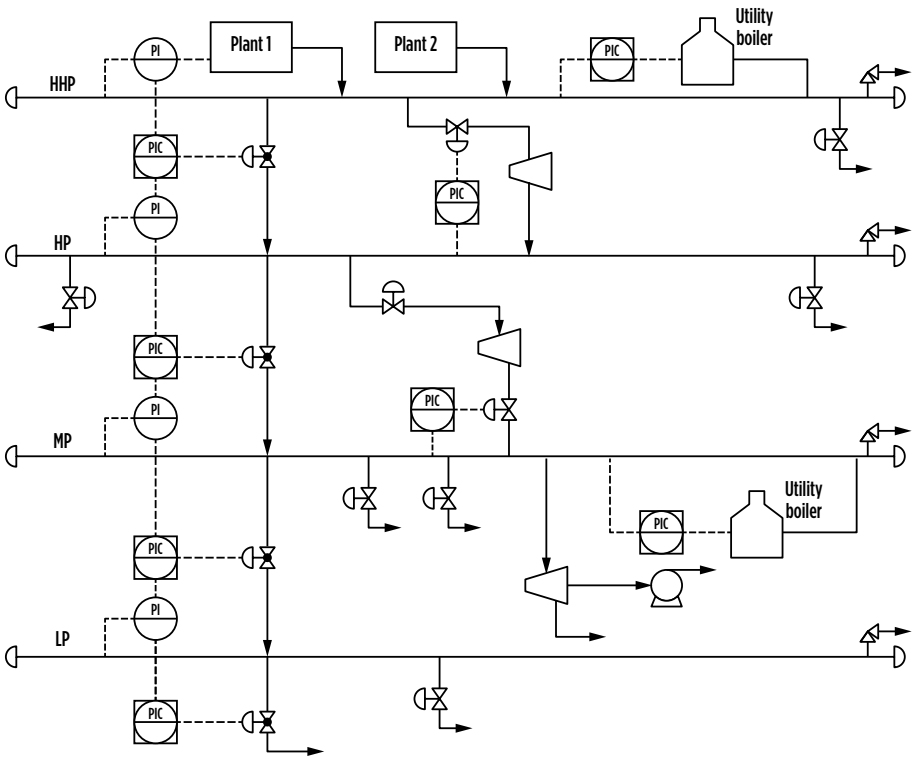

FIG. 1. A typical steam system.

The work scope included the development of a dynamic model for the entire steam system with major steam producers, users and a control system; evaluation of the interactions in the steam system; and a determination of the proper control tunings and load-shedding strategy to prevent a cascade trip of the facility during transient and upsets.

Model features include:

- Rigorous modeling of equipment, piping and controllers based on as-built design
- Validation against plant data and past trip events
- Detailed implementation of control logics and operator actions.

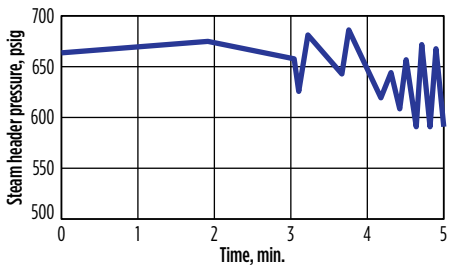

FIG. 2. Steam header pressure before the simulation study.

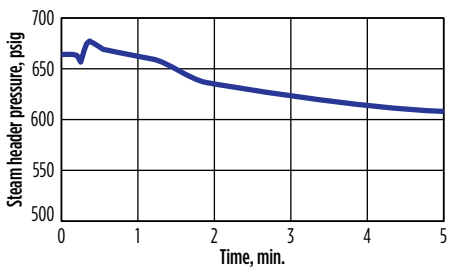

FIG. 3. Steam header pressure after study recommendations.

Simulation cases. The following scenarios were designed for the steam study: a boiler trip, a trip of a steam turbine driver, a steam turbine generator trip, a trip of a large unit, and plant startup and shutdown.

Study results. Summaries of the study results are shown in FIGS. 2 and 3, which show the steam header pressure before the simulation study (FIG. 2), and the steam header pressure after the study recommendations (FIG. 3).

FIG. 2 shows a large fluctuation of steam header pressure when a turbine driver was tripped, as well as a plant trip on low header pressure in less than 5 min. Following the study recommendations, FIG. 3 illustrates stable header pressure during transition, and the plant remained in stable operation.

The major benefits achieved in this study included:

- The prevention of multiple cascade trips after the modifications
- Improved plant uptime by about 10 days in a year. ●

AFPM testifies to Energy subcommittee on NAFTA and future of energy trade

On December 13, 2017, AFPM President and CEO Chet Thompson provided testimony to the House Committee on Energy and Commerce, Subcommittee on Energy in a hearing titled, "The Impacts and Future of North American Energy Trade." Mr. Thompson's verbal testimony is included here.

"Good morning, thank you Chairman Upton (Rep. Fred Upton—R-Michigan), Ranking Member Rush (Rep. Bobby L. Rush—D-Illinois) and members of the subcommittee for the opportunity to testify today.

"AFPM represents 97% of the nation's refining and petrochemical manufacturing capacity, including 118 refineries and 248 petrochemical facilities in 33 states. We support more than three million US jobs and add $568 B each year to the US economy.

"Our members make the gasoline, diesel, jet fuel and petrochemicals that make modern life possible.

"We are the world's largest refining industry and a global leader in petrochemical production, making us the backbone of global manufacturing and transportation. Our energy trade relationships with Canada and Mexico are critical to enhancing our position.

"I would like to expand on a couple of the points from my written testimony.

"First, Canada and Mexico are helping us achieve North American energy security. Although US crude production has increased dramatically over the last decade, our refineries still import, on average, 8 MMbpd of crude. Canada and Mexico combine to supply nearly half of this volume.

"In fact, Canada is the largest supplier of crude oil to the US, supplying more than 3 MMbpd, or 41% of all imports. Mexico supplies 600,000 bpd, our fourth-largest supplier at 7%.

"Not only do we import from our neighbors, but we export a substantial amount of energy, as well. The US exports more than 5 MMbpd of petroleum products, about one-third of which went to Canada and Mexico last year.

"Mexico is the largest export market for US refined products. Last year, we exported almost 14 Bgal of petroleum products to Mexico. This helped to meet more than half of their gasoline demand, and contributed to an $11-B energy trade surplus with Mexico.

"Likewise, we exported almost 9 Bgal to Canada. Together, exports to Canada and Mexico have gone from essentially zero in 1995 to more than 1.4 MMbpd of petroleum products. That's about 7% of our total refinery production, and about a third of our exports just to those two countries.

"As a result of our increased energy production and the increasingly integrated North American energy market, the International Energy Agency (IEA) now projects that North America will be energy secure by 2020. This is good for our country and American consumers.

"We also export a substantial volume of chemicals to both Mexico and Canada. Trade in all chemicals has more than tripled over the last two decades, from $20 B in 1994 to $63 B in 2014.

"Secondly, North American energy trade is growing our economy. Our relationship with Canada and Mexico has made our energy industry strong, and that strength attracts investment. Indeed, right now there is more than $185 B in committed investment to growing our industries.

"With that investment comes the need for more employment and a strong workforce. Demand for skilled labor positions is expected to grow by 12%

▶ See HEARING, page 20

Inline density sampling system for continuous pipeline operation

The Dynatrol® Red Goose v2 Circulator combines with the CL-10HY v2 Density Sampling Cell to provide accurate SG, API or density measurement in flowing pipelines. Originally developed for areas where pumps cannot be used, the Red Goose uses product velocity to sample petroleum products from pipelines at flowing conditions. No pump is needed to circulate a stream of gasoline, diesel fuel, jet fuel or other refined petroleum products through the CL-10HY v2 Density Sampling Cell.

Units are rated for 600# ANSI class (1,480 psig), and the required velocity of product can vary upwards from 2 ft/sec. The Red Goose Circulator can accommodate any diameter pipeline, provided a 2-in. ball or gate valve with 5 in. of clearance is installed (**FIG. 1**). The retractable "scoop" is interchangeable for a right-to-left or left-to-right flowing pipeline.

The latest improvement to the Red Goose focuses on easy maintenance. The Red Goose v2 is designed for a unique "through-valve" mounting installation. Complete maintenance of the CL-10HY v2 Density Cell and Red Goose v2 is enabled by retracting the "scoop," closing the valve and relieving pressure via the bleed valve. This allows the Cell and Circulator to be isolated or removed from the pipeline without interruption to pipeline operation.

Also, the Red Goose v2 Circulator's retractable scoop may be used during pigging or scraping operations; removal during pipeline pigging maintenance in unnecessary. If the scoop is not retracted, a spring-loaded pivot will allow the pig to push the scoop out of the way without damage. As the pig passes, the scoop pivots back into place and the product sampling can quickly resume.

The threaded, retractable scoop mechanism of the Red Goose v2 Circulator is double-sealed with a Teflon® bushing and tapered pressure cap fitting. The 1,480 psig-rated stainless-steel sampling tube of the CL-10HY v2 is double sealed by an 8-in. diameter housing. No auxiliary pump is required for operation, and this eliminates a source of leaks and the need for an AC power supply, making the unit ideal for remote installations.

The design features of the Dynatrol v2 Density System with Red Goose Inline Circulator help address challenges facing the everyday operations of the pipeline transmission industry.

Specifications include:

- Pressure ratings of 1,000 psig and 1,480 psi
- Double-sealed protection against leaks
- Temperature rating of 0°F–250°F (–17°C–121°C), consult factory for other options
- Housing is rugged, sealed, all-weather, X-proof
- Meets CSA Class 1, Div 1 area classification.

The DYNATROL® Division is part of Automation Products Inc. ●

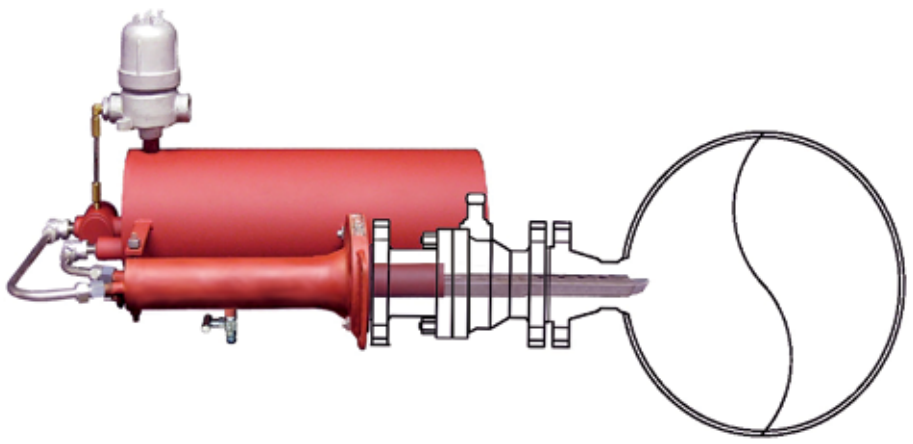

FIG. 1. The Dynatrol Red Goose uses product velocity to sample petroleum products from pipelines at flowing conditions.

PORVAIR FILTRATION GROUP ACQUIRES KEYSTONE FILTER

Porvair Filtration Group has acquired Keystone Filter, a division of CECO Environmental Corp (CECO). Keystone designs and manufactures a range of filter cartridges and housings for the chemical process, food and beverage, and drinking water markets in the US.

Porvair Filtration Group is a leader in the development and supply of high performance, innovative materials and solutions for applications in filtration and separation. The group manufactures in both the UK and the US.

For more than 50 years, Porvair has delivered world-class performance to the most demanding of environments, including chemical and industrial processes, energy, OEM, aerospace and defense, and nuclear. ●

Honeywell UOP continues to advance the technologies of the future

LEE NICHOLS, *Hydrocarbon Processing*

As AFPM's Annual Meeting kicked off with a well-attended opening reception, one of the highlights of the night was Honeywell UOP's customer appreciation dinner. The invitation-only event featured more than 150 oil and gas professionals from some of the most notable and well-respected companies in the hydrocarbon processing industry.

The dinner was held in the historic Orpheum Theater in the Central Business District of New Orleans. The theater, which has a vertical hall design, was constructed in 1918 to host vaudeville acts. Throughout the decades, the facility began to include films, concerts and performances from the Louisiana Philharmonic Orchestra. The ingenuity in the event hall's design provides perfect sight lines and acoustics for attendees. Although flooded during Hurricane Katrina, the theater was restored to its original design in 2015.

The stunning locale is a testament to the flavor and culture of the city of New Orleans, a theme that resonated with attendees of the Honeywell UOP event. As they entered the venue, guests were greeted by the swinging sounds of a New Orleans brass band (**FIG. 1**). An opening reception allowed business associates and old friends to mingle before taking their seats for dinner. Rebecca Liebert, President and CEO of Honeywell UOP, gave opening remarks. She first thanked Honeywell UOP's customers for the opportunity to participate in their projects and operations through technology licensing and/or providing catalysts.

She also stressed that the relationships Honeywell UOP has formed with downstream producers have provided the company with direction on developing new technologies that the industry and consumers want and need.

"We are fortunate to speak with operators and colleagues in the industry on a regular basis, because it gives us an objective view of where the industry is headed," Ms. Liebert said. "It helps us decide how to direct our investments in research and to determine what technologies we need to develop. At UOP, we spend heavily and carefully on research and development. For example, in 2017, 38% of our revenue came from technologies and products we introduced in just the last five years."

FIG. 1. The sound of true New Orleans jazz welcomed Honeywell UOP guests to the renowned Orpheum Theater.

REBECCA LIEBERT, President and CEO of Honeywell UOP

Staying ahead of the curve. The ability to stay in front of major trends is imperative to increasing revenues and market share. However, ambiguity remains around new regulations that will have significant effects on the industry—such as the Renewable Fuel Standard and the International Maritime Organization's Global Sulfur Cap regulation.

"The Renewable Fuel Standard is still presenting uncertainty," continued Ms. Liebert. "However, one company last year made a huge bet in favor of renewables—again with our technology. In many regions of the world, our customers are planning for the impacts of the new MARPOL (International Convention for the Prevention of Pollution from Ships) regulations. The move toward low-sulfur fuels threatens to strand millions of barrels of capacity outside the US, and that could affect diesel markets in the US."

The IMO announced its new global sulfur cap on marine vessels in October 2016. The regulation calls for the reduction of sulfur content in marine fuels from 3.5% to 0.5%. The new standard, which will affect more than 50,000 ships worldwide, will go into effect in 2020. How the refining and shipping industries will respond is uncertain. The three main options for compliance include burning a low-sulfur, compliant fuel; installing scrubbers in marine vessels; or burning an alternative fuel, such as LNG. The most likely scenario, especially at the start of the new regulation, is that shippers will burn a low-sulfur, compliant fuel to adhere to the new rule. Penalties for non-compliance, which will be a subject for debate throughout the year, have yet to be decided.

Petrochemicals. Another area of tremendous growth is within the global petrochemicals sector. "Demand for petrochemicals is growing three times faster than fuels—primarily due to growth in developing economies," Ms. Liebert said. "The US is emerging as a major petrochemicals exporter."

Due to the shale gas boom, the US petrochemical industry is in the midst of one of the largest industry expansions to ever occur in North America. Total capital expenditures in capacity expansions, upgrades, plant restarts and greenfield facilities have eclipsed $135 B.

One of the largest impacts on the US petrochemical industry will be from the construction of new ethylene capacity. According to *Hydrocarbon Processing's* Construction Boxscore Database, the US will add more than 10 MMtpy of new, grassroots ethylene capacity by the end of the decade. An additional 1 MMtpy of ethylene capacity expansion projects are set to conclude by the end of the year. A second wave of new ethane crackers has the potential to add 8 MMtpy of new ethylene capacity by the early 2020s. These projects bring a substantial amount of new ethylene derivatives capacity. For example, the US plans to add more than 8 MMtpy of new polyethylene capacity by 2020, with nearly all of it destined for the export market.

"Investment in petrochemicals capacity has always been cyclical, and prices for them can swing wildly," Ms. Liebert explained. "However, returns on petrochemicals are still higher than on transportation fuels. We will continue to see petrochemical manufacturers integrating upstream into chemical feedstocks as refiners are moving downstream into petrochemicals."

Ms. Liebert posed a question that has resonated throughout the downstream industry: Where do we go from here? "We all know that fuel specifications are getting tighter, which will increase demand for higher-octane fuels that burn more cleanly and provide more fuel efficiency," Ms. Liebert said. "There is a consensus that higher-octane gasoline blends will be mandated by future CAFE (corporate average fuel economy) standards, and we see that through interest in our Platforming technology. Economies of scale are driving interest in enormous, new, integrated refining and petrochemical complexes. In fact, we may even see the day when refineries are built specifically to feed only petrochemical plants."

Continuing her point, Ms. Liebert provided additional remarks on the growth of electric vehicles (EVs). "I spoke recently about EVs, and we think that their numbers will grow, but not as many and not as soon as some people are saying," Ms. Liebert said. "In the near-term, EVs will continue to be hampered by their limitations on range, refueling speed and supply infrastructure. In fact, their biggest competitor will be more fuel-efficient gasoline engines, which will burn more advanced fuels that will be produced—at least in part—by the refiners that are in attendance."

The focus then turned toward the digitalization of the processing industry. "As we head into the future, our industry continues to demand higher asset performance, and better yields and throughput. The solution lies in doing something revolutionary with the reams of data you collect on your plants," Ms. Liebert said. "Honeywell and UOP have developed a Connected Plant service that uses this data to detect emerging problems and their causes by analyzing your data against a library of process knowledge that UOP has developed over the last 100 years. We already have contracts for 29 installations, and this service is delivering operating profit improvements of approximately $20 million per year everywhere it is installed." ●

Reactor internals for naphtha hydrotreaters—an innovative bottom support grid

Haldor Topsoe Inc. and Woven Metals Products Inc. from Alvin, Texas have jointly developed and patented an innovative bottom support grid for gas-phase, fixed-bed catalytic reactors, such as straight-run (SR) naphtha and coker naphtha units. The bottom support grid is also used in hydrogen (H_2) plants in the high-temperature and low-temperature shift and the methanation reactor.

The main advantages of the bottom support grid, which replaces the existing elephant stool, include:

- A pressure drop reduction over the reactor of about 50%
- A reduction in the use of ceramic balls of as much as 75%
- Faster unloading and loading, as the use of large ceramic balls are eliminated
- Easy access to inspect inside the elephant stool and outlet pipe.

Bottom support grid design. The catalyst support grid consists of a modified outlet collector, outlet brackets, outlet connector rods, skirt section and a top grid section that can be wire mesh or profile wire—all of which sits in the bottom of the reactor. Side and top views of the grid are shown in FIG. 1 and FIG. 2, respectively.

Flexible mechanical sealing. The catalyst support grid has been designed without the need to use packing rope or insulation to seal to the vessel wall. A good seal between the support grid and the vessel head performs well over thermal cycles and is critical in preventing support ball or catalyst migration over the life of the grid through many shutdowns.

Top manway hatch. The bottom support grid design includes an inspection hatch located at the top of the outlet collector. This allows access to the outlet collector and outlet piping for inspection during maintenance outages without having to disassemble and remove the entire catalyst support grid or disconnect the external outlet piping fitting or disconnect the external outlet piping fittings.

No-weld installation. A no-weld installation results in no approval requirements from local pressure vessel authorities for modifying equipment. This also results in a lower required installation time, and the catalyst support grids are easily retrofitted to existing vessels. The outlet collector is fitted with three tabs that prevent the grid from shifting horizontally, which would result in an inadequate grid-vessel seal.

Due to the no-weld design, the installation is typically carried out by the catalyst loading contractor. The contractor employees are well-trained and equipped for confined space entry and have experience with numerous catalyst containing vessels.

Performance data. The first generation of the bottom support grid was installed in 2001 and is still in successful operation. Thirty units are now using the bottom support grid, which are all designed for more than 50 years of service.

▶ See GRID, page 21

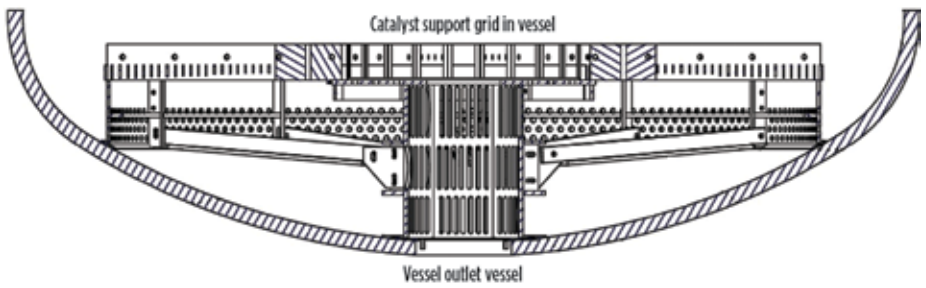

FIG. 1. Side view of bottom support grid in vessel.

FIG. 2. Top view of bottom support grid.

Programming to succeed requires industry experience and insight

SAM MORTON and **PRICE NAQUIN,** SNC-Lavalin

In the oil and gas industry, advancements in the collection of data have created a growing gap between the amount of "usable" data being mined and the increasing amount of data being generated (**FIG. 1**). As the amount of data continues to increase, the challenge to extract usable data to deliver insightful information for projects grows. Certainly, today's programming tools and digital data analytics platforms can help deliver insight more quickly, but they are only part of the answer.

Closing this gap and more rapidly extracting actionable information requires an in-depth understanding of the industry. A programming team that combines industry-specific knowledge with innovative programming talent yields a better understanding of client needs, and thus better solutions.

Oil and gas people who are programmers. For one SNC-Lavalin client, a pressing need was how to manage many "small" jobs simultaneously, including tracking all the details of short-duration jobs, such as facility repairs, changes and upgrades. With hundreds of such jobs each year, the main challenge was tracking budgets for each while also managing all other aspects of job progress.

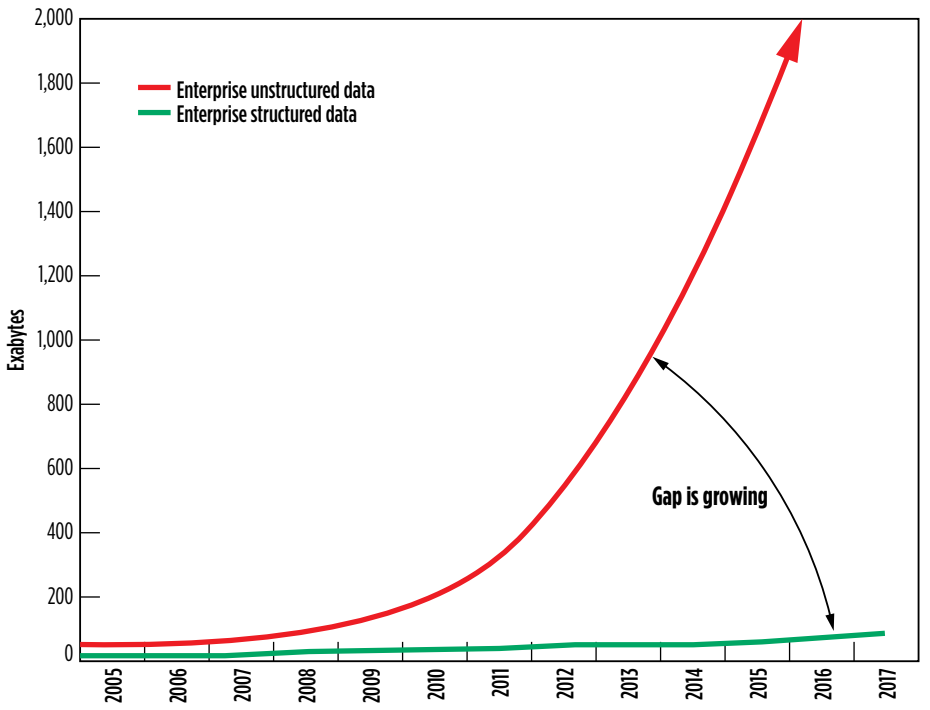

FIG. 1. As the total amount of data continues to increase, usable data takes longer to mine, requiring programming solutions that close the gap by extracting actionable information more quickly.

SNC-Lavalin developed a dashboard solution comprising a dynamic data feed and multiple data points that include scheduling and budget. The dashboard displays a complete job overview in a one-screen view, indicating by red light any "hot spots" in the process that may impact other aspects down the line.

Created and delivered in a matter of just weeks, this solution enabled the client to quickly solve a number of specific project issues and drive improvements to existing processes more efficiently than could have been done previously, due in large part to the industry expertise of the programming team.

For example, a plant that has been in operation for decades has thousands of active drawings, some of which, at any given time, will be needed to complete a specific task. Packaging drawings requires them to first be located, prepared, labeled and otherwise processed before being handed off. For one partner client, this process of checking out engineering drawings was taking as long as three days; SNC-Lavalin identified the issue and supplied a programming solution that cut the time to just 45 sec.

Besides the benefits of freeing manpower to do other things, the ROI on the programming's initial cost is paid for twice over each year in time savings alone.

Specialized industry, specialized solutions. Industry insight allows the SNC-Lavelin team to rapidly develop large-scale solutions, such as the "Life of Plant" database developed for a major customer that allows all users to search drawing revisions and dates rapidly, and drill down to the level of line numbers and document numbers. Fully integrated with the client's network security, the custom solution proved much more cost effective than the prohibitive expense of adapting "off-the-shelf" programs for each site throughout the plant.

Similarly, when an engineer finds a bottleneck or sticking point that cannot be solved by working faster, programming can be rapidly developed in-house to improve efficiency and speed the completion of jobs. Internal solutions that gain efficiencies through automation typically result in greater output for lower cost. In turn, this means greater value for external customers.

Industry experience means that the programming team can ask the right questions—how drawings are packaged, or how a short-duration job will impact operations—when developing engineering support solutions, both for customers and internally. This provides confidence in the solutions.

In addition, part of every solution is assurance that the programming meets international standards for coding, including code writing standards to prevent liability and for securely archiving all data. Holding to these professional standards confirms that all code is vetted, secure and backed up, ensuring the long-term viability of every solution.

By incorporating industry experience into all programming solutions, clients can close the data gap and gain better information, faster. ●

PARKER HANNIFIN SIGNS EFA WITH SHELL FOR INSTRUMENTATION PRODUCTS

Parker Hannifin Corp., a global leader in motion and control technologies, has signed a new four-year enterprise framework agreement (EFA) with Shell for the provision of instrumentation valves, manifolds, process-to-instrument valves, fittings, tubing, protective enclosures and related products. Parker's Instrumentation Group will supply a broad range of process instrumentation products to Shell and its affiliates worldwide.

The Instrumentation Group is dedicated to being the global leader in the design, manufacture and distribution of high-quality, critical flow and ultra-high purity components for the petrochemical, chemical processing, oil and gas, power generation, water analysis, biopharmaceutical, semiconductor and analytical equipment industries.

Parker has invested heavily in innovation, and has made many significant advances in areas including safety, speed of installation and maintenance, and lowering emissions. The company's new products can dramatically reduce the number of potential leak paths in a fluid system technology, and improve ergonomics for instrumentation and maintenance engineers.

Also important is Parker's long experience in designing and manufacturing instrumentation using corrosion-resistant alloys that optimize protection in upstream and downstream environments. ●

HEARING, continued from page 16

by 2024 as we hire additional skilled labor to work as welders, electricians, pipefitters, boiler makers and other similar positions.

"Changes in the global energy markets, advances in technology and legal reforms will provide further opportunities for US companies. For example, the opening of the Mexican energy sector has allowed us to compete and sell our products, leading to billions of dollars of investment by US companies in the Mexican energy sector.

"Finally, AFPM supports NAFTA and believes it helps achieve energy security. North American energy security is the result of plentiful natural resources and the ingenuity of our energy sector. But NAFTA has played an important role, too. Thus, we support its continuation, but think the agreement should be modernized. For example:

- NAFTA's investment protections should be strengthened consistent with other US free-trade agreements, or at the very least maintained.
- Secondly, NAFTA should help increase regulatory coordination and cross-border energy infrastructure.
- Finally, NAFTA customs procedures should be streamlined and modernized to reflect the way modern energy and petrochemical trading moves across borders.

Thank you again for the opportunity to testify today."

On February 25, Mr. Thompson released the following statement ahead of the North American Free Trade Agreement (NAFTA) negotiating meetings in Mexico City.

"US trade representatives must work with their Canadian and Mexican counterparts to ensure that the core tenets of NAFTA facilitating the free flow of trilateral energy trade remain in place. This is a historic trade relationship that bolsters the US economy, encourages investment and is critical to maintaining strong North American energy security.

"Reinforcing ties with Canada and Mexico—two of our most important energy trading partners—is essential to US global competitiveness and the ability of the US fuel and petrochemical industries to support manufacturing and transportation globally.

"Shutting these borders and obstructing the flow of critical products would stall progress here at home and around the world.

"As our trade representatives look to modernize the agreement, they should do so with an eye towards enhancing the protection of American companies operating abroad against theft, discrimination and unfair treatment in investor-state dispute settlements. Doing so will support the ability of US industries to invest and reach new consumers, delivering benefits and goods to our domestic economy." ●

GRID, continued from page 19

A low-temperature reactor (shift catalyst) achieved a 50% reduction in the overall reactor DP.

The bottom support grid was installed without any safety incident, and the installation took about two shifts. On top of the new bottom support grid, a 4-in. layer of ¾-in. ceramic balls and a 4-in. layer of ¼-in. ceramic balls were loaded. The active catalyst was loaded on top of the ¼-in. ceramic balls.

Gas-phase scale catcher. Haldor Topsoe has developed a gas-phase scale catcher for naphtha hydrotreating units prone to pressure drop issues due to iron sulfide (FeS), coke fines or carbon spalling off the tubes in the heater. The scale catcher is installed on top of the tangent line in the head space of the reactor; therefore, it will not take away any reactor volume used for grading and catalyst.

A number of these units have been installed, and a three-to-five time improvement of the cycle length has been seen. The performance of the Topsoe gas phase scale catcher is shown in FIG. 3.

Takeaways. This new innovative bottom support grid reduces the reactor SOR pressure drop, which may be utilized to increase the feedrate, to increase the recycle gas rate or simply to increase the cycle length before a pressure drop in a naphtha hydrotreater becomes a limitation. The faster unloading/loading and insection helps reduce downtime and increase profitability.

If pressure drop limits cycle length, a Topsoe gas-phase scale catcher can solve the issue and significantly increase the cycle length.

This article was written by Henrik Rasmussen of Haldor Topsoe Inc. ●

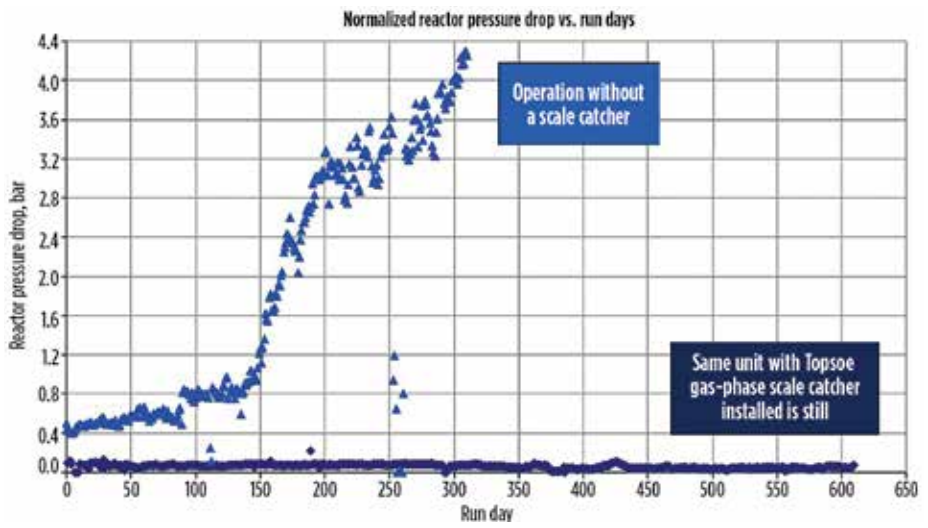

FIG. 3. Pressure drop in a naphtha hydrotreating unit.

ART, continued from page 10

The same ULSD testing protocol also shows a significant boost in aromatic saturation activity for 548DX relative to its predecessor, 545DX. This is readily demonstrated by the significant gains in API gravity and Cetane Index at ULSD conditions. This translates directly into increased volume swell and refinery profitability.

SmART Catalyst System. ART pioneered the combined use CoMo and NiMo catalysts with the introduction of the SmART Catalyst System® technology in the early 2000s. This technology has since become widely accepted as the premier method to fully utilize existing assets within a refinery's individual constraints. FIG. 2 shows how catalyst selection and placement can be tailored to provide the optimum balance of HDS activity and hydrogen (H_2) consumption.

The SmART Catalyst System design is the culmination of an extensive effort toward understanding the chemistry and process conditions required for ultra-low sulfur fuels. ART has devoted significant resources to designing the most active and robust ULSD catalysts for use in the SmART Catalyst System. This effort has led to the recent commercialization of ART's new CoMo catalyst, ICR 316, and new NiMo catalyst, 548DX, which capitalize on the extensive material science and catalyst knowledge encompassed in the ART joint venture. ●

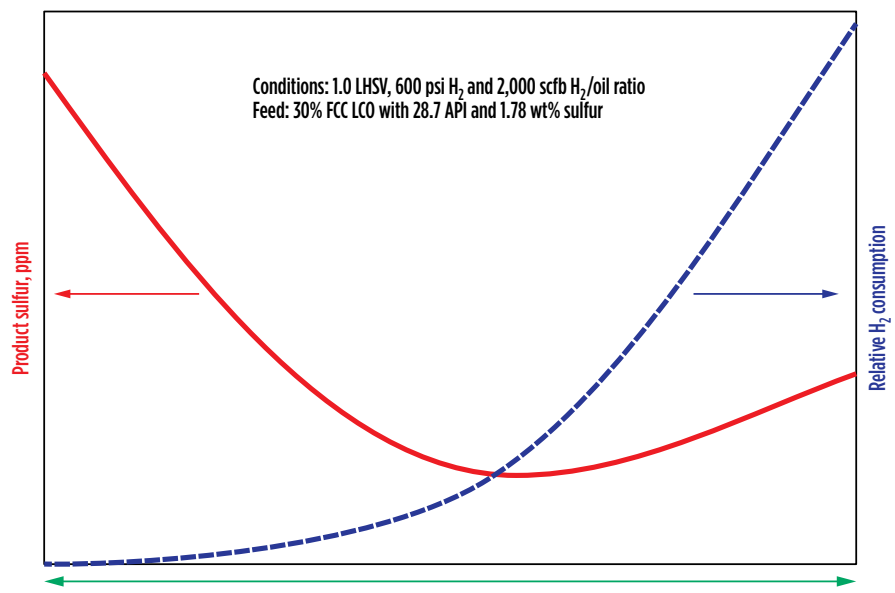

FIG. 2. ART uses its SmART Catalyst System to optimize activity with hydrogen consumption and product quality for maximum refinery profit.

SCENES FROM THE 2018 AFPM ANNUAL MEETING

1 **Michael Palasch, James Norton, Chris Steves, Jim Norton** and **Scott Haydel** (left to right) from Norton Engineering welcomed visitors to the company's hospitality suite on Sunday night.

2 Monday afternoon's Lunch/Tech Talk networking session drew a large crowd to hear the informal presentations on emerging technologies.

3 **Tariq Malik** (left) from CITGO Petroleum Corp. and **Raghu Menon** from The Linde Group shared their expertise with each other at Sunday night's welcome reception.

4 **Daniel Evans** from IHS Markit stepped into a virtual realty training demo produced by METECS in the executive room.

5 After months of planning and hard work, a trio from the capable AFPM team—**Naila Stocks, Colleen LeWallen** and **Yvette Brooks** (left to right)—took the opportunity to relax and unwind at the kickoff for the Annual Meeting. Another job well done by the entire AFPM team.

6 Curious visitors to the **DuPont** Voodoo Lounge were able to have their dolls blessed (or is it cursed?) by a real New Orleans voodoo princess.

7 The Sunday evening reception is always a great opportunity for AFPM colleagues to gather together, begin and renew friendships, and celebrate the opening of another great and informative conference.

8 The first thing that guests saw at **ART** and **Grace's** hospitality suite was a vibrant painting created by local artist Reggie Ford, who created this work of art during ART and Grace's annual AFPM Brunch Sunday morning.

POWERING AHEAD IN 2018

AFPM 2018 Meetings

Annual Meeting
March 11 – 13
New Orleans Hilton
New Orleans, LA

International Petrochemical Conference
March 25 – 27
Grand Hyatt
San Antonio, TX

International Base Oils and Waxes Conference
March 25 – 27
Grand Hyatt
San Antonio, TX

Security Conference
April 23 – 25
Omni Royal Orleans
New Orleans, LA

Labor Relations/ Human Resources Conference
April 26, 27
Omni Royal Orleans
New Orleans, LA

National Occupational & Process Safety Conference
May 15, 16
Grand Hyatt
San Antonio, TX

Reliability & Maintenance Conference
May 22 – 25
Henry B. Gonzalez Convention Center
San Antonio, TX

Cat Cracker Seminar
August 21, 22
Royal Sonesta
Houston, TX

Operations & Process Technology Summit
October 1 – 3
Atlanta Marriott Marquis
Atlanta, GA

Environmental Conference
October 14 – 16
Marriott Rivercenter
San Antonio, TX

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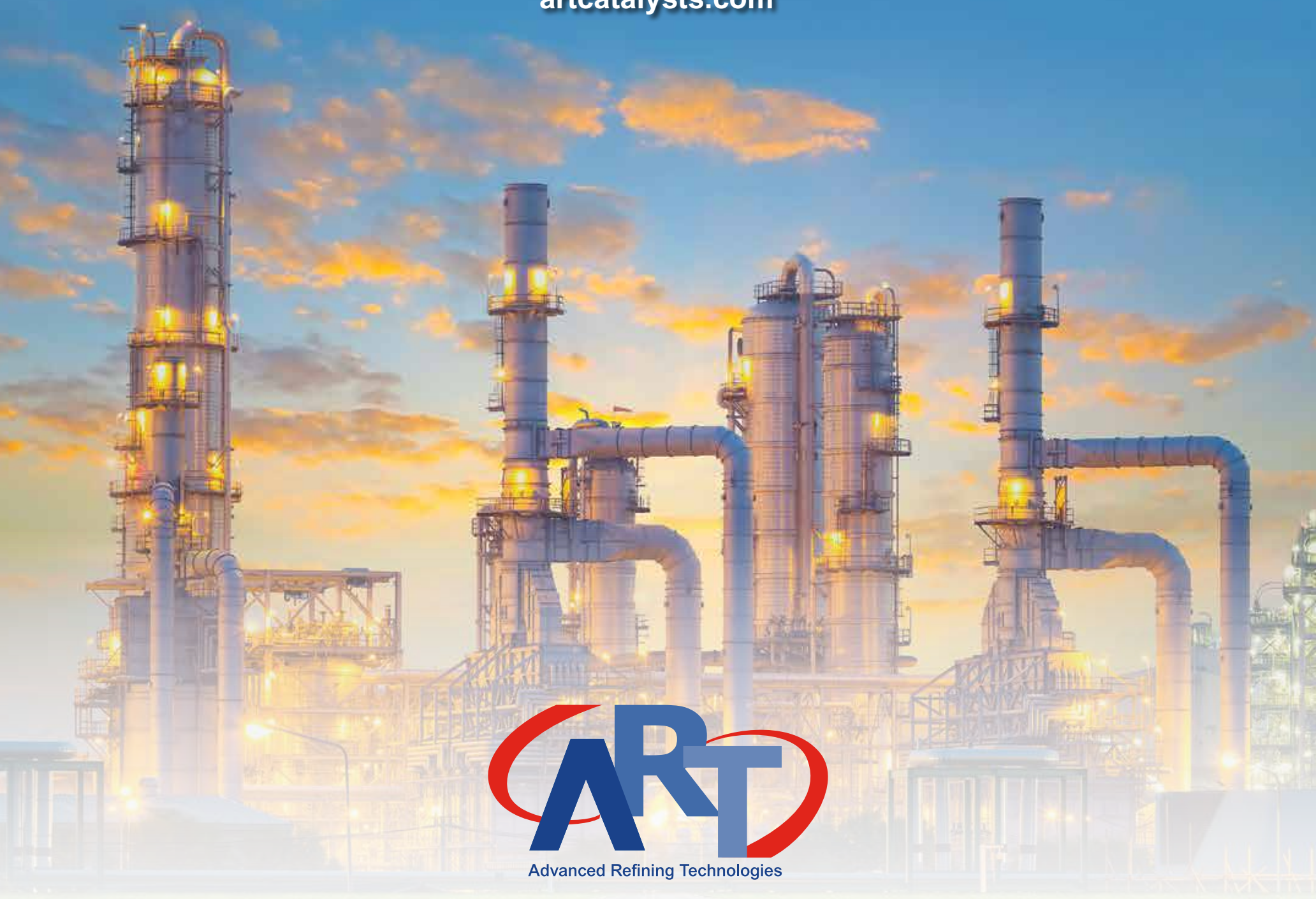

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