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DAY THREE | #AM17
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Merging OT with IT in the name of cybersecurity

ASHLEY SMITH, *Hydrocarbon Processing*

With the advent of technological advances and the interconnectivity that accompanies it, comes the potential for cyber attacks. Gavin Mead, partner at KPMG, explored cybersecurity for operational technology (OT) during a Tuesday morning session at the AFPM Annual Meeting.

While cybersecurity is becoming more prevalent, the expansion into OT has been more recent, even though security issues have occurred in OT for years, Mr. Mead said.

"We've seen an increase in more sophisticated automation," Mr. Mead said, "and increased demands for the data generated by the automation systems into the business world."

OT environments are incorporating custom-made hardware and software from automation vendors, coupled with commodity IT systems.

One thing Mr. Mead has noticed, he said, was the basic communication breakdown between engineering and operations teams and corporate IT.

"The only interaction between those that run the facility and IT is actually held in the sense of 'Hey, corporate IT, send us some servers, but don't put any of your stuff on them,'" Mr. Mead said. "And that's kind of the end of the flow."

The goal is to achieve more intelligent integration, he said. One of the biggest issues seen is air gaps, which are network security measures employed to computers to ensure that the network is physically isolated from other unsecured networks, such as the public Internet. Mr. Mead said that every organization he works with says, at some point, that it is not worried about a specific issue because it has been air gapped.

"It never is," Mr. Mead said. "The air gap has ceased to exist."

Looking at specific IT security issues in control rooms, the large num-

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Gavin Mead, partner at KPMG, discusses how cybersecurity can be implemented into the OT environment, and the challenges companies face in doing so.

RIN obligation: Refiners, blenders or retailers?

ASHLEY SMITH, *Hydrocarbon Processing*

Finding where to put the point of obligation when it comes to Renewable Identification Numbers (RINs) can be difficult to pinpoint, but Mark Broadbent of Wood Mackenzie explained several scenarios and outcomes during a mid-morning session on Tuesday.

Background. Delving first into the background of the US EPA's renewable fuel standard (RFS), Mr. Broadbent explained how RINs came to be.

"RINs stem from the RFS put in place in the Energy Policy Act of 2005, which amended the Clean Air Act," Mr. Broadbent said.

Wood Mackenzie analyst **Mark Broadbent** speaks about RIN obligation, giving three scenarios for point-of-obligation placement and their consequences.

The Act mandated that 5 Bgal of ethanol be used in the gasoline pool in 2006, with increasing amounts through 2012. In 2007, categories of different renewable fuels were established, and targets were raised for the newly established categories.

"Another important thing to note about the law is that it gives the EPA [Environmental Protection Agency] power in certain circumstances to waive the requirements," Broadbent said.

Two circumstances can occur:

- If Congress finds that a severe threat exists to the economy, or to the environment, as a result of the law
- If domestic supply of renewable fuel is inadequate.

Individual refiners can calculate their total renewables obligation by multiplying their total production of gasoline and diesel by the RFS standard percentage, and then adding any carryover from the previous year.

OBSTACLES

Two major obstacles have occurred in the years since the Energy Policy Act was passed:

Cellulosic biofuels. These biofuels have not developed at the speed that Congress expected them to, Mr. Broadbent said. The total amount mandated by the government far outweighs the actual domestic supply produced.

"Congress hasn't adjusted these [targets] down in a way that the waiver can be exercised each year, because there has clearly been inadequate domestic supply," Mr. Broadbent said.

Blend wall. Gasoline demand growth stalled during the recession, Mr. Broadbent said. Most pre-2001 engines were not guaranteed for ethanol blends higher than 10%. As a result of this, retail stations were reluctant to install higher blend pumps due to liability and lack of demand.

The blend wall was first approached in 2013 with a large price spike in RIN prices, Mr. Broadbent said. Congress then reduced the mandates so that compliance could be achieved. Since that time, however, the percentage of ethanol in the gasoline pool has been hovering around 10%.

"The EPA, in their recent rulings,

▶ See RIN, page 8

INSIDE THIS ISSUE

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Language, lies and energy

MIKE RHODES, *Hydrocarbon Processing*

During Monday morning's general session, Mark Mathis discussed the origins of "common terms" that are misleading the public about the essential nature of oil, gas, coal and nuclear power, and his views concerning what the industry must do to educate and change those false perceptions.

"How can we have a rational discussion about the vital energy industry when virtually every word, term and phrase used in describing energy production and consumption is wrong?" he asked.

Mr. Mathis is a well-known documentary filmmaker (*Fractured* and *SpOILed*), author and media consultant. He was first introduced to the energy sector when a client took him to a small refinery.

"To be a competent consultant, I needed to go to school on the oil/gas industry," he said. "I was astonished by how much I didn't know, and how much I 'knew' that was completely wrong. That's when the switch was turned on. I was impressed by how such a valuable resource was turned into products, as well as the importance of those products."

Mr. Mathis discussed how language forms ideas, which then lead to beliefs and the development of a set of rules. As he began examining the words and phrases that are used to describe the energy industry, he concluded that they were most often inaccurate.

He selected "clean energy" as an example. When asked to define this phrase, the general population will almost always indicate wind, solar and renewables. "Here's how I express a real, practical definition of clean energy: A source that provides a substantial, reliable amount of energy and makes the environment cleaner as a result of using it," Mr. Mathis said. "These renewable sources that have been lauded as 'clean' are just not robust enough to come close to supplying the energy our world demands.

"We have been told that energy consumption is bad. The question must be asked, 'What would our lives be like if we didn't have that energy?' Without hydrocarbon energy, most of us would be desperately poor and struggling to survive," Mr. Mathis said.

"Interestingly, most common terms are just innocent mistakes in creating poor definitions. When engineers shortened 'fracturing' to 'fracking,' they had no idea that one day the term would be distorted and used against them by anti-industry activists.

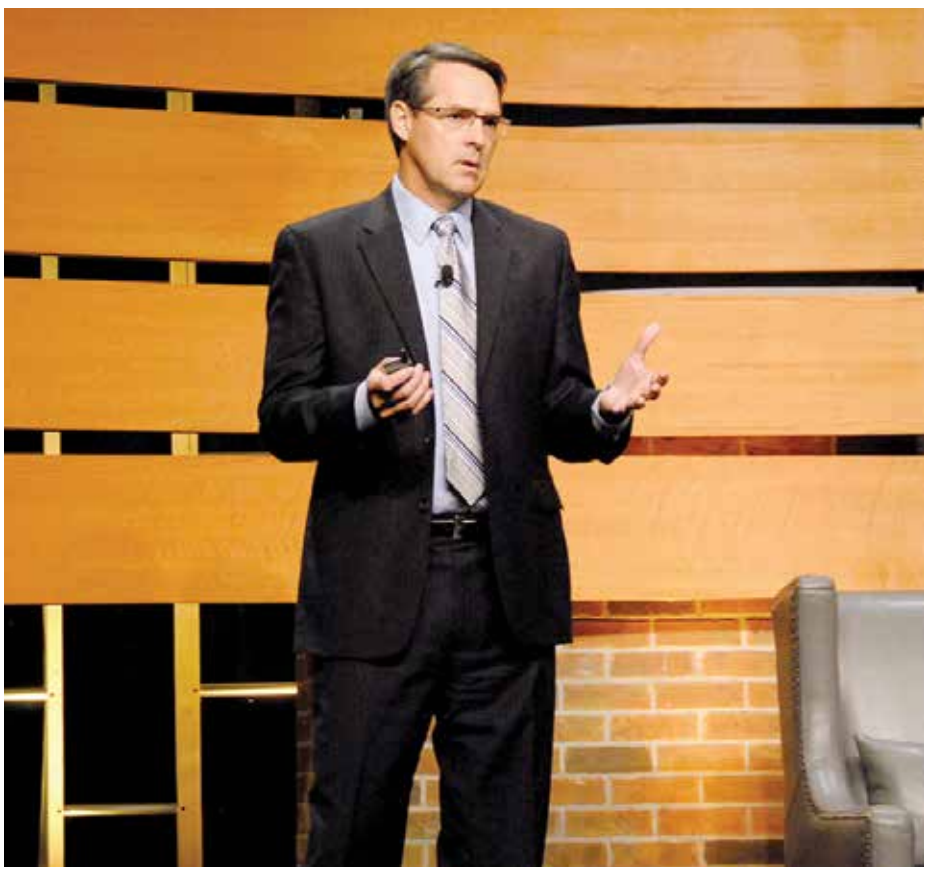
"'Fossil fuel,' 'addicted to oil,' 'alternative energy,'—all of these terms, and others, are misleading," he said. "I don't think there is malevolence in their origins. However, other terms such as 'carbon pollution' and 'climate change denier' are calculated deceptions created by activist groups that are using enormous sums of money to obstruct oil and gas development. The words being used have moved from being inaccurate to downright deceptive."

Mr. Mathis cited examples of the public's misconceptions about energy development. He said that land requirements were an often overlooked factor when discussing energy. To produce an equal amount of energy as a four-acre natural gas facility, a wind farm requires 2,500 acres.

He also commented on the public's "ignorance" of exactly what was created by the refining and petrochemicals industries. In Seattle, Washington, kayakers and boaters formed a blockade as Shell's massive drilling rig left the city to explore for oil in Arctic waters offshore Alaska. Mr. Mathis quipped that what those boaters and kayakers didn't consider is that their boats, the fuel, kayaks, life vests, helmets and clothing were all products of the petrochemical industry.

"So, how do we get the truth out there?" he asked. "The industry must spend a lot more time and energy informing and inspiring its own people. The problem I see is that most companies are not aggressive enough in creating their own ambassadors to carry a positive message outside the industry. Most people are not going to stick their necks out to challenge the propaganda against their industry if they don't feel confident in their knowledge and their ability to competently counter the inaccurate views that are widely held by the public. That is a big reason why I made *Fractured* and *SpOILed*. Our industry must give its people anchor points that are easy to learn and remember, so that the negative 'propaganda' can be challenged."

Mr. Mathis concluded by saying that he sees some companies taking action. He also complimented the AFPM and its members on their efforts and plans to dynamically increase their media engagement. "Our efforts should be focused on educating the public and working to correct the poor definitions that describe our industry." ●



Mark Mathis, speaking at Monday morning's general session, issued a call to action for the industry to challenge the public's misconceptions of energy production and use.

AFPM

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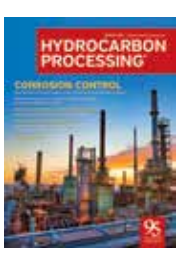

Can US refiners snatch the global bunker crown?

ALAN GELDER, Wood Mackenzie

In October 2016, the IMO Marine Environmental Protection Committee implemented a flue gas emissions requirement that the global shipping sector will be limited to burning the equivalent of 0.5-wt%-sulfur fuels from January 2020. A number of compliance options are available, but, broadly speaking, the market impact of the regulation will be determined by:

- The availability of fuel oil with a sulfur level of less than 0.5 wt% (termed ULSFO) and its associated price
- The penetration of onboard scrubbers, which treat the exhaust gas, enabling HSFO to continue to be used
- Legislative compliance, as this determines the amount of gasoil required by the sector.

The market outlook is uncertain, but a shift away from HSFO to gasoil by the shipping sector will have implications on the global refining system. Fuel oil demand falls, resulting in lower prices, as it must be converted to more valuable fuels by existing spare residue upgrading capacity; and gasoil demand expands, resulting in higher prices as refining margins rise to increase supply while fuel oil prices fall.

Due to the configuration of many USGC refineries, the North American (NA) market should benefit and has the opportunity to assume a larger role in the global bunker market, given its capabilities to be a major supplier of ULSFO components and gasoil. This will require investment in the necessary logistics.

FIG. 1 shows the historical pricing relationships between the regional refining centers of the USGC, Asia (Singapore) and Europe (Northwest Europe, NWE) for fuel oil and gasoil. NWE has a structural pricing advantage for HSFO, as both USGC and Singapore prices have been at significant premiums to Europe. This suggests that shippers would prefer to source fuel oil from Europe, if possible. However, for gasoil, the USGC has the pricing advantage because the region is a significant exporter of diesel/gasoil to the Atlantic Basin. This pricing advantage is evident in its gasoil bunker market share, which was almost 20% for NA in 2016 (over three times its level for fuel oil). Any switch in bunker fuel toward distillate can increase NA's bunker market, as it is one of the lowest-cost providers of such fuel.

Refining implications. The structural shift in demand has implications for the refining sector, shown in a sudden increase in the availability of fuel oil (as demand has fallen) and demand for gasoil.

Our analysis suggests that, in 2020, the global refining system will have sufficient spare capacity within residue upgrading units to process the residue displaced from the bunker sector. NA and Asia both have an opportunity to upgrade additional residue supplies within their existing configurations. For the refining system to process such feedstocks, the price of fuel oil and heavy fuel oil components must fall relative to crude oil. This presents an opportunity for deep conversion refiners, such as those in the USGC, to capture value from processing this emerging "surplus."

Supply of compliant fuels. Aside from the improvements associated with shifting market dynamics, North American refiners have the opportunity to take a larger share of the global bunker market through their advantaged supply of compliant fuels. This will require the development of the necessary port and bunkering infrastructure, with the expectation that NA can punch above its weight in global bunker supplies post-2019 if it focuses on capturing the forthcoming opportunity.

A risk exists that this fuel specification change could be disruptive, but the anticipated market reaction could benefit USGC refiners that have deep conversion/distillate oriented configurations. ●

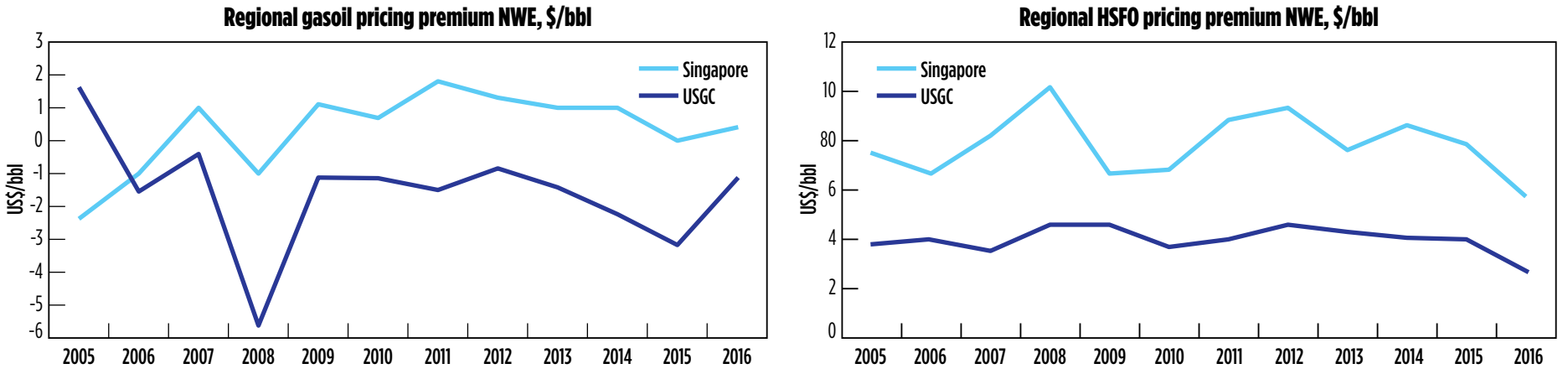

FIG. 1. Regional fuel oil and gasoil pricing differential to Europe. Source: Wood Mackenzie.

CYBERSECURITY, continued from page 1

ber of monitors—all connected to a Windows PC or some other commodity platform—allows for more attack surface, Mr. Mead explained.

Beyond the control room, another unique issue is that control system vendors and other support organizations are changing their business models and how they engage with a company, offering more services on top of the implementation of the technology.

"This is great and really exciting stuff," Mr. Mead said. "However, it also means that data is streaming all the way out of the environment and out to trusted third parties—hopefully, only to those trusted third parties."

As if these considerations were not enough to manage, cyber attacks are only growing worse.

"Hackers are better funded," Mr. Mead said. "They have better tools and techniques and have developed their own criminal-to-criminal marketplace."

In this marketplace, they have software support agreements, Mr. Mead said. A cyber attack organization can buy software written by someone else, with a guarantee and a support number to call if the software does not work correctly.

"This is the evolving, threat actor world," Mr. Mead said. "It's not a 12-year-old in the basement, trying to write their name on the website anymore. They're nation-states; integrated, organized criminals; and real advisories."

Cybersecurity is expected to grow into a $120-B market on the legal side by 2020, Mr. Mead said. The last estimate of costs associated with cybersecurity was approximately $85 B in 2016.

Along with the cost of cybersecurity, a change has been seen in how technology is delivered, both on the IT and OT side—e.g., the Internet of things (IoT).

"The IoT is a complete inversion of the model we spent years building in the control systems world, which was 'None of these will connect outside of my four walls,'" Mr. Mead said.

Putting all of these factors together, the top risk most organizations face is the misallocation and overallocation of funds to cyber risk, driven by fear and spending in ways that are not necessarily helpful.

Four important things must be considered with regard to cybersecurity, specifically within the control systems environment:

- **Shared vocabulary.** Words used in both the IT and OT worlds may have fundamentally different meanings. This is one of the biggest challenges these two groups face in coming together, Mr. Mead said.
- **Moving beyond assessments.** Companies will spend too much money "admiring" the problem, Mr. Mead said. The driving down to a level of specificity in the gap analysis on a plant-by-plant basis, or a practice-by-practice basis, is unimportant because it will not change what a company must do to remediate the issue.
- **Leveraging IT capabilities.** Some IT solutions that have been implemented on the business side are applicable and useful on the OT side, Mr. Mead said. Privileged access management is one example. These tools are able to rotate passwords on servers, broker access and record admin activity. However, IT policies cannot be shifted from business to OT.
- **Tightly governing change.** An organization can spend a lot of money very quickly on cybersecurity, Mr. Mead said. A company can put in a new, intricate system as it exists today; however, every day afterward, it will degrade a little more. Technology is quickly evolving, so realistic expectations must be set on what systems can do.

Mr. Mead is the principal in KPMG's Atlanta office. He has led and executed projects spanning cyber strategy, identity management, large-scale technology transformation and global incident response. On the innovation side, he is responsible for the development of security analytic capabilities, global integrity recovery approaches and cloud security enablement.

Before joining KPMG, Mr. Mead worked for a boutique security consultancy, developing security training, managed services and service methodologies. ●

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Driving octane in an ultra-low-sulfur gasoline market

ANDY HUANG, GARY CHENG, ANN BENOIT and **BOB RILEY,** W. R. Grace & Co.

Over the last two decades, the refining industry has weathered volatile market conditions and increasingly stringent fuel regulations. In North America, refiners are tasked with meeting challenging ultra-low-sulfur gasoline regulations (Tier 3). As more turbocharged vehicles enter the market, the demand for premium, higher-octane gasoline will also increase as automakers begin recommending or requiring the use of higher-octane gasoline.

Tier 3 regulations will create challenges as refiners turn to higher gasoline post-treatment severity for increased desulfurization, which will negatively impact octane. Under new regulations, refiners are required to produce gasoline with an annual average sulfur content of ≤ 10 ppm, with a maximum gasoline sulfur cap at the refinery gate of ≤ 80 ppm. Fluid catalytic cracking (FCC) naphtha is the main "problem stream," as it comprises 40 vol%–50 vol% of finished gasoline volume and contributes 80%–90% of the total sulfur in the refinery gasoline pool.

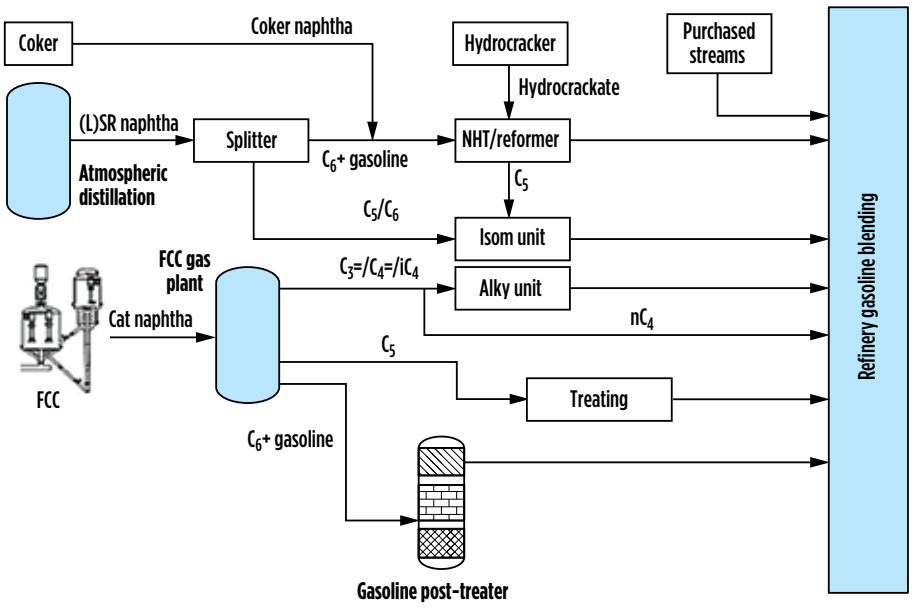

FIG. 1. Simplified refinery naphtha routings. Unit configurations and flows may differ among refineries.

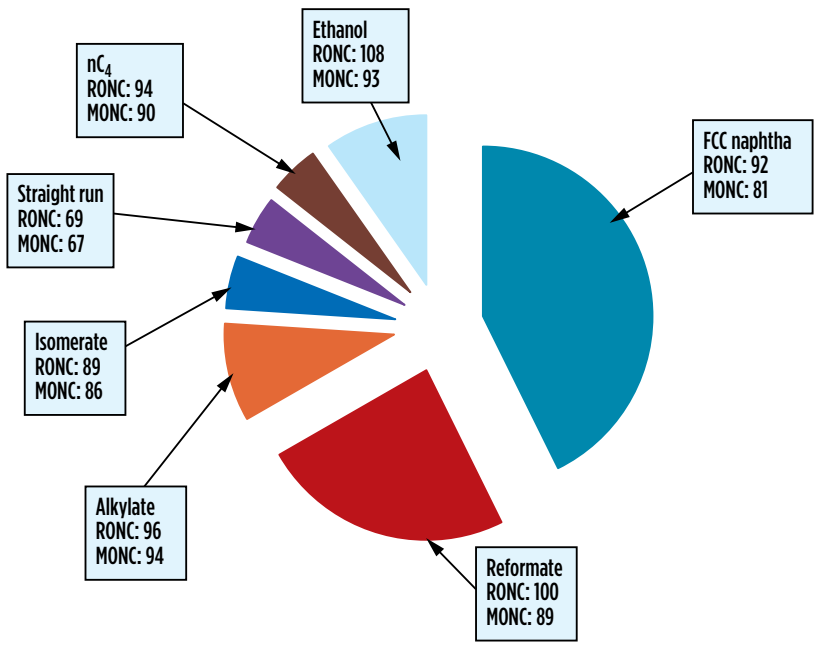

FIG. 2. Octane contribution of various streams. **Note:** Numbers should be used as approximate, and not absolute.

Meeting sulfur limits will require operational adjustments, catalyst formulation changes and/or capital investment. Operating strategies that reduce sulfur may decrease gasoline octane, diminishing flexibility of the refinery gasoline blending system. Incremental production from the reformer or alkylation complex can alleviate some of this pressure, depending on the refinery configuration and capabilities (**FIG. 1**).

Capital solutions around the FCC unit (FCCU) include feed and/or product hydrotreating, or other sulfur removal units. Most refiners have some form of feed and/or product hydrotreating in place, and these systems are very effective at reducing sulfur content of gasoline streams. However, some tradeoffs persist: increased hydrotreating severity can reduce gasoline octane, and octane preservation is a key feature in the design of these systems (**FIG. 2**). Also, higher hydrotreating severity increases refinery hydrogen (H_2) consumption and reduces the hydrotreater run length. For some, pretreating FCC feed sufficiently for sulfur minimization results in a heat balance challenge for the FCCU. Some of these challenges can be exacerbated at refineries using shale-derived crudes, which are naturally light and produce low-sulfur, but also low-octane, gasoline.

FCC operating strategies include undercutting gasoline for sulfur control, and control of FCCU heat balance parameters to ensure that the FCCU produces enough feedstock to keep the alkylation unit full. Refiners can face FCCU limitations (e.g., wet gas compressor capacity) when pursuing these changes, but the changes are quick and often very easy to implement.

Catalytic solutions, such as Grace's Gasoline Sulfur Reduction (GSR®) technologies, convert sulfur molecules to hydrogen sulfide (H_2S) in the FCCU, reducing the sulfur that ends up in FCC naphtha. These solutions can be implemented in concert with feed/product treating to improve octane preservation. Additionally, catalytic solutions to maximize alkylate production, such as Grace's ACHIEVE® 400 technology, can improve the overall refinery octane balance.

Most refiners can benefit by employing a combination of strategies to maximize refinery octane. In case studies presented at the AFPM Annual Meeting, Grace examined several scenarios regarding the challenges and choices available to refiners, including:

- Feed and operational changes to maximize LPG olefins to the alkylation unit and improve octane; undercutting FCC naphtha to reduce post-treat requirement and improve octane
- Catalytic solution to maximize LPG olefins to the alkylation unit and improve octane; additives to boost LPG olefins to the alkylation unit and improve octane
- GSR technology to reduce post-treat requirement and preserve octane
- Combining multiple approaches.

For more information, request a copy of the full technical article at grace.com/value. ●

SAP INTRODUCES IOT PORTFOLIO ENABLEMENT PROGRAM

Enterprise application software leader SAP has released a jump-start enablement program for its Internet of Things (IoT) innovation portfolio that will help customers connect the emerging world of intelligent devices with people and processes.

Following on a commitment to invest more than $2 B in the IoT over five years, SAP named the IoT portfolio SAP Leonardo after the figure known for ushering in a groundbreaking era of science and discovery. It combines adaptive applications, Big Data applications and connectivity in packaged solutions across line-of-business and industry use cases ranging from connected products, assets and infrastructure to vehicle fleets, markets and people.

The jump-start program will ease the first steps of the IoT journey and help organizations identify and validate IoT pilots and use cases that define full-scale IoT strategies and further deployment.

With SAP HANA Cloud Platform, SAP Leonardo offers intelligent IoT applications, business services for development, technical services for processing high-velocity data and an intelligent edge to process information at the device level. End-to-end offerings address the following areas:

- Connected products for new insights into lifecycle management, sourcing, response and supply, and digital supply networks; and the design, manufacturing and delivery of smart, connected products across all industries
- Connected assets to track, monitor and analyze fixed assets, including manufacturing and maintenance business processes, to reduce costs and increase equipment uptime
- Connected fleet to enable businesses owning moving assets to improve services and safety, visibility to logistics and service quality
- Connected infrastructure for new digital operational intelligence from physical infrastructure systems, construction and energy grids, enabling improved service, efficient operations, and compliance and risk mitigation
- Connected markets to enable new production, and business models of local relevance and optimum timing for customer and marketing insights, digital agribusiness, smart ports and smart cities.

AIR PRODUCTS SECURES LONG-TERM HYDROGEN SUPPLY CONTRACT

Marathon Petroleum Co. LP has awarded Air Products the long-term supply of approximately 30 MMft³/d of hydrogen for its Garyville, Louisiana refinery. This new supply award, which begins in November 2017, is in addition to volumes of hydrogen that Air Products already provides to the Garyville refinery.

The additional hydrogen will be provided to Marathon Petroleum from Air Products' existing Gulf Coast Pipeline (GCP), the world's largest hydrogen plant and pipeline network system. The 600-mi pipeline span stretches from the Houston Ship Channel in Texas to New Orleans, Louisiana, and supplies customers with more than 1.4 Bft³/d of hydrogen from 22 hydrogen production facilities. ●

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Looking past the surface: Novel alumina improves silicon capacity

SERGIO A. ROBLEDO, Haldor Topsoe Inc.

Silicon (Si) found in oil fractions originates from Si-containing antifoam additives used in coker units, as well as from the use of chemicals introduced during oil transport and tertiary oil recovery. Si reacts with the surface area of the catalyst and forms a silica gel, hindering access to the active catalytic sites and deactivating the catalyst. Si penetrates into the pore system of the catalysts, and deactivation is proportional to the concentration of Si on the catalyst. Therefore, Si poisoning of the main bed catalysts is a major concern (depending on the concentration in total feed), and Si guard catalysts are required for the catalyst load, which "steals" active main bed catalyst volume.

Impact of Si on catalyst activity. Si poisoning of hydrotreating catalyst will impact HDN activity much more than HDS activity. Typical nitrogen target levels for reformer feed are very low to avoid ammonium chloride salt deposition. This means that the severity required in a unit processing coker naphtha is high, and this requirement can be met either by increasing operating temperature, or by higher catalyst activity. Sulfur recombination limits the maximum operating temperature, so the severity must be accomplished with an optimally designed catalyst load.

Si from a coker vs. Si in crude. A difference exists between Si from coker antifoams and those coming in with the crude or purchased feedstocks. Polydimethylsiloxane (PDMS) and other siloxanes are used to control foaming in coker drums.

Typical coke drum cycles take 16 hr–24 hr, and are operated at approximately 900°F (480°C). In this environment, PDMS breaks down into cyclosiloxanes.

Si pick-up takes place on the surface area of the catalyst. The siloxanes enter the pore structure of the catalyst and react with the hydroxyl groups present on the alumina surface. Therefore, traditional Si pick-up catalysts have very high surface area. These cyclosiloxanes are relatively small, so the pore diameter of the catalyst does not have to be very big for these molecules to access the surface area. This article focuses on Si entering with coker-derived streams.

While surface area is reported in units per mass (m^2/g), the key is to know how much surface area is available per volume. A fixed reactor volume is typically available for Si trapping catalysts, making the bulk density another important factor.

SiliconTrap™ technology. Haldor Topsoe has always been at the forefront of surface science. While total surface area is key for Si pick-up, Haldor Topsoe's knowledge of alumina design and surface technology is key when designing Si guard catalysts. Based on its detailed fundamental alumina research, Topsoe has commercialized its new SiliconTrap technology.

A novel alumina technology has led to the development of new high-surface-area coker naphtha catalysts with significantly higher Si capacity. The use of SiliconTrap technology has allowed the commercialization of new catalysts with 15% more Si pick-up per volume. Applying this technology also increases the overall activity in the reactor system, due to higher HDS/HDN activity of the SiliconTrap catalysts.

These new catalysts (**FIG. 1**) are available in different sizes, shapes and activity levels, and have been commercialized as TK-441 SiliconTrap, TK-447 SiliconTrap and TK-449 SiliconTrap. TK-449 SiliconTrap is a true guard catalyst with no HDS/HDN function, but with maximum Si capacity needed for very high Si feeds or as a top layer in the front reactor. TK-447 SiliconTrap is a medium-activity catalyst with high surface area and excellent Si capacity that is ideal for the first stage of a coker naphtha HDT, or as a guard layer. TK-441 SiliconTrap is a high-activity main bed catalyst for coker naphtha hydrotreaters, while still providing a very high Si pick-up per reactor volume.

Haldor Topsoe's main bed catalysts, BRIM and HyBRIM, show a high level of both capacity and tolerance for metals. BRIM and HyBRIM catalysts, designed with an optimum combination of pore diameter, pore volume and surface area, have also shown pick-ups as high as 20 wt% of Si.

The high surface area SiliconTrap catalysts offer the best HDS/HDN activity and highest Si capacity on a volume basis (**FIG. 2**). Combining Haldor Topsoe's SiliconTrap technology with our high-activity BRIM and HyBRIM catalysts provides clients with the ability to extend cycle length, process more barrels or process more difficult feed to improve the profitability of their coker naphtha unit(s). ●

FIG. 1. SiliconTrap™ catalysts.

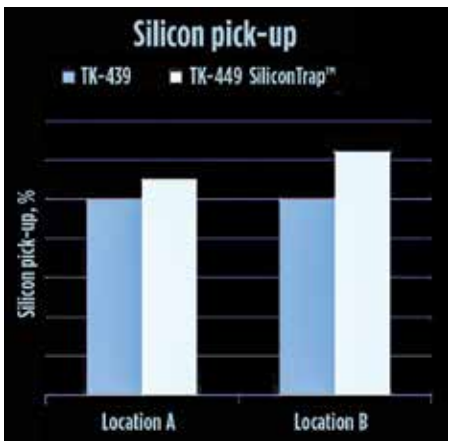

FIG. 2. Silicon capacity comparison of SiliconTrap™ catalyst vs. previous technology.

RIN, continued from page 1

has actually emphasized its belief that lawmakers intended for the blend wall to be breached," Mr. Broadbent said. "That's important to note, because gasoline demand has changed significantly since 2007. The recession came and demand took a big hit, and it hasn't been until 2016 and 2017 that demand has been reaching those 2007 volumes again."

MOVING OBLIGATION

In response to the challenges it faces, the industry has petitioned to move the point of obligation to the blenders, Mr. Broadbent said.

"The idea is that refiners are far removed from the retail segment themselves, and have little ability to influence or push more biofuels into the actual fuels pool," Mr. Broadbent said.

The response by the EPA was a brief and flat rejection. Their main argument, according to Mr. Broadbent, is that refiners are not adversely effected by high RIN prices, due to pass-through.

Another argument used by the EPA is that moving the point of obligation is unlikely to increase the amount of renewables in the pool.

"The data they use to support this," Mr. Broadbent said, "is that 50% of retail stations in the US are branded, but only 25% of stations that are selling blends are branded. The logic here is that refiners are not using those levers to push more biofuels into the market today, so blenders would also be ineffective."

The EPA also argues that higher administrative costs—i.e., more obligated parties and a higher cost of enforcement—would increase uncertainty, which would be detrimental to investments.

QUALITATIVE SCENARIO ANALYSIS

Three scenarios should be examined when considering RIN obligation, Mr. Broadbent explained.

Refiners maintain point of obligation. In 2016, the total RINs produced were enough to satisfy the 2017 requirements, including exports. With the uncertainty that surrounds the new administration, along with the emerging 2016 RIN data, RIN prices dropped 40%–50%, Mr. Broadbent said. The industry does not expect a return to 2016 levels.

"In this scenario, you see ethanol continue to make slow inroads into the gasoline market until that magic 15-Bgal line is reached, returning RIN prices to $0.03–$0.05 per RIN, rather than $0.50–$0.60."

Point of obligation moved to blenders. Moving the obligation to blenders carries both pros and cons, Mr. Broadbent said. Blenders may share in the incremental cost of biofuels protection, potentially increasing blender incentives to push renewable fuels into market. That could create improved price stability, he said.

However, moving the obligation could raise costs to blenders, which could cause consolidation as smaller blenders look to avoid costs, Mr. Broadbent said. This could shrink the market.

Moving point of obligation to retail. Moving the obligation to retailers would give them strong incentives to install higher-ethanol blend pumps, Mr. Broadbent said. This would likely speed up ethanol adoption and create higher RIN price stability, as investments are small and relatively fast.

Mr. Broadbent explained that moving the obligation would require a legislative change, causing administrative costs to rise and allowing for more corruption due to system size. This scenario would also create easier pass-through to consumers, which could deter investments.

Mark Broadbent leads the analysis of refining and refined products in the Americas, including the competitive benchmarking of more than 100 refineries. He has led Wood Mackenzie's North American refining analysis for three years, and has five years of refining experience as a process engineer at Wood Mackenzie's Baytown refinery. ●

Does your company have a digital strategy?

JUSTIN V. CONROY, Radix Engineering and Software

By now, you have probably heard of topics such as, "Internet of Things," "Big data," "Advanced analytics," "Mobile technology," or "Cybersecurity." New technologies, such as intelligent sensors, high-speed networks, cloud infrastructures and machine learning capabilities, are changing the way we do business. More and more information is moving more quickly through intelligent networks. Regardless of the source of technological improvements, these changes will add billions of dollars in value to global businesses in the form of revenue increases, reduction of operational costs and/or new business models. Businesses and markets are now empowered to reconsider past solutions, revisit previously unsolved problems and consider new improvement opportunities that were previously unavailable.

What is a digital strategy? Data converted into information that can be analyzed, visually represented and acted on can provide a significant competitive advantage. A digital strategy is the vision and roadmap to create wealth from that data/information asset, and it can decrease overall reaction time when a problem is identified or a question is asked. At its core, a digital strategy should be focused on the human-technology interface. Data that cannot be interpreted is largely useless. Once the base questions to any digital strategy are determined ("What do we want to know?" or "What questions do we have?"), the focus shifts to shaping the data into a workable, interpretable format (FIG. 1).

Each layer is important, and it is imperative to understand how they affect each other, particularly in terms of capabilities and security. While many companies are focused on data collection and storage, they lack the capability to retrieve, analyze or consume it.

Why is a digital strategy needed? Demand for increased reaction capability is driven by a surge of available data that was once largely nonexistent. Obsolete mindsets—"If it ain't broke, don't fix it"—are hindering companies in this rapidly changing technological environment.

Progressing along the same re-engineered process efficiency curve has not resulted in significant financial impact. Advancements that leverage new technologies or software platforms have resulted in new business models, allowing an organization to simultaneously jump to a lower-cost and higher-revenue curve. A digital strategy is not a magic bullet, but it significantly reduces the overall time it takes to make decisions and create wealth.

Digital strategy benefits. Countless business cases exist for each digital strategy layer outside of the oil and gas industry. Improved data analysis in the construction industry (machine learning techniques) have increased sales volume by 10%, improving awareness of customer, inventory or heavy machinery maintenance needs.

Fully integrated digital strategies have resulted in complete overhauls of inefficient manufacturing work processes, reducing rework by an estimated 55%. In the medical industry, aggregation of data on mobile devices has optimized patient care. Advanced cybersecurity methodologies also ensure that financial transactions are conducted accurately, securely and quickly.

So, why is the oil and gas industry lagging behind? Some may believe that these strategies are too expensive, or lack return on investment and long-term benefits. However, some companies are indeed relying on their digital strategy to change their past cost and revenue curves, and the financial results have been impressive.

Organizations that choose not to embrace asset and process digitalization will be left behind in today's fast-moving markets. A digital strategy provides a plan and execution vehicle to communicate and deploy a staged migration that leverages best practices. ●

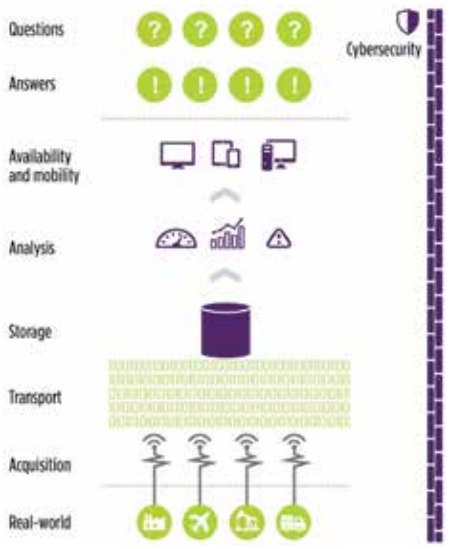

FIG. 1. Nine layers of a digital strategy.

The cost of opportunity crudes

BRIAN FOY and **SEAN O'MARA,** Burns & McDonnell

As US refineries continue to accept and process more opportunity crudes, desalter brine variability will continue to negatively affect wastewater treatment plants (WWTPs). Opportunity crudes are typically heavier than desalters were designed to process, reducing oil-water separation and increasing emulsions. Processing these heavier opportunity crudes has made the practice of segregating the desalter brine for pretreatment more common to reduce oil and grease loading on the downstream WWTP.

When desalters are operating incorrectly, inefficient oil-water separation exists. This leads to more free oil and emulsions flowing to the WWTP than allowed by the design. The primary oil removal process cannot handle the additional loading, and it will be passed down the line to the secondary oil removal, and then to the biological treatment system. Inhibition of biological treatment systems can occur at influent oil concentrations exceeding 50 mg/L. Inhibition typically manifests in these ways: reduced nitrification, depressed dissolved oxygen, elevated biochemical oxygen demand (BOD) effluent concentrations, and the carryover of solids from gravity clarifiers. Solids that do not settle can elevate effluent metal, nutrient and organic concentrations. Above 50 mg/L, oil coats and becomes incorporated into biological floc, inhibiting the transfer of oxygen and organics to the biological population and changing the floc density. Oil-associated inert and biological solids tend to be neutrally buoyant or float; therefore, the effectiveness of gravity clarification is diminished.

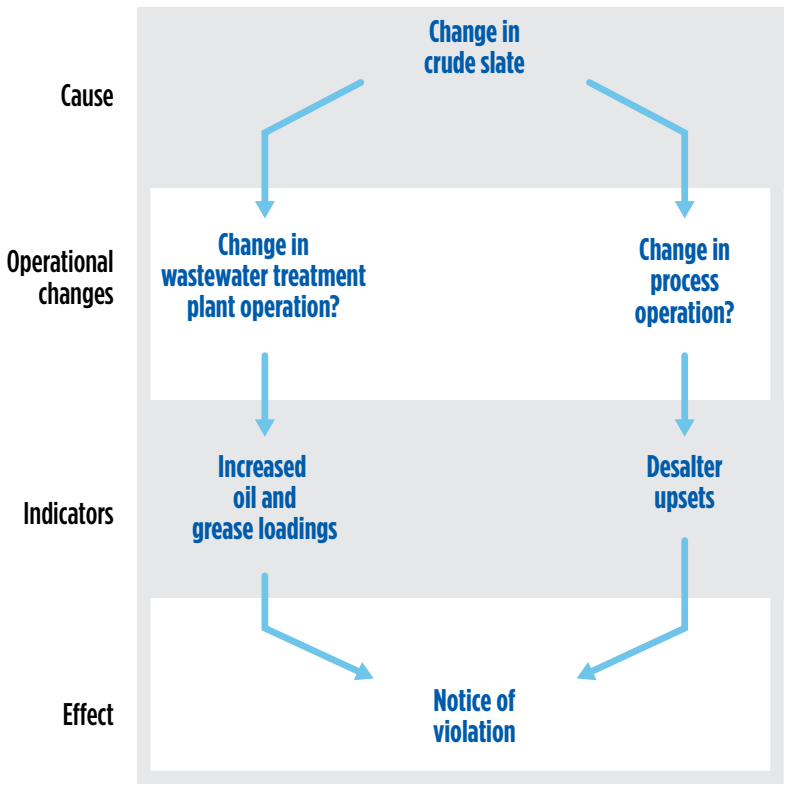

FIG. 1. Refineries make numerous decisions when processing opportunity or heavy crudes, including crude cost, availability and profit opportunity.

Biological treatment unit evaluation. Poor operation of biological treatment units leads to noncompliance with discharge permits. If a refinery is running opportunity crudes and finds that the oil and grease in the biological treatment unit is above 50 mg/L, then desalter brine pretreatment should be evaluated. As crude slates change, different approaches should be considered for each refinery's needs (**FIG. 1**). Segregating the desalter brine is necessary because many WWTPs are incapable of handling the increased loading. Refineries that do not segregate their desalter brine must either increase the size and/or capacity of existing equipment, or improve the technology in the existing WWTP to avoid violating discharge permits.

The first step in determining desalter brine treatment is to understand if the issue at hand is free oil, emulsions, oily solids or a combination—choosing the correct technology is imperative. Jar test sampling, bench top study and pilot study are useful tools to assess the main pollutants of concern and to narrow down technology options. Often, the most efficient choice is a blended option using multiple processes to remove free oil, solids that freely settle and emulsions. This allows for the greatest overall reduction in oil and grease, and is robust enough to still assist the downstream WWTP during desalter upsets.

Designing and executing a complete treatment plan. Gravity separation (API oil-water separators, clarifiers, large-break tanks) and flotation (dis-

▶ See OPPORTUNITY CRUDES, page 16

Expanding regeneration portfolio into sulfuric acid

According to research published by Accenture, "The circular economy could generate $4.5 T of additional economic output by 2030." The research also finds that, "Today's business practices will contribute to a global gap of 8 Bt (billion tons) between supply and demand of natural resources by 2030."

A circular industrial economy delivers value by diverting waste from landfills, moving materials up the waste hierarchy, and producing quality materials and products that are competitively priced and have a smaller environmental footprint than those made with virgin materials. Simply put, the circular economy designs out waste, reusing and recycling everything that is produced.

For example, sulfuric acid is the most widely used—and reused—chemical compound in the world, with applications in nearly every industry, including refining, chemical manufacturing and fertilizers, among others.

Veolia North America acquired the Sulfur Products division of Chemours in 2016 and, with this acquisition, formed its Regeneration Services business. From seven operating sites across the US, elemental sulfur, spent sulfuric acid and captured acid (sulfur) gases are regenerated into clean-fuming and non-fuming sulfuric acids and other high-value sulfur derivative (HVSD) products. Four of these plants are in geographies that make strategic sense for customers, product transportation and other supply chain logistics. The other three plants in Veolia's network are located on property, or adjacent to, a major refinery customer.

For example, Veolia's Morses Mill plant is located inside the gate at the Phillips 66 Bayway refinery in New Jersey. All of the refinery's spent acid, plus its acid gases, are directed to this plant, where they are regenerated into fresh sulfuric acid and returned to the refinery for reuse as alkylation catalyst.

Alkylate demand is one of the primary drivers for sulfuric acid in the refining segment. As demand increases for gasoline with higher octane and lower vapor pressure to meet regulatory requirements for cleaner and more efficient fuel standards, alkylate has emerged as the preferred additive. For the approximately 100 refiners with alkylation units in North America, alkylate is high-value and in constant demand.

Sulfuric acid is one of two catalyst options for refiners running alkylation units. The other option is hydrofluoric acid, which is a feedstock in Veolia's existing potassium hydroxide (KOH) recycling process. By adding sulfuric acid regeneration capabilities, a no-waste, closed-loop, circular economy solution can be offered to every refinery with an alkylation unit.

Support and collaboration. What makes Veolia's sulfuric acid business different from other players in this market is its Acid Technology Center (ATC), which comprises 30 engineers, scientists and technicians who exclusively support the company's sulfur plants and customers. The nature of the ATC is to maintain, improve and provide customer support and to bring experts together to solve problems. This nimble group travels to customer sites as needed, supported by "assistance to operations" engineers located at each Veolia plant.

Sulfuric acid is an essential but hazardous chemical, but with the right training and preparedness planning for first responders, spills or other incidents can be handled safely. The ATC's product stewardship team works closely with customers, carriers and communities to ensure safe handling of sulfuric acid products.

For refiners, sulfuric acid management is a required, but non-core, component of operation. Available options include sending materials offsite for treatment, disposal or regeneration, or managing those materials through onsite regeneration plants. We can partner with a refinery to manage its spent acid at one of our existing regeneration plants, or build a new sulfuric acid regeneration plant to meet its specific needs. Alternatively, if refiners want to outsource existing regeneration plants, we are open to coming in and operating them. This allows refiners to focus on the core business of processing oil, rather than dealing with the challenges of running a sulfuric acid plant safely and reliably. •

STEVE HOPPER, President and COO, Veolia North America

Selected technology services for refineries

JAVIER VAZQUEZ-ESPARRAGOZA and **BHARAT BANSAL,** KBR

KBR has produced two refinery studies: the development of a marine operation simulation for the scheduling and management of the number of vessels and marine operations (loading and unloading) at terminals, and the development of solutions to optimize the traffic network during refinery construction periods, as well as normal operations.

Marine operations simulation. The development of a computer-based terminal simulation model (TSM) simulates fast-time changes to key facilities at a refinery port and terminal. The simulation includes changes in storage, loading, transportation and delivery systems with additional capacity analysis, throughput and logistics optimization.

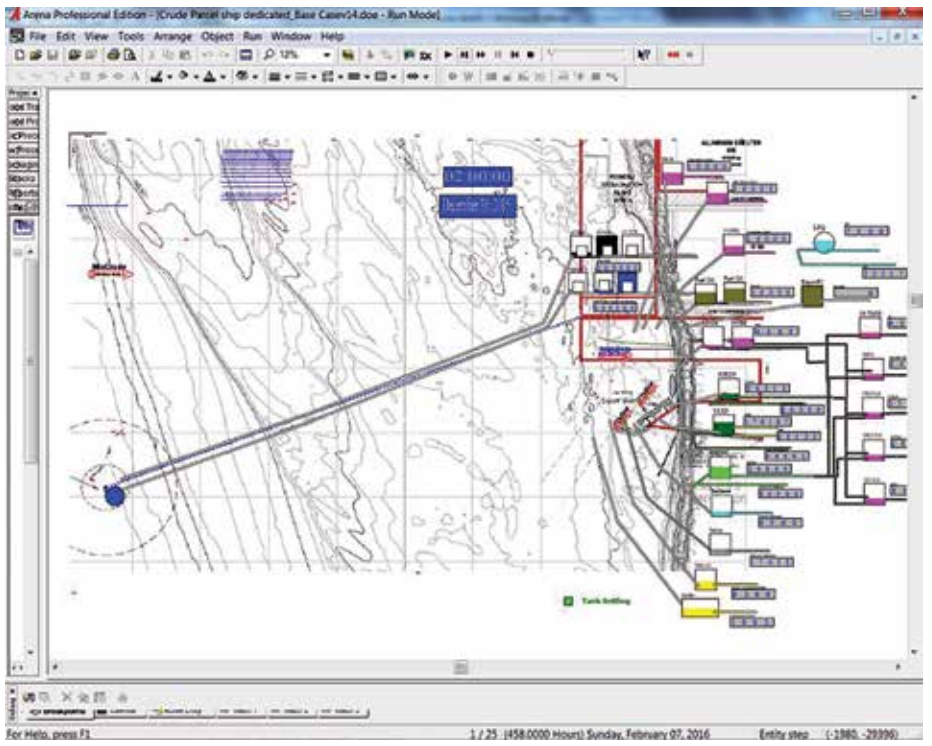

FIG. 1. A screen capture of a refinery model with crude oil received through a single mooring point, and tanks for product and crude storage.

The model simulates one or several terminals that serve different products and have unique arrangements of storage tanks and berths.

The simulation uses a discrete simulation software to develop the model and predict tank capacity, crude and products storage levels, number of vessels and arriving/departing times to optimize scheduling.

Refineries receive, store, process and ship several types of stabilized crudes and refined products. The terminal shown in **FIG. 1** consists of a single-point mooring (SPM) for receiving crude, a tank farm and three berths.

The crude oil can be received daily from various locations at defined quantities. For refined products, the terminal receives products from a nearby refinery or from ships. Products are then pumped to a remote bulk plant, to storage tanks or to ships.

The model can also include testing scenarios, including a base case with normal operations; a change in the number of terminal berths; a modification of the number of tanks in the terminal; and an adjustment of the number or type of vessels, and their arriving distribution or schedule.

Weather outages, draft limitations, vessel arrival patterns, outages of terminal facilities and animation display variables can be defined. Model outputs can be analyzed for conclusions, including maximum tank levels, vessel demurrages, queuing of entities waiting for resources, berth utilization, import crude and export products quantities, refinery shutdown due to crude supply shortage, etc.

Traffic operations simulation: Zero risk. Simulation modeling tools were used to evaluate refinery traffic operations at all levels of scope and detail. Alternatives are investigated and recommendations made for cost-effective traffic improvement measures. Alternatives range from traffic control optimizations (signal timings or checkpoints), travel demand management strategies (the use of transit or flexible work schedules), to capital infrastructure projects. For example, a significant improvement was made in the morning commute to the site during the construction phase of a petrochemical plant in Saudi Arabia.

The traffic simulation is paired with EPC experts in logistics, freight profile plots, operations processes and construction labor curves. As a result of the study process, the designed traffic measures and infrastructure improvements for both projects' construction and operations saved countless hours of labor and millions of dollars. ●

Balancing cost, risk and performance

Manufacturing and industrial facilities rely on rotating and reciprocating assets, such as motors, engines, turbines, pumps, compressors, fans and generators. Advances in automation have successfully reduced operating costs, but maintenance costs in several industries have steadily increased due to:

- Machine suppliers focusing on maximizing spare parts revenue
- Services suppliers maximizing labor revenue (walkabout inspections, repairs and overhauls)
- Capital expenditures driven by lowest cost, rather than by total cost of ownership (TCO)
- Service contracts based on uptime rather than overall equipment effectiveness (OEE).

To address this challenge, progressive companies have begun to adopt reliability centered maintenance (RCM) methodologies that were originally developed for the aircraft industry—for obvious reasons, those procedures have an extremely low tolerance for unplanned failures.

RCM adoption begins with the foundational principle that assets should *not* be treated equally, and that a risk-based assessment should be performed to classify asset criticality, determine its reliability signature and identify the appropriate maintenance strategy.

Three types of maintenance strategies, and the corresponding characteristics that would make an asset appropriate for each strategy, are shown in FIG. 1.

Companies that implement RCM typically experience benefits, such as 50%–80% reductions in repair cost, 50%–80% reduction in maintenance cost, 30% reduction in spare parts inventory, and a 20%–60% increase in production.

Recent advances in sensor technology, communications and cloud computing have substantially reduced the cost of online condition monitoring. CBM Enterprise Solutions' CBMvision™ is a unique, cost-effective solution that can be rapidly installed to monitor and diagnose asset health periodically. To learn more, or to speak with a member of the CBM team, contact us at +1 (713) 481-3320 or info@cbmenterprise.com. ●

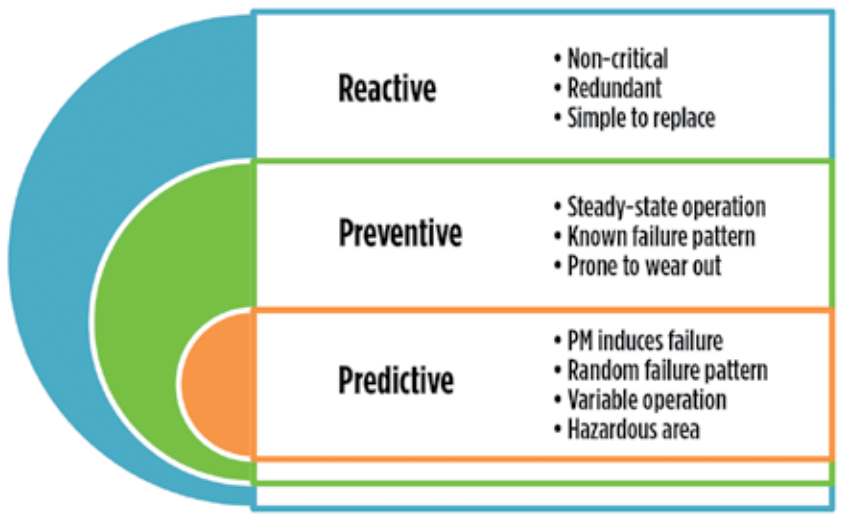

FIG. 1. Assets should not be treated equally. A risk-based assessment should be performed to identify the appropriate maintenance strategy.

GE WATER & PROCESS TECHNOLOGIES UPGRADE ENABLES AUTOMATIC CAUSTIC CONTROL

TrueSense COMS, GE Water & Process Technologies' continuous measurement and control solution for crude unit overhead systems, is now equipped to automatically control caustic injection. The upgraded system continuously measures overhead water chloride concentration and adjusts caustic injection upstream of the crude tower.

Continuous control of this important chemical additive is critical to regulate crude unit overhead corrosion and to limit system fouling and failure related to caustic overfeed. Automation via the upgraded TrueSense COMS replaces manual testing and subsequent pump adjustments conducted a few times a shift, or automated wet chemistry methods, which are limited to a few dozen readings per day.

This upgrade has been tested and proven to minimize corrosion potential by limiting acid attack and salting in the overhead system. It also helps refineries avoid issues in the hot train and furnace caused by caustic overfeed. The result is less unplanned downtime and improved performance. ●

Effective use of generic training simulators

DONALD C. GLASER and **MATTHEW GARVEY,** Simulation Solutions Inc.

Generic simulators are useful tools that allow trainees to begin applying generic process knowledge, and to develop critical thinking and problem-solving skills. To use generic simulators effectively, trainees must enter generic simulator training as prepared learners. This preparedness can be gained through the use of paper-based manuals for specific process elements and units.

However, independent learning and paper-based exercises will take trainees only so far. Instructor-led training is paramount to the retention of knowledge. Trainees maximize their absorption of knowledge in an environment where they can partake in group discussion, simulate an activity and teach others (**FIG. 1**).

To achieve this active learning, an instructor-led classroom environment must be provided. A highly competent instructor can identify knowledge gaps in individual trainees. When trainees are among their peers in a "safe" learning environment, they are free to assist, challenge and learn from each other as part of group discussions.

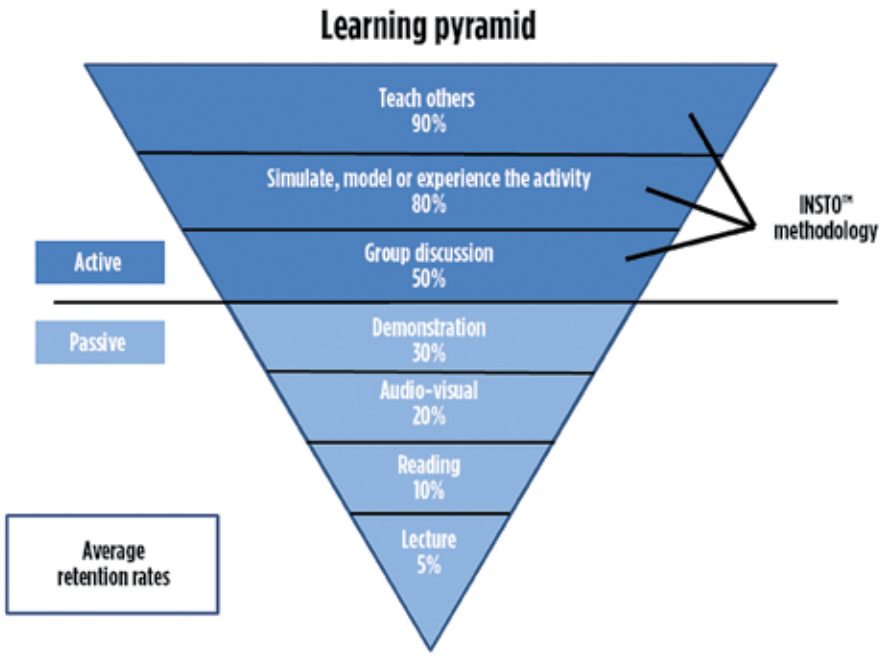

FIG. 1. Retention rates for active and passive learning. Source: Simulation Solutions Inc.

With an instructor and comprehensive training materials, generic simulators are effective tools to develop troubleshooting, problem-solving, critical thinking and optimization skills that are transferable to the trainees' work in the plant.

Generic simulators allow trainees to use and build upon preexisting knowledge while applying the process knowledge that they gained during paper-based and self-guided, computer-based training.

For high-consequence units, trainees will apply the skills they learned with the generic simulators on custom unit-specific simulators.

Proper training on generic simulators is mandatory before a trainee can work with a custom, unit-specific simulator. For example, after NASA purchased a $100-MM custom simulator in the 1980s, it still spent 18 months of its 24-month training window on generic simulator models. Just as paper-based manuals are used to prepare a trainee for a generic simulator, a trainee must use a generic simulator to learn critical thinking and problem-solving skills before working with a custom simulator.

Trainee support. When coupled with highly competent instructors and a proven learning methodology, generic simulators can change trainee behavior and develop high-level skillsets. Generic simulators should be supported with training exercises that teach generic operating skills such as utilizing trends, the proper way to consider causes of upsets and abnormal situations, and general cause-and-effect relationships. This will best prepare a trainee for unit-specific training on a custom simulator, as well as running their eventual unit.

Too often, investments are made in the tool itself (in this case, a simulator) rather than in its implementation. During a 2013 conference session titled, "The promise of simulation: How to use experimental learning methods for console training," Dr. Richard Ortloff from ExxonMobil said that training departments will achieve better results if they, "spend 25% of [their] time, effort and money on the training, and the rest on the machine."

It is important that trainees are exposed to instructor-led training in their initial training and when they are incumbent operators to combat the atrophy of skills caused by the increase in plant automation. In an increasingly complex workplace, operators are being pushed away from the process and have little time to develop and maintain these problem-solving skills (**FIG. 2**).

Training provided to incumbent operators should focus on strengthening operating skills and troubleshooting techniques that can immediately be applied in the field. The goal of generic simulator training should always be to make better plant operators, not better simulator operators.

Generic simulators and instructor-led training provide benefits that cannot be achieved through independent work on any tool, whether in initial paper-based training or in a custom simulator. ●

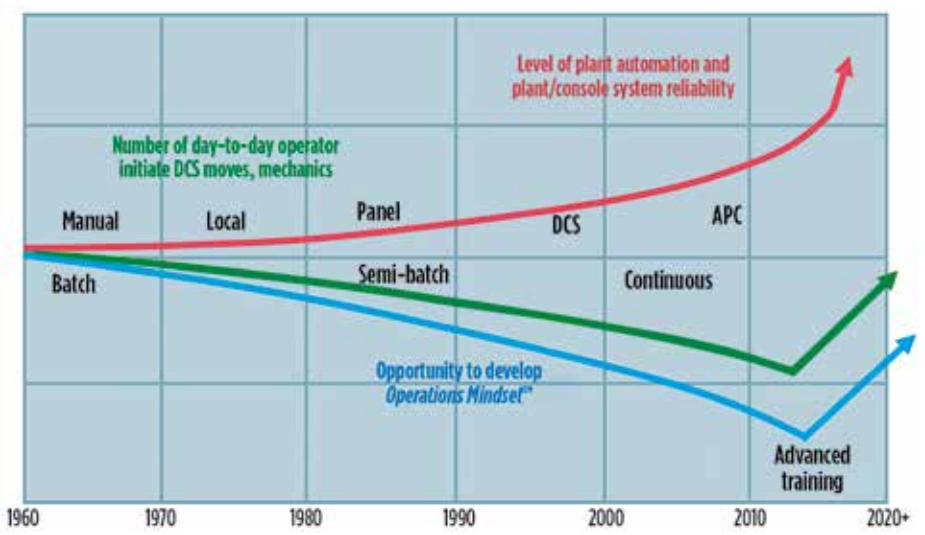

FIG. 2. The increase of plant automation and complexity prevent control room operators from developing mechanics and an *Operations Mindset*™.

ALTRAN INVESTS IN H2SCAN

Engineering and R & D services provider Altran has made a minority equity investment in California-based H2scan, which specializes in analyzers for measuring hydrogen concentration in oil and mixed gases environments within the power industry, petrochemical and oil refinery markets. H2scan sells private label systems, subassemblies or fully integrated sensors to global multinational OEM customers, and distributor representation in over 65 countries. The investment will bolster the existing business relationship between the two companies, which will partner to develop the design of custom system solutions for its customers, the development of a lower-cost sensor and ASIC, and the development support for production efficiency initiatives. Altran also will become a board member of H2scan. ●

Designing a full-service vapor control system

A properly designed volatile organic compound (VOC) collection system is the key to safe and efficient collection and abatement of VOCs.

Ship & Shore Environmental Inc. (S&SE) specializes in air pollution capture and control systems for industrial applications, with a special emphasis on reducing energy consumption and improving operational efficiency. The company's capabilities include not only the design and fabrication of VOC abatement systems, but also engineering, installation, commissioning and maintenance services.

S&SE case study. Design of a vapor control unit (VCU) to collect and destroy VOCs emitted during operations involving the transfer or evaporative hydrocarbons, including high-vapor cargoes such as gasoline. The VCU is designed for compliance with USCG33 Part 154, Subpart P, Part 156; and SCAQMD Rule 1142. The support burner complies with SCAQMD Rule 1147 for low-NO_x burners.

The system is designed as a specific Btu/hr thermal oxidizer with a minimum destruction efficiency of greater than 95% operating at 1,500°F–1,700°F. A low-NO_x support burner is provided for startup and loads that have low vapor pressures, where concentrations are below lower explosive limit (LEL) levels (e.g., diesel fuel).

When the concentrations of loading vapor pressure liquids require enrichment, a hydrocarbon monitor will open the natural gas enrichment valve to keep VOC concentrations above the upper explosive limit (UEL) level.

The system consists of several skids that can be connected, depending on the connection configuration from the filling tanker to the thermal oxidizer. Liquid droplets are separated in a centrifugal liquid dropout vessel, with a level gauge and indicator, and a high-level switch to turn on a pump for liquid transfer to a designated tank.

The skid also contains a vapor extraction blower (FIG. 1) and an additional detonation arrestor.

From the liquid dropout skid, the vapors travel through a safety skid where, in the event a safety limit is activated, the vapor stream is interrupted by closing a valve in the main line and venting at the end of the line flame arrester.

A vapor booster blower is at the other end of the quick-closing main valve. At the same time that the vapor is vented, a quick-opening vent valve is opened to pull in ambient air and purge the vapor line to the thermal oxidizer with clean air.

Under normal conditions, both quick-opening vent valves are closed while the main vapor valve is open. The boosted vapor stream is passed through a velocity section and thermal oxidizer detonation arrestor, and equipped with a quick-closing valve on each side before the thermal oxidizer vapor entrance nozzles.

The vapor entrance nozzle manifold consists of two separate sections, each controlled by a control valve.

When the system is processing at the lower cargo loading (the lower vapor vent stream), only one section is operating; and when the vapor vent stream increases, the second section will engage.

A low-NO_x support burner is provided to bring the thermal oxidizer up to an operating temperature of 1,500°F before allowing any vapor to enter the thermal oxidizer, which is an L-shaped configuration. The low-NO_x support burner is located in the horizontal section in the center of the vapor injector. The vapor injector consists of two sections. Each manifold section is constructed with six nozzles, and designed to deposit the vapor at high velocity into the combustion chamber.

The combustion chamber is lined with castable refractory, and is located in the horizontal portion of the unit. Dilution air surrounds the combustion chamber, and enters the front of the retention chamber before the retention chamber turns to the vertical position. The retention chamber is lined with 10-lb density ceramic fiber insulation and coated with a rigidizer.

Since the thermal oxidizer operates between 1,500°F and 1,700°F, a dilution air stack is provided to reduce the exhaust temperature to approximately 700°F. The thermal oxidizer is manufactured of carbon steel plate.

Operation of the thermal oxidizer system is programed through a programmable logic controller. Program adjustments are made to verify all alarm setpoints and component operation during startup of the unit. The thermal oxidizer control panel and certain instrumentation are housed in a temperature controlled room.

For some applications, the design of a VCU may include the recovery of condensable vapors. For more information, visit us at www.shipandshore.com. ●

FIG. 1. Ship & Shore Environmental Inc. designs and fabricates VOC collection systems.

We can sulfur problems: Catalyst solutions to meet Tier 3 regulations

MELISSA CLOUGH, BASF Corporation

Global regulatory efforts strive to reduce sulfur in gasoline to improve air quality. For the US, this means modifications to fuel specifications—as of January 1, 2017, gasoline specifications mandate 10-ppm sulfur or lower. This matches other countries and regions that have a 10-ppm sulfur mandate, including the EU and Japan. Since 90% of gasoline sulfur within a refinery complex comes from the fluid catalytic cracker (FCC), FCC naphtha—the FCC product in the gasoline boiling point range that is either further treated or blended as a high-octane component into the refinery gasoline pool—is a prime target for reduction efforts.

An array of options available to refiners includes feed pretreatment, gasoline posttreatment, cutpoint adjustment, sulfur credits and catalyst technology (**FIG. 1**).

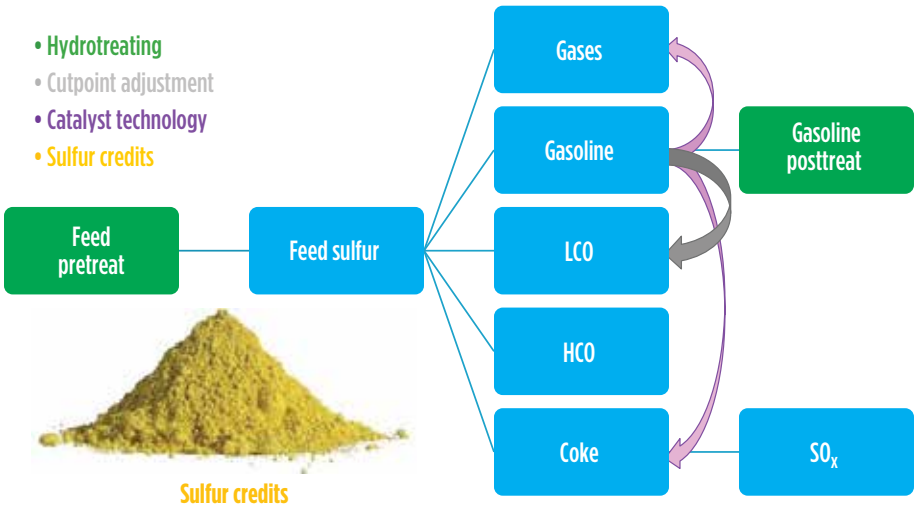

FIG. 1. FCC gasoline sulfur reduction options.

Feed and naphtha hydrotreating. Feed pretreatment reduces the total amount of sulfur coming into the FCCU (e.g., a typical reduction of 70%–90% incoming sulfur) while leaving behind the hard-to-convert sulfur species (e.g., benzothiophenes and derivatives). Gasoline posttreatment is an effective method for reducing FCC naphtha sulfur; however, octane loss is observed during post-hydrotreatment, so this negative effect must be considered when choosing a sulfur strategy. In some cases, a loss of almost 3 numbers in octane—(RON+MON)/2—has been observed.

Cutpoint adjustments and sulfur credits. Sulfur concentrates in the back end of the FCC naphtha boiling point range due to the presence of difficult-to-remove benzothiophenes. Refiners can employ a cutpoint adjustment strategy in which a portion of the heavy naphtha is pushed into the LCO fraction, thereby eliminating some of the heavy sulfur molecules in the naphtha cut. This has obvious impacts on naphtha absolute yields; in a time when gasoline pricing is dominant in most of the country, this is often a last resort. Sulfur credits are an option for refinery networks and/or refineries trading in the sulfur credit marketplace.

Catalyst technology solutions. State-of-the-art catalyst technologies are an alternative option that can help optimize (e.g., delay or lower) CAPEX requirements, and can be used on a continuous-basis or on a spot-basis, as needed (e.g., BASF's catalyst solution NapthaClean™, or catalyst additive Low Sulfur Additive, or LSA). Available technologies include both the cracking and coking of sulfur, pushing sulfur species to either H_2S or SO_x, respectively, and can be tailored depending on the downstream requirements of the refinery. NapthaClean is employed in refineries where a continual need for gasoline sulfur catalyst technology is needed. LSA is used as an additive on a spot basis or for refineries that want additional flexibility. Unlike other catalyst additives, LSA has catalytic cracking activity, so dilution of the base catalyst activity is not a concern. LSA has been employed in many scenarios, including:

- Temporary octane preservation through bypassing a portion of gasoline in the post-hydrotreatment process
- During turnaround of a hydrotreating unit
- To extend hydrotreating catalyst life
- Temporary processing of a higher-sulfur feed
- During a hydrogen supply outage.

Feedstock applications for LSA and NapthaClean range from low-sulfur to high-sulfur levels. In the low-sulfur level case, both customer testing and separate refinery applications demonstrate that a reduction of sulfur from a level of 20 ppm–30 ppm is achievable when employing gasoline sulfur reduction catalyst technology. Sulfur reduction can range between 20% and 40%, depending on the naphtha sulfur species present. A technical recommendation is performed with the refinery after understanding upstream and downstream needs and constraints, feed sulfur profiles, local value of sulfur credits, octane retention requirements and existing naphtha sulfur speciation. For the latter requirement, BASF has developed a sulfur speciation method to provide this enhanced technical service capability.

Looking forward. For refiners, the ultimate question remains: How are you meeting Tier 3 regulations today? With the changing regulatory and market challenges that refineries face, catalyst development and innovative solutions remain the key to staying ahead of the competition. ●

OPPORTUNITY CRUDES, continued from page 10

solved gas/nitrogen flotation) are typical unit processes for desalter brine-specific treatment. Gravity separation targets free oil but does not treat emulsions. Flotation can remove free oil and emulsions, but the free oil is not recoverable as slop oil. Other technologies, such as ceramic membranes, are on the market and have strong pilot test history, but have yet to replace the standard API oil-water separators and dissolved gas flotation.

Technologies such as corrugated plate interceptors (CPIs), hydrocyclones, induced gas flotation (IGF) and centrifuges are not recommended, as they are not designed to handle the variation in water quality from desalters. This variation makes these technologies less effective and more labor-intensive.

In addition to the main type of pollutant and the chosen technology, a refinery must consider chemical pretreatment to break down emulsions in the desalter brine. A carefully designed and executed chemical treatment plan can save time and money, while a poorly executed plan can result in high chemical costs with minimal efficiency and emulsion breakdown.

Refineries make numerous decisions when processing opportunity or heavy crudes, including crude cost, availability and profit opportunity. The effect of the new crude on the entire refinery operation, including the WWTP, should be considered. To mitigate the risk of noncompliance, the refinery should evaluate the necessity of segregating desalter brine for pretreatment or making upgrades to the existing WWTP.

For more information on this topic, please contact Brian Foy at +1 (816) 822-3039 or bfoy@burnsmcd.com. ●

Tracking the growth of the BRM market

On March 23, 2005, the US petroleum refining and chemical processing industries were irrevocably altered. A devastating explosion at BP's Texas City, Texas refinery—caused by the ignition of a hydrocarbon vapor cloud in an isomerization process unit—claimed 15 lives and injured more than 180 people.

A subsequent investigation determined that the deaths occurred when the blast's pressure wave struck a series of contractor trailers that were located near the explosion's epicenter. It was also ascertained that the trailers were located inappropriately close to the process unit's blast-relief outlets, greatly contributing to the loss of life.

As a result, builders and suppliers of mobile structures that house workers at refinery sites rushed to develop what would become known as "blast-resistant modules," or BRMs, that would better withstand the forces of an explosion. While these efforts were admirable (and necessary), they were also a bit premature, as it would be two more years before the American Petroleum Institute (API) would release its *API Recommended Practice (RP) 753: Management of Hazards Associated with Location of Process Plant Portable Buildings*.

During the subsequent trial and error period, the refining industry worked expeditiously to improve the safety for its site personnel by relocating all mobile units outside of potential blast zones.

All uncertainty ceased when the API released RP 753, which provides guidance in reducing risk of explosion, fire and toxic releases to personnel that are located in portable buildings. The guiding principles of RP 753 include:

- Locate personnel away from covered process areas consistent with safe and effective operations
- Minimize the use of occupied portable buildings near covered process buildings
- Manage the occupancy of portable buildings, especially during periods of increased risk, such as planned startup or shutdown operations
- Design, construct, install and maintain occupied portable buildings to protect occupants against potential hazards
- Manage the use of portable buildings as an integral part of the design, construction, maintenance and operation of a facility.

Armed with these guidelines, the producers of mobile buildings now had a blueprint that could be used to direct their BRM development efforts (**FIG. 1**). Most significantly, effective BRMs must now meet certain ratings pertaining to blast waves, pounds per square inch (psi) and overpressure.

Meeting mandated specifications, configurations. Today's API 753-compliant BRMs are constructed of explosion-resistant, steel-reinforced roof and wall panels, and are available in standard 12 ft × 40 ft, and 12 ft × 20 ft sizes. Multiple units can be linked together to make a larger complex and can be stacked two stories high. All units can be custom-built and outfitted with a number of options and configurations, depending on the needs of the facility. These options include control rooms, ports for incoming electrical and communication services, air conditioning, lockers, showers, break rooms with kitchenettes, restrooms, windows, cargo doors, emergency lighting, insulation, smoke detectors, and washers and dryers.

"Refineries now know what they need to do to protect their people, and how state-of-the-art BRMs can help them do that," says Robert Slagel, CEO and President of DropBox Inc., a subsidiary of the Portable Solutions Group (PSG) and a provider of containerized products and custom builds for use at global jobsites, refineries and plants worldwide. ●

FIG. 1. DropBox Inc. mobile structures provide numerous options and configurations, and are compliant with API RP 753 to protect onsite personnel.

SCENES FROM THE 2017 AFPM ANNUAL MEETING

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1 **TechnipFMC** showed their team spirit and shared their technologies with AFPM attendees.

2 **CB&I** welcomed visitors to its event with a Texas cowboy showcasing his lasso skills.

3 Willkommen to the **Linde** Biergarten!

4 The team from **Merichem Co.** highlighted its innovative caustic treating technology.

5 Breaks throughout the conference were put to good use by AFPM attendees, as colleagues discussed what they were hearing in the technical sessions.

6 Criterion Catalysts and Shell Global Solutions transformed the second floor atrium into the Wild West, where attendees were greeted by a sheriff and saloon girl. Showing off his rifle skills, **Juan Estrada** from Criterion Catalysts takes careful aim at the targets on a computerized carnival game.

7 Thanks to the Marriott Rivercenter and Riverwalk hotels for providing AFPM members with comfortable spots to share key learnings and industry insights.

8 Sand artist **Joe Castillo,** who was featured on America's Got Talent, used sand to draw the likeness of one of the visitors to the Axens hospitality suite on Monday night.

9 **W.R. Grace & Co.** welcomed its guests for a fiesta-themed Sunday brunch and networking event.

What's missing in this picture?

AFPM

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Annual Meeting
March 19-21, San Antonio, TX

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

International Base Oils &
Waxes Conference
March 27-28, San Antonio, TX

Security Conference
April 24-26, San Antonio, TX

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

National Occupational &
Process Safety Conference
May 17-18, New Orleans, LA

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

Operations & Process Technology Summit
(Formerly Q&A and Technology Forum)
October 2-4, Austin, TX

Environmental Conference
October 15-17, Denver, CO

afpm.org/Conferences

a superhero approach to Tier III standards

With the majority of gasoline sulfur coming from the Fluid Catalytic Cracking (FCC) unit refiners are looking at control strategies to reduce gasoline sulfur while managing octanes.

There are a number of key approaches:

- Hydrotreating of FCC feeds comes with considerable hardware investment and octane loss
- Decreasing gasoline end points at the expense of gasoline volume and octane
- Hydrogenation post treatment at the expense of octane loss
- FCC additives to reduce gasoline sulfur while enhancing octane

Johnson Matthey's industry leading INTERCAT$_{JM}$ FCC additives are a lower cost option to capital investment that allow refiners to quickly respond to changing feeds, maintain and improve octane, and reduce gasoline sulfur.

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