

Goff implores industry to better educate general public

Gregory J. Goff, president and chief executive of US-based refiner Tesoro, woke up conference attendees at Tuesday's breakfast with a rousing speech on the challenges faced by the domestic industry.



GREGORY J. GOFF

Mr. Goff implored attendees to concentrate efforts on educating the general public about the importance of the industry.

"The future of refining may depend on the extent [that] we're able and prepared to engage those who have a key stake in our business," Mr. Goff said.

"Most importantly, that's our customers," he added. "They need to know what's at stake if we can't do our job. If customers understand our industry's value, the hearts and minds of politicians will surely follow."

Mr. Goff lauded recent news that the US became a net exporter of refined products in 2011 for the first time in more than 60 years.

"Ten years ago, [refined fuel] wasn't in our top 25 exports," he said. "It used to be airplanes. Now, it's the stuff that allows them to fly."

"Our success in the future will depend on our ability to expand that reach," he said.

Unfortunately for the industry, Mr. Goff said the market alone will not be the dictator of the types of products that are manufactured and exported.

"There's another dictator of sorts, and it lives in Washington, D.C.," he said.

"Among all the obstacles we face, EPA's Tier 3 sulfur proposal underscores the regulatory challenge each of us faces going forward."

Mr. Goff said that in less than a decade, the industry slashed sulfur content in gasoline by 90%, spending upwards of \$9 billion to do so.

"But now, we're told the EPA wants to cut whatever excruciatingly small amount is left by another 70% to 90%, for double or triple the cost," he said.

To combat this, the industry must mount a public campaign for science to "reclaim its rightful place" in the process, Mr. Goff said.

"If we don't start asking the right questions, we will continue to get the same wrong answers," he said.

However, companies must bear in mind that the process starts at the customer level.

"As we continue to make new investments in technology on our processing units, we cannot forget the importance of engaging, educating and informing our customers—which, in our case, include just about everything on two legs and four wheels. These are people who vote, show up at town hall meetings and communicate with elected officials on a daily basis."

Mr. Goff said he was "ready, willing and eager" to have those conversations, both with those that support the industry and those that do not.

"People love their iPad, but a much smaller proportion knows all the things that went into it to make

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Maximizing diesel production

Tuesday's FCC operations technical session was chock-full of useful and pertinent information. Phillip Niccum of KBR led the agenda with a presentation on maximizing diesel production in the FCC-centered refinery. Mr. Niccum's remarks utilized expertly cited examples from the past to help explain how diesel production might fare in future refining operations.

One of Mr. Niccum's key points was how FCC-based refinery diesel production can be maximized while taking advantage of existing FCC assets. As shown in Fig. 1, the simple answer is to avoid the loss of virgin distillate to the FCC feedstock and maximize the production of hydroprocessed LCO and diesel synthesized from the oligomerization of lower-boiling FCC olefins.

Mr. Niccum indicated that, after a refiner has taken the steps necessary to minimize the loss of straight-run diesel to the FCC feedstock, some FCC operating adjustments can be

commonly applied in the interest of increasing refinery diesel production. These include:

- Lower FCC naphtha endpoint
- Increased FCC catalyst matrix activity and lower rare earths/hydrogen transfer activity
- Maximized LCO endpoint.

Aside from these somewhat common strategies, Mr. Niccum advocated two other approaches. The first was to reduce FCC cracking severity, allowing for maximized LCO production, while taking action (if necessary) to mitigate the associated loss of FCC naphtha octane and LPG production. The second approach was to increase FCC cracking severity to maximize the production of lower-molecular weight olefinic products from the FCC unit and oligomerize these olefins to produce high-quality synthetic diesel.

Mr. Niccum concluded his remarks by issuing the following predictions, based on the assumption that demand

for diesel continues to increase faster than growth in gasoline:

- The loss of virgin diesel to the FCC unit will diminish through crude distillation unit improvements
- FCC gasoline endpoint will be minimized

• Hydrocracking and hydrotreating units designed to upgrade LCO quality will proliferate

• Low-hydrogen-transfer, higher-matrix-surface-area FCC catalyst will

► See **KBR**, page 3

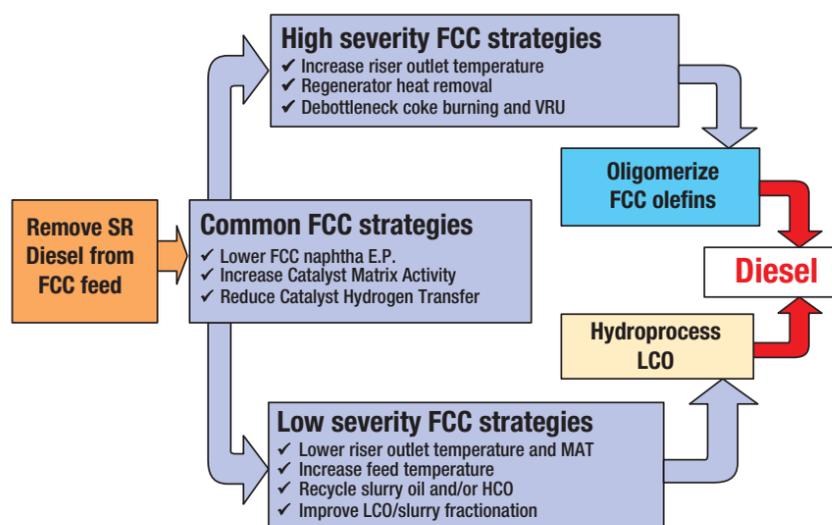


FIG 1. FCC diesel maximization.

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AIR PRODUCTS AWAITS RESULTS FROM GROUNDBREAKING CO₂ CAPTURE PROJECT

The technical and economic results from Air Products' groundbreaking CO₂ capture project in Port Arthur, Texas will be critical to determining the most effective commercialization path for future projects.

Those were the thoughts of Bill Baade, an Air Products official involved with the project. He spoke at Tuesday morning's AFPM technical session on hydrogen.

"As of now, the existing CO₂ market does not support current CO₂ capture economics without external funding," he said.

As a result, the Air Products project was accomplished via \$284 million in funding from the US Department of Energy (DoE), which represents about 66% of the overall cost, Mr. Baade said.

When complete, CO₂ captured from hydrogen steam methane reformers (SMRs) at Valero's refinery in Port Arthur will be compressed and purified, and then sent to Denbury for injection into Texas oilfields for enhanced oil recovery.

The foundations for the project were laid in September 2011, and mechanical construction began in January 2012.

One plant is expected to start up in late 2012, with the other launching in early 2013, Mr. Baade said.

Shell in Canada and Air Liquide in the Netherlands are planning similar CO₂ capture programs, although those are not expected to start up until 2015.

As such, early results from the Air Products project will be closely examined.



BILL BAADE of Air Products answered many questions about his company's CO₂ capture project in Port Arthur, Texas.

CARBON RULES COMPLICATE CRUDE SUPPLY FOR FUEL MANUFACTURERS

Regulations to limit the carbon intensity (CI) of gasoline and diesel could make crude derived from natural bitumen and oil shale less viable to fuel suppliers, said Bill Keesom of Chicago-based Jacobs Consultancy.

Mr. Keesom addressed AFPM members at Tuesday morning's technical session on crude oil supply.

"Crude oils will have to be treated differently," Mr. Keesom said. "You'll have good crudes and bad crudes. Some crudes will be more or less valuable, not based on economics, but on other variables."

For example, he noted that in Europe, the Fuel Quality Directive mandates a 6% reduction in carbon intensity by 2020.

Likewise, in California, the Low Carbon Fuel Standard (LCFS) mandates a 20% drop in carbon intensity by 2020.



BILL KEESOM of Jacobs Consultancy spoke about increasing carbon intensity regulations and their impact on crude oil supply.

That could hurt the viability of crudes from natural bitumen and oil shale, which have much higher CI figures, Mr. Keesom said.

"If you have a fuel deemed to have a high CI, you can either use less of it, or you have to have something to offset it, like more non-petroleum-based fuels," Mr. Keesom said.

"It's an economic burden. You need to find other fuel supplies."

RESID FCC CATALYSTS CAN MINIMIZE DELTA COKE

The use of resid FCC catalysts instead of traditional gasoil catalysts can help tremendously with minimizing delta coke in FCC operations, said UOP's Patrick Walker.

Walker spoke to conference attendees at Tuesday morning's technical session on FCC operations.

"A resid FCC catalyst gives you a lot of features you don't get with a regular gasoil catalyst," Mr. Walker stated.

In particular, the matrix design



UOP's **PATRICK WALKER** discussed the benefits of resid FCC catalysts.

considerations are made to minimize delta coke. There is also significant pore volume to accommodate large PNAs.

Additionally, the resid FCC catalysts have traps for vanadium and nickel, both of which boost delta coke if not addressed.

High delta coke is bad for an FCC unit because it increases the regenerator temperature, accelerates catalyst deactivation and decreases the working life of internal equipment, Mr. Walker explained.

To help with the process, UOP offers proven technology for processing delta coke-rich feeds, Mr. Walker said.

The company specifically designs every component of reactors to minimize delta coke, he explained, including VSS riser termination, AF stripper trays or packing, and *Optimiz* feed distributors.

Once complete, resid FCC units have many benefits, including higher propylene yields. ●

KBR, continued from page 1

be used to improve LCO yield and quality while increasing LPG olefins production and naphtha octane

- In some cases, ZSM-5 catalyst additives will be used to further increase LPG olefin production and octane, but in low-severity FCC operations this may come at the expense of some LCO yield.

For refiners that also place high value on propylene production, high-octane gasoline, and the minimization of refinery bottoms production, Mr. Niccum said the high-severity FCC route for making more diesel would gain favor.

Meanwhile, if a refiner has a more singular focus on diesel production, the low-severity, traditional FCC route to increasing diesel can be optimized and economically favored with a few enhancements, including:

- The loss of LCO in slurry oil product or recycle will diminish through the use of dedicated slurry distillation hardware

- Some of the stripped slurry oil may be recycled to the FCC reactor to produce more LCO and help maintain FCC heat balance, while HCO recycle may also be advantageous.

Mr. Niccum also said that an ultimate vision for maximizing diesel

production in a specific FCC-centered refinery may include a selective combination of extraction processes that will separate aromatics-rich fractions of FCC gasoline from fractions rich in olefins and paraffins. ●



PHILLIP NICCUM, KBR, was the opening speaker in the FCC Operations technical session.

In yesterday's edition of the show daily newspaper, attendance figures for the AFPM annual meeting were cited incorrectly. The correct information is as follows: Attendance at this year's AFPM annual meeting is 1,600, up by over a hundred from last year. *Hydrocarbon Processing* regrets the error.



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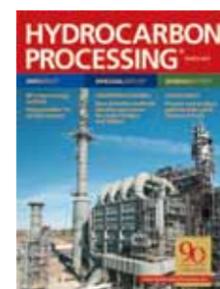
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TECHNICAL SESSIONS ROUNDUP

CAREFUL CHANGES TO TRANSPORTATION FUELS

Policymakers must carefully consider unintended consequences when proposing changes to the transportation fuels mix, said Khush Nariman, consultant with Houston-based McKinsey & Co.

Mr. Nariman spoke at Monday afternoon's technical session on gasoline and petrochemicals.

He detailed alternatives to gasoline such as sugar- and corn-based ethanol, but warned that consumers would need a price drop of 30% or more to change their buying habits.

As such, leaving ethanol to fend for itself in a free-market environment could seriously threaten that industry, he explained.

"If you leave it to free markets, you won't have the same growth or adoption," Mr. Nariman explained.

"On the other hand, incentives could be offered to producers as an alternative to mandates or requirements," Mr. Nariman said.

Overall, policymakers should consider three primary questions when formulating a proposal, he said. What are the most efficient ways to change behaviors, what is the impact of "market inefficiency" in consumer decision-making, and are there unintended consequences?

"These decisions will drive the market in entirely different directions," Mr. Nariman said. "It will have a very large impact on our industry going forward."

OPERATORS INCREASINGLY USING PREDICTIVE ANALYTICS

Refinery and plant operators are turning more often to predictive analytics when it comes to safety and operational risk management.

That was the opinion of Mark Weitner, global leader of operational risk management at Connecticut-based IBM Global Business Services.

He spoke at Monday afternoon's technical session on process safety.

Mr. Weitner applauded the industry, saying that predictive analytics are emerging as an important technique to identify organizational, operational and safety risk factors.

Moreover, those analytics are becoming core to companies' performance-management programs, he said.

"We're seeing a natural progression of using the increasingly sophisticated tools available," Mr. Weitner explained. "It's especially become more common in the chemicals and petroleum industry in areas like predictive maintenance."

In the past, there has been a disconnect between plant management, which looks at process safety from a reactive standpoint of injuries and deaths, and company management, which views safety on a broader, strategic level.

However, the industry seems to be coming together around predictive analytics, which allow companies to focus on pattern recognition.

Mr. Wietner noted key factors to shifting a company to predictive behavior, including an organizational maturity assessment, an information strategy readiness assessment, and proving value.

IBM assists in that process, he explained.

Once implemented, studies show regulatory citations for those companies as dropping significantly below industry averages, he said.

AUDITING PROGRAMS CAN BOOST PROCESS SAFETY

Plant operators should consider first- and second-party process safety auditing programs because data indicators do not fully measure quality or completeness, according to Thomas Lemm of DuPont Sustainable Solutions.

Mr. Lemm noted that his company's process safety incidents (PSIs) have dropped dramatically since the late 1990s, which is largely the same time period that audit programs became stronger, he said.

"You can't tell everything from just looking at a dashboard," said Mr. Lemm, who spoke at Monday afternoon's technical session on process safety.

The problem with earlier audits was that they tended to focus on seri-

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MARK WEITNER of IBM Global Business Services spoke on Monday about the use of predictive analytics in safety and operational risk management.



McKinsey & Company's **KHUSH NARIMAN** offered advice to industry and policymakers at Monday's technical session on how to frame transportation fuels proposals.

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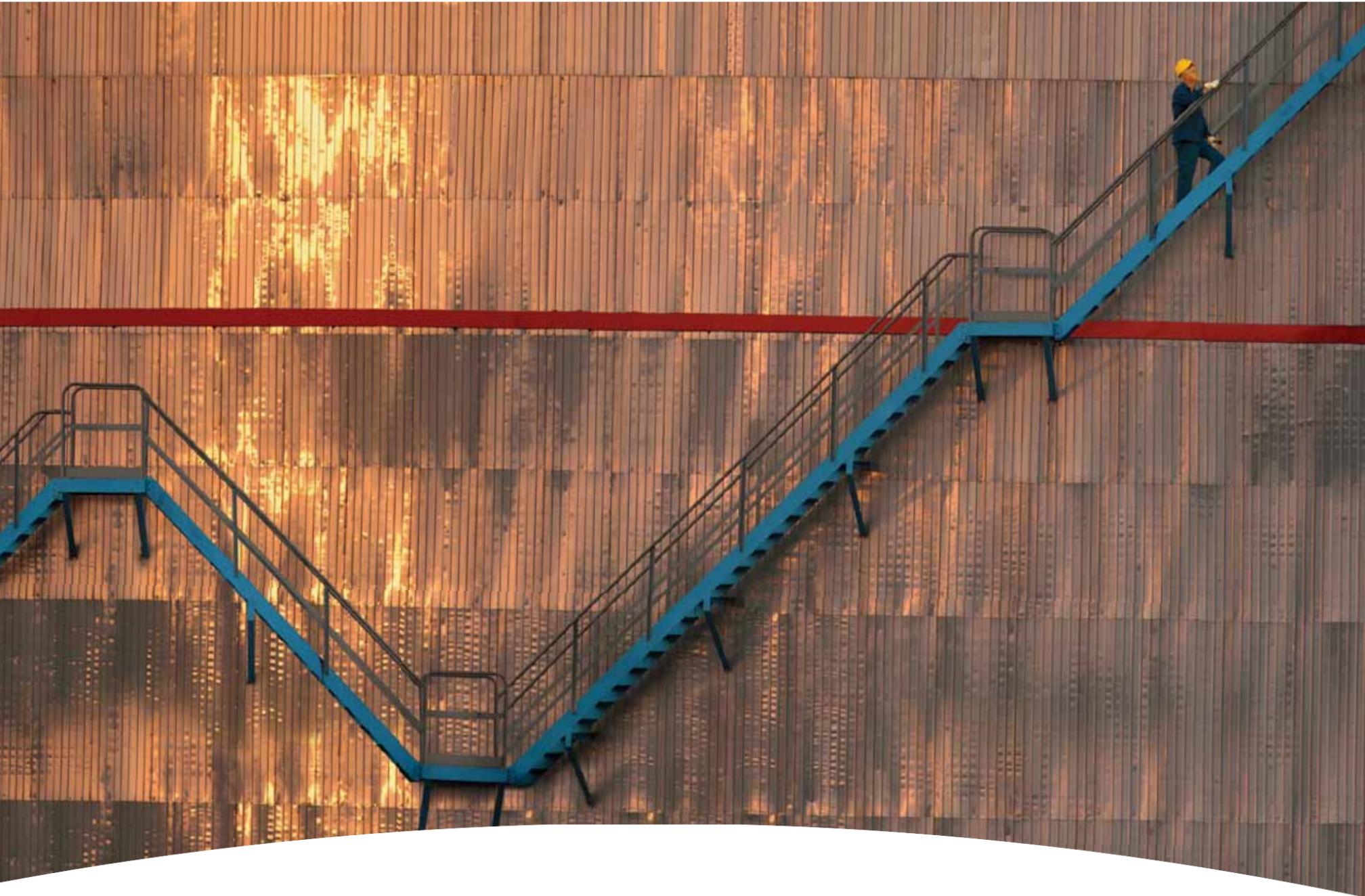
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The race is on to find the best route to renewables production

In discussing renewable energy and biofuels, it is not so much *if* and *when*, but *how* to cost-effectively produce and integrate biofuels into the US transportation fuel market. The given is that biofuels do play a role in the US fuel market; they are required by several mandates. Other countries are pursuing renewable fuel programs and, in some cases, they are ahead of the US in biofuels usage.

In the US, the ethanol blending wall has been hit. Domestic demand

for gasoline continues to decline. Refiners are challenged to find the means to blend mandated ethanol volumes into the gasoline supply. As gasoline demand decreases, refiners are mixing ethanol into regional gasoline blends that do not require oxygenated fuels.

Cellulosic ethanol development is making advances, but it is struggling with commercial-scale units at reasonable costs. However, there are definite benefits in converting no-value raw materials into qual-

ity transportation fuel blendstocks. Tuesday's Technology Pathways to Advanced Biofuels session set the stage for several biofuels developers to provide updates on their innovative biofuels technologies.

Biomass/biowaste-to-jet fuel is an opportunity being investigated by Terrabon. In 2009, this group began research and development work at its pilot plant outside Bryan, Texas. Terrabon's MixAlco process converts wet non-food organic waste (biowaste) into organic salts, which are further converted to ketones. With an octane number of 92, the bio-based ketone product can be used as a "drop-in" gasoline blendstock. The conversion from organic salts to ketones uses CRI/Criterion catalyst.

Gary W. Luce, CEO of Terrabon, explained that the MixAlco product has an estimated carbon intensity of 16.3 gm/MJoule and is compliant with California's Low Carbon Fuel Standard. Plans are in progress to transition from demonstration-scale to commercial-scale facilities and produce jet fuel through the BioJet program. Startup and flight testing of the biojet fuel are forecast to occur late next year.

Envergent Technologies, a joint venture between UOP LLC and Ensyn Corp., is developing a second-generation biomass process known as Rapid Thermal Processing (RTP) technology. RTP is a fast, thermal process that converts forest or agricultural residues into liquid fuel products. The heart of the process is UOP's circulating fluidized-bed reactor, which is similar to the company's fluid catalytic cracking (FCC) technology. Hot sand vaporizes the biomass, which is quickly quenched, thus yielding 65% to 75% RTP green fuel.

Envergent Technologies is constructing an RPT demonstration unit at Tesoro's Kapolei, Hawaii refinery. The DOE-funded unit will further investigate the conversion of forest re-

siduals, algae and other cellulosic biomass into green transportation fuels. The unit began operation last month and is demonstrating the technology. For refiners, the fact that the RTP process uses technology similar to the FCC process is a bonus, as refiners are already familiar with this type of operation. The process is an alternative to low-sulfur fuel oil.

Süd-Chemie is also moving forward with its proprietary bio-fermentation process to produce cellulosic ethanol. In 2011, the company broke ground on Germany's largest demonstration-scale cellulosic ethanol production plant, in the Bavarian town of Straubing. The process, Sunliquid, is a second-generation technology to process agricultural residues into bioethanol.

In this waste-to-fuels process, chopped organic waste undergoes hydrothermal treatment in a vapor pressure pot. The pre-treatment prepares the cellulose and hemicellulose sugars for further enzymatic hydrolysis and fermentation processes. In the hydrolysis, highly optimized enzyme mixtures are used to process different feedstock varieties. The enzyme mixtures are chosen based on the specific feedstock type and the responding process conditions. Process-integrated production of the biocatalysts provides flexibility and reduces production costs. C5 and C6 sugars can be converted to ethanol, which increases the yield by around another 50%.

Also, Süd-Chemie is developing a new purification process for first-time application at the Straubing plant. This is a significant factor in ensuring that the total amount of process energy required can be gained from the non-recyclable residual substance lignin. The demo plant has 300,000 gpy and should be operational in the second quarter of 2012. The race is on to convert "one man's trash" into high-value transportation fuels. ●



The Technology Pathways to Advanced Biofuels technical panel was comprised of some of the industry's brightest individuals. Panelists included **JEFF BRADEN**, Sud Chemie, **GARY LUCE**, Terrabon, **AL DEL PAGGIO**, CRI Catalyst, and **RICK KOLODZLEJ**, Mustang.



GARY LUCE, Terrabon, highlighted his company's technology during the advanced biofuels panel discussion.

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ous process safety incidents and fatalities, all of which are lagging indicators, Mr. Lemm explained.



THOMAS LEMM of DuPont Sustainable Solutions offered new perspectives used by his company on process safety performance indicators and metrics.

As such, there was very little data available with which to form analyses.

In the past 15 years, however, predictive metrics have gained in popularity. Within DuPont, their use continues to evolve, he explained.

For example, any new DuPont plant employee must show a "competency demonstration" within 90 days, he said.

Moreover, the company is integrating process safety metrics (PSMs) into individual performance reviews and employee surveys, he said.

Finally, DuPont is seeking to develop a web-based, central database of its PSMs, along with management system guidelines and workflow management tools.

These new perspectives continue to improve process safety within the industry, said Mr. Lemm. ●



JIM GILLINGHAM, Valero Energy, was a featured speaker at the advanced biofuels technical session.

Refinery scheduling for grassroots refineries

SIMON ROGERS, M3 Technology

Although there is almost no prospect of a grassroots refinery in North America or Europe, there are several being built in South America, the Middle East and Asia. M3 Technology is currently working on projects to implement refinery scheduling and multi-blend optimization systems for two grassroots refineries. In both cases, the objective of the operators of the refineries is to build and operate a best-in-class refinery using top technologies.

In first case, the refinery has recently been commissioned in Asia. Crude oil is imported via a crude oil terminal and transported inland via a dedicated pipeline. The refinery includes residue conversion and polypropylene production and is designed to produce fuels for the local market. The scheduling system is fully integrated with the other components of the manufacturing execution system, including the production planning, performance monitoring, operations instructions, oil movements and blending systems. The scheduling system covers:

- The two single point moorings and associated pipelines for receiving crude oil
- The crude oil tanks at the crude terminal including multi-period optimization of the crude blending into the pipeline
- The pipeline itself including tracking of the line-fill and each batch of crude
- The inventory and oil movements at the refinery
- The refinery and petrochemical units
- Multi-blend and multi-period optimization of the gasoline and diesel run-down blending
- Product shipment.

In the second case, the refinery is not due for completion for many months. The refinery will process locally produced crude oil supplied by pipeline and produce fuels for local consumption and export by ship. This refinery also has a high degree of conversion and includes aromatics production rather than polypropylene. The scope of the application is similar to the first project but without crude blending and pipelines and a product export terminal rather than a crude import terminal.

In both cases, the SIMTO Scheduling model was built using an existing LP planning model of the refinery. The unit models used in SIMTO are the same as those used in the LP planning model. This reduces the time to build and maintain the scheduling model.

SIMTO's M-Blend function is

used to optimize both feed and product blending across the entire 60-day scheduling horizon. And SIMTO's Dock Manager function helps to schedule the terminal operations and minimize demurrage costs associated with shipping delays. The SIMTO applications include utility and economic calculations to allow an economic comparison of alternative schedules.

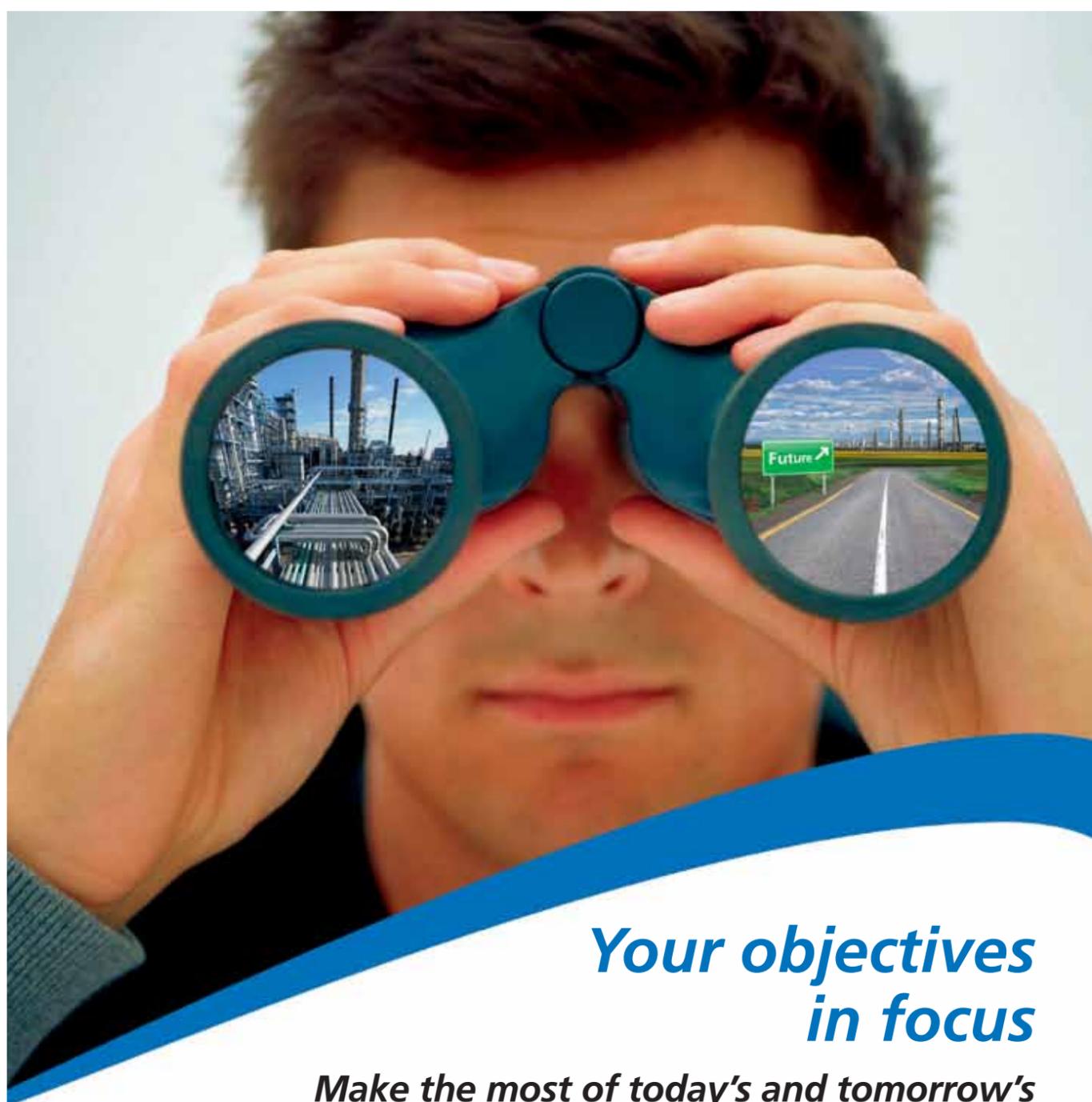
The systems are tightly integrated with the other MES applications at both refineries using SIMTO Integration Depot. Integration Depot leverages Web Services to minimize the time required to maintain the integration. The current status of the refinery, receipt and shipment nominations and the operating plan are automatically brought into SIMTO as the starting point for the schedule. The actual data

is used to compare with the schedule and the reasons for any deviations can be analyzed and used to improve the models used in the planning and scheduling systems when required. The resulting schedule, including operating instructions and blend recipes are exported to the MES and reports are sent to the relevant people for their information or action.

The systems were each designed and built in about six months, well ahead of the start-up of the refinery. This allows the refinery to use SIMTO Scheduling to model different commissioning scenarios and to become familiar with the scheduling of the refinery prior to startup. The availability of a comprehensive scheduling system helps to minimize logistics issues during the refinery

startup which can significantly reduce the commissioning costs.

There are three significant advantages associated with a project for a grassroots project compared to a project for an existing refinery. Firstly, accurate information about the design of the refinery and all refinery facilities is readily available in digital format. Secondly, the entire manufacturing execution system is designed and built as an integrated whole rather than being built piecemeal over many years. And lastly, the refinery schedulers are available to participate in the design and implementation of the system, as there is no refinery to schedule at the time of the project. These advantages enable to development of a manufacturing execution system which has at its heart SIMTO Scheduling. ●



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Improving operator-driven reliability in refineries

Mark Porter had an exciting opportunity on his hands. In the summer of 2009, the 25+ year veteran at the Irving Oil refinery in Saint John, New Brunswick, Canada, had

just been tasked with finding ways to improve safety, improve overall reliability and decrease operating costs at the 300,000-bpd facility. Mr. Porter and his team of opera-

tions and maintenance veterans attacked the problem with a view that it would take a multi-faceted approach involving people, processes and technology to achieve the gains required.

They started with the premise that operations personnel have a critical role to play in the reliability of the plant. Mr. Porter used the analogy of the family car, and the roles that both the owner-operator and the maintenance technician at the service shop have in the ongoing safe, efficient operation of the vehicle. The concept was developed into a comprehensive approach that the team describes as operator driven reliability (ODR). They worked with operations personnel to develop deliberate, direct operator involvement in equipment basic care, including equipment cleanliness, minor maintenance and inspection to promote early detection of potential failures.

They supported this operator hands-on approach with process refinements such as regular operator rounds (inspection routes) providing data transparency, improved shift-to-shift communications, and the development of operator task lists. Technology support to these process improvements involved the deployment of the Meridium Asset Performance Management (APM) software and the choice of Intermec hand-held computers for use by field technicians.

The team also developed data analysis that helped dimension the size of the opportunity. They calculated the cost of site safe incidents related to standard operating procedures and discovered they exceeded \$6 million per year over the last five years. The difficulties associated with developing, maintaining and providing timely access to accurate, current operating procedures for literally thousands of individual assets will be familiar to readers experienced in the industry, as they were to Mr. Porter and his team. But the absolute requirement to address safety improvement as a driving goal forced them to take a harder look at possible solutions.

This led them to work with Innovatia, a knowledge management company with extensive experience in capturing and disseminating technical product knowledge using a wide variety of processes and technologies. Together, they developed a software engine named Procedure Accelerator that enables dramatic reductions in the time, effort and cost to develop and deploy current, effective operating procedures for critical assets throughout the plant. An important feature of Procedure Accelerator is the ability to capture operator feedback on individual procedures in real time, so that best practices can be evaluated, refined and

quickly disseminated to the whole operations team. The system also interfaces with existing asset management and content management systems in use throughout the refinery. This product has been in use at the refinery for over a year, and is helping deliver significant improvements in both safety and operational reliability.

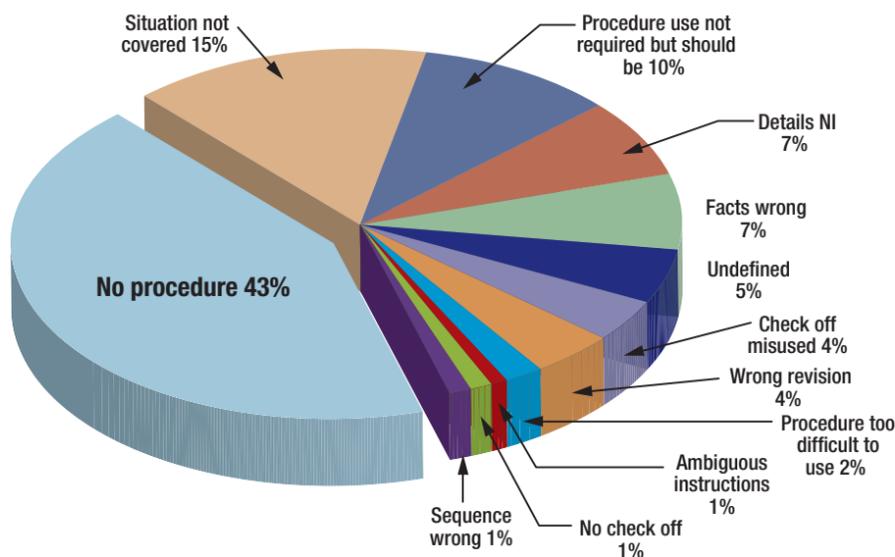
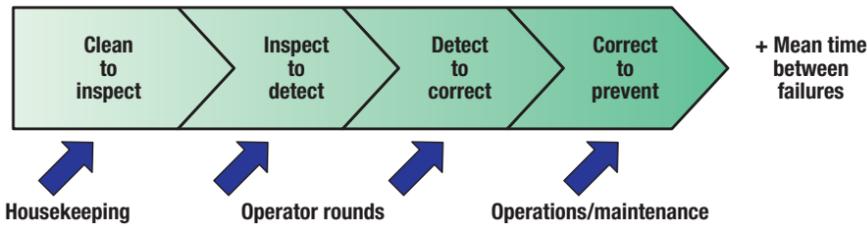
Mr. Porter explains some of the operational reliability improvements by telling a story based on his own experience. "When I was working with Innovatia to lay out asset operating procedures, the example came up of doing a pump return-from-maintenance with an API Plan 32 seal. Looking at the original sequence of steps that I had laid out from my own 25 years of experience, I thought to double-check with the supplier," he said. "Sure enough, my sequence was incorrect, and would have resulted in a shorter mean-time-between-failures. Then I got to thinking about how many technicians I had trained in those 25 years, and how many more they themselves would have trained. No other example drilled home to me more directly how critically important it is that every field technician uses a proven, consistent and accurate SOP, no matter how experienced he or she may be."

The ODR program is now fully entrenched in the original pilot areas of the refinery, and is being rolled out throughout the plant. The sustained focus on the combination of people, processes and technology to produce new, better results is proving to enhance operations and maintenance procedures. Clear benefits are now being achieved, including:

- Improved business decisions based on automated data collection and analysis
- Reduced maintenance costs with improved safety, with operations taking ownership of pre-failure maintenance routines
- Improved knowledge transfer throughout the work teams
- Improved consistency of work processes, based on new clarity of roles, responsibilities, expectations and accountability for operations personnel
- Increased clarity regarding priorities, issues and risks, based on improved communications and documentation to support shift changes
- Increased safety and risk reduction, through effective adherence to process safety management standards.

Mr. Porter's team is still fully engaged in the rollout, and in maximizing the benefits being achieved across the organization. He sums up their motivation by saying, "At Irving Oil, we believe that operations can have at least as big an impact on plant reliability and safety as does our maintenance department." ●

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NEWS IN BRIEF

AIR PRODUCTS AND TECHNIP HYDROGEN ALLIANCE: CELEBRATING 20 YEARS

Back in 1992, Air Products and Technip formalized their worldwide hydrogen alliance whereby Technip provides the design and construction expertise for steam reformers while Air Products provides the gas separation technology. This worldwide alliance has built over 30 hydrogen production facilities and currently has over 1.7 billion scfd of hydrogen capacity on-stream. Air Products and Technip continue to provide the worldwide refining and petrochemical industries with competitive technology and world-class safety and reliability. Air Products, through its extensive operating network, and Technip, from its large reference base, also bring effective operational and engineering knowledge to “design-in” high reliability and efficiency. The plants are operated and maintained by Air Products under long-term agreements with customers.

In the early 1990s, the sale of gas (SOG) business model (whereby an industrial gas company owns and operates the hydrogen plant) was a new phenomenon to the refining industry. The Hydrogen Alliance built its first two hydrogen plants to accommodate the needs to two refineries in Martinez, California. One plant was designed to maximize hydrogen generation efficiency, provide for a 40% capacity increase within three years of startup, while at the same time minimizing export steam to the refinery. The second plant was custom designed to process a blend of up to eight different refinery fuel gas (RFG) streams to be utilized as either feed or fuel.

Some things have changed over the past two decades. The sale of gas business model for hydrogen has been very successful with over two-thirds of the on-purpose hydrogen capacity awarded in North America and 40% in Western Europe choosing the SOG model. The paradigm of “Make shifting to buy” hydrogen is starting to take hold in developing refining centers in India, China and the Middle East. Some things have not changed, as efficiency and environmental concerns remain top considerations for refiners. The Hydrogen Alliance has been focused on improving efficiency and focusing on being more environmentally friendly through the use of low NOx burners and selective catalytic reduction (SCR) units.

As an alternative to venting CO₂ into the atmosphere, Air Products is constructing a commercial scale CO₂ capture demonstration from two SMRs in Port Arthur, Texas. Air Products is installing its proprietary vacuum swing adsorption technology as part of a cost sharing program with the Department of Energy. A significant portion of the CO₂ will be put to productive use for enhanced oil recovery (EOR), by recovering and compressing the CO₂ into Denbury Resources’ “green” pipeline for EOR in Texas oil fields.

Air Products’ current hydrogen forecast anticipates that an additional

10 billion scfd of hydrogen will be awarded globally by 2020 primarily driven by global trends: clean fuels, increased demand for transportation fuels, increased use of heavy, sour crude and replacement of aging hydrogen production assets.

KNOWING THE FACTS ABOUT BLAST-RESISTANT MODULAR BUILDINGS

A blast-resistant modular building is more than a luxury in many industries—it’s a necessity and one that can save the lives of many people. But from the outside looking in, it may be hard to truly understand why some modular buildings differ so much from others. After all, they look similar in size and function. So why worry about the details?

First and foremost, the safety of your employees is paramount. Hunter Buildings has quality control over every aspect of its structures, beginning with the planning process through project completion.

With OSHA’s enforcement of “Process safety management of highly hazardous chemicals” in 1992, the entire industry was discouraged from using portable buildings within plant process areas. API and CMA jointly developed API Recommended Practice 752 (API RP 752) due to OSHA’s stance and the specific incidents of collapse and resulting injury/death of wood-framed trailer occupants.

In light of that, Hunter Buildings was conceived with a singular goal of designing and marketing a superior building to replace wood-frame construction altogether. Hunter offers bolted designs in addition to the traditional welded design for multi-module complexes, providing more options while maintaining high safety standards.

Modular buildings might look alike, but that does not mean they are all created equal. Ensuring the safety of employees and technical equipment is a priority in this industry. Hunter Buildings vows to always be completely API RP 752/753 compliant. Its structures are custom designed, engineered and manufactured from the ground up, to meet the requirements of the client’s site safety, project needs, and current ASCE recommendations.

All Hunter analysis calculations are performed by third party professional structural-blast engineers. This ensures that each calculation is made with the utmost integrity and professionalism. Hunter Buildings’ blast design has been validated by physical tests performed by third party specialists. And unlike wood-frame construction, all Hunter buildings carry a blast rating and arrive ready to meet your specific area instructions.

While some modular building companies stop there, Hunter goes beyond expectations to include US Department of State-certified forced entry, ballistic-resistant modular buildings and complexes, disaster response solutions and specialty doors and windows. Hunter’s forced entry, ballistic-resistant (FEBR) buildings continue to gain popularity. ●



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Are corrosion inhibitors causing problems in today's diesel engines?

Filter plugging and internal diesel injector deposits (IDIDs) continue to grow as a significant industry concern in today's diesel engines. With so much going on in the industry, such as the growing use of newer technology common rail direct injection engines, the growing use of biodiesel fuel blends, and even the transition to ULSD several years ago, there is no lack of speculation as to the cause. However, one common theory seems to be drawing a lot of attention—that corrosion inhibitors are likely contributing to the problem.

Corrosion inhibitors have an important role to play protecting refinery assets, such as pipeline and storage systems. Likewise, they are important for terminal storage and delivery systems. They also help to protect vital engine parts from the corrosive effects of water that may enter vehicle fuel tanks. Unfortunately, evidence is surfacing that, while some corrosion inhibitors are very effective at preventing water-related issues, they may be introducing other major problems for equipment manufacturers.

Responding to filter plugging. Lubrizol is taking a proactive role in response to rising field reports of filter plugging

from engine and vehicle manufacturers. As the industry leading researcher, innovator, and supplier of advanced petroleum additive solutions, Lubrizol can help refiners ensure their corrosion inhibitors are not contributing to the problem. Lubrizol has developed a new filter plugging test that can help screen out corrosion inhibitor technologies that may be leading to clogged fuel filters.

The filter plugging test, based on the ASTM D6426 standard test method for the filterability of middle distillates, has been formally shared with the American Society for Testing and Materials (ASTM). Extensive data from the new test confirms that corrosion inhibitors with higher acidic properties tend to show a propensity to cause filter plugging in today's diesel engines. Twelve corrosion inhibitor technologies were tested, and the results are seen in Fig. 1.

The results suggest that corrosion inhibitors with higher acidic content provide strong corrosion performance, but are likely to cause filter plugging. The results also suggest that low acid corrosion inhibitors are less likely to cause filter plugging, but with lower corrosion protection.

“What it means to petroleum refiners is that refiners should be aware of the possible downstream impact of their corrosion inhibitors on filter plugging issues in today's vehicles,” said Ryan Chun, product manager for Lubrizol, “It's quite possible the industry will recognize the need to move away from problem corrosion inhibitors, and through this new testing capability, Lubrizol can help refiners make a proactive and smooth transition to a winning solution.”

Advanced corrosion inhibitor technologies are available, such as a Lubrizol medium acid corrosion inhibitor chemistry that provides excellent protection and does not plug fuel filters. “These technologies can help reassure refineries that their corrosion inhibitor selection is not triggering downstream headaches,” concluded Mr. Chun.

A look at internal diesel injector deposits. Deposits can build up in the tiny spray holes of diesel fuel injectors, eventually choking off the flow of fuel in a process called nozzle coking. These deposits impact the amount of fuel delivered, the spray size and pattern of the fuel droplets, and how the fuel and air mix in the combustion chamber. This impacts the power, fuel economy, and emissions we get from the engine. For decades, though, deposit control additives have existed to effectively control or eliminate this conventional type of injector deposit.

But today, as equipment evolves to meet ever-stringent fuel economy and emissions regulations, older diesel fuel injection systems are giving way to high pressure common rail injection systems where fuel is supplied already at much higher pressures and temperatures to the fuel injector. Injector components, like the needle and command piston, have become very small and lightweight. Tolerances be-

tween moving and stationary injector parts are now extremely tight—down to just a few microns. All these factors magnify the effects of deposits that occur deeper inside these newer, more intricate injectors. Commonly known as IDIDs, these deposits are now causing binding or sticking of the moving parts, with consequences ranging from mild operability issues to complete engine failure.

Why now? Corrosion inhibitors have been effectively used for decades in diesel fuel, so why might some be causing problems today?

“It all comes down to how the composition of diesel fuel has changed with ULSD as well as the new challenges of biodiesel blends,” said Dr. Stuart Bartley, technology manager, Lubrizol. “Throw in that engine equipment itself has become much more complex and is subjected to significantly more extreme environments under the hood, and you've got a recipe for a host of potential new diesel concerns today.

“One very interesting fact that we've uncovered through Lubrizol's testing capabilities came from an analysis of injectors used in real world situations,” continued Dr. Bartley. “Manufacturers submitted many failed injectors to us for testing, and results indicated that the deposits are consistent with the use of high acidity type corrosion inhibitor chemistries.”

Responding to injector sticking. Lubrizol has demonstrated in a proprietary engine test that certain high acid corrosion inhibitors generate injector deposits and injector sticking consistent with those seen in the field while other, lower acid corrosion inhibitors do not. Ongoing efforts seek to understand the correlation between filter plugging tendencies and deposit formation.

Lubrizol is also a participating member of the Diesel Deposit subpanel operating under the Performance Committee of the Coordinating Research Council (CRC). CRC is a non-profit organization in which mobility and energy industries work together on mutual problems. The Diesel Deposit subpanel is investigating the phenomenon of IDID.

Conclusion. The ultimate goal of every refinery is to deliver more performance at less cost. But short-term savings can result in unforeseen and unintended consequences. The possibility that some corrosion inhibitors are either causing or contributing to vehicle filter plugging and IDID is such an example. A better scenario is when refiners can increase output and reduce downtime while also helping to eliminate downstream problems. Fortunately, corrosion inhibitor technologies do exist that are proven to not cause filter plugging problems. In addition, these same corrosion inhibitors show promising results that they are not causing IDID concerns. ●

Corrosion inhibitor	Acid number	Corrosion inhibitor performance	Filter test result
A	High	Excellent	Plugged
B	High	Excellent	Plugged
C	High	Excellent	Plugged
D	High	Excellent	Plugged
E	High	Good	Did not plug
F	Medium	Excellent	Did not plug
G	Medium	Good	Did not plug
H	Medium	Excellent	Did not plug
I	Medium	Good	Plugged
J	Medium	Poor	Did not plug
K	Low	Poor	Did not plug
L	Low	Poor	Did not plug

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Enterprise risk management offers sustainable advantage

In business, risk is everywhere. Failure to recognize and mitigate these risks can jeopardize lives, output, forecasts, compliance and valuation. Finding the sweet spot (the area providing the optimal balance of business risk and benefits) is the challenge.

Enterprise risk management (ERM) provides the framework to identify and prioritize risk exposure and to mitigate potential threats. To be clear, ERM does not reduce risk. Rather, ERM balances risk taken in pursuit of business objectives against the organization's appetite for risk. ERM helps drive opportunity and advantage in three critical areas: accountability, visibility and agility. To do this, ERM consolidates fragmented risk management silos into a contextual, enterprise-wide view. The ERM 360° perspective correlates and prioritizes diverse risk factors in context with competing enterprise priorities and performance metrics to overcome the false sense of security inherent with a "partial view of risk" approach.

According to McKinsey & Company, successful ERM initiatives have two facets; a "bottom-up" system that identifies and prioritizes risks in context with tactical risk policies and processes, and a second, "top-down" component that provides crucial leadership and oversight of enterprise-wide risks. The resulting clarity and risk dialogue allow top management to optimize the risk-reward balance. This holistic approach embeds risk diligence into normal management processes and equips employees to make the right risk-return decisions in daily activities. While mishaps may occur, ERM processes help create bulwarks to contain or even prevent associated damage and liability. It also helps leadership manage the crisis by pro-

viding clarity on what went wrong and how to solve the problem going forward. Over time, it may even create a protective halo.

ERM aligns management accountability with its ability to monitor, control and forecast business variables. ERM provides critical 360° visibility into operations that were previously opaque and helps validate strategy performance down to the local level. It also helps ensure local risk decisions, such as a maintenance cutback, don't jeopardize higher-level enterprise goals for uninterrupted production and low-incident safety.

ERM drives enterprise agility by allowing management to recalibrate policies based on dynamic goals and risk appetites. ERM facilitates the risk visibility and safety net an enterprise needs to aggressively pursue opportunities, without crossing the line into blind recklessness. In effect, ERM allows the enterprise to safely change directions or "run the tight rope." In contrast, a partial view of risk requires tiptoeing across the tightrope—while blindfolded. The lack of ERM insight and fallbacks require them to conservatively feel their way along, unable to seize opportunities that may present themselves.

A sense of urgency. According to Deloitte and Touche partner Henry Ristuccia, "There is enhanced [regulatory] scrutiny of how organizations manage risk and how a board is executing its fiduciary responsibility for risk oversight. Sitting idly by is not a solution." Bad things happen. Mechanical failure, supplier default, natural disaster or otherwise, if something can go wrong, it eventually will. Properly contained, it may be a nuisance. Worst-case, it can be crippling. On rare occa-

sion, disasters may be the result of a "black swan," a high-impact, hard-to-predict event beyond the realm of normal expectations.

However, these rarely offer an acceptable explanation. Data compiled over a 15-year period by Marsh Risk Consulting and Det Norske Veritas (DNV) demonstrate that efforts on the part of companies to eliminate dangerous and costly equipment failures have failed, and point instead to a steady increase in these events costing the US refinery industry on average \$4 billion per year.

Looking back to recent catastrophes (oil spills, mine explosions, the credit market collapse), a consistent pattern emerges. In virtually every case, the autopsy reveals precedents and warning data that were not collected, correlated or acted upon. At the time, the disaster trigger may have appeared to be an insignificant event or flaw. However, these overlooked bits of information eventually become the focus of board meetings and the front page.

Getting started. Fortunately, ERM advances have streamlined the integration of financial risk models with risk management for critical line-of-business functions like production. The COSO "Enterprise Risk Management: Integrated Framework" provides a good baseline for risk evaluation and management best practices. Another option is to embed ERM into existing, proven processes. If the enterprise has a financial risk management system in place, it may be possible to integrate it with risk management efforts in areas such as production. Meridium asset performance management supports this effort by aligning business strategies and plant objectives to help executives and practitioners mitigate

risk and capitalize on opportunities. Using asset performance management, solutions for diverse financial, operational and maintenance challenges converge at the asset, providing a cohesive framework to transform the management of assets into a world-class competitive advantage. Asset performance management solutions anticipate and quantify risk, from the costly to the catastrophic, and provide dynamic asset strategies to manage it.

Explosions, tornadoes, recessions and floods, the world should be considered a dangerous place: ERM helps anticipate and mitigate these risks. ERM is not a patch to fix a crisis, nor is it a one-size-fits-all approach. Rather, it offers a tailored and sustainable framework to maintain visibility and control over critical enterprise metrics. ERM provides the prioritized awareness and tools needed to mitigate threats and achieve objectives for safety, valuation and advantage.

This article is condensed from "Black Swans, Black Sheep, Black Ink: Driving safety, valuation, and sustainable advantage with ERM." For more information on this topic or to receive the full article, please contact info@meridium.com. ●



FIG 1. A complete view of risk.

DID YOU KNOW?

TECHNIP IN MALAYSIA

Technip has been awarded a front-end engineering design (FEED) contract by PETRONAS for its proposed refinery and petrochemical integrated development (RAPID) project located in the state of Johor, Malaysia.

RAPID aims at building a world-scale integrated refinery and petrochemical complex by 2016 to answer the growing need for specialty chemicals and to meet demand for petroleum and commodity petrochemical products in the Asia-Pacific region, officials said.

The proposed refinery will have a capacity of 300,000 bpd and will supply naphtha and liquid petroleum gas feedstock for the RAPID petrochemical complex, as well as produce gasoline and diesel that meet European specifications. ●



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Narrow the gap between refinery planning and scheduling

ZAFAR ALI AND ALLISON MCNULTY, Aspen Technology

The increased volatility of crude oil prices and regional demand shifts for petroleum products, increasingly larger presence of Middle Eastern and Asian refiners in the global market, the added complexity of meeting new product specifications demands in developed countries, and economic uncertainties have increased risks that affect refinery operations and profitability. The availability of new crude feedstock sources has driven the evaluation of refinery assets to lessen these risks and leverage supply chain optionality to maximize profit.

Facing pressures on multiple fronts, refineries continue to examine business processes and supporting systems to find new ways to streamline operations and improve the bottom line. This examination includes the key refinery processes of production planning and scheduling. Planners are charged with creating the optimal (profitable) plan considering constantly changing market conditions, while schedulers are tasked with executing against these plans.

Defining the gap. Gaps between the optimal refinery plan and the actual operating schedule exist because the plan does not often consider all the refinery asset constraints. Gaps can be easily identifiable such as degradation of the FCCU catalyst or delays in the delivery of a shipment of crude. Other gaps less easily detected include deviation of model predicted yields versus actuals, or it can be the ongoing margin leak during “normal” operations due to disconnects between planning and operations. While there are many technologies available to support refin-

ery planning, automation tools for scheduling and operations are relatively new. Bringing operations closer to the optimal plan while respecting refinery constraints and safety requirements can yield refining companies anywhere from 5% to 10% of gross margin or up to 10 cents per barrel.

Synergies in planning and scheduling. A good plan combined with poor scheduling does not yield desired results. Scheduling automation provides planners with the ability to validate their plans and make adjustments considering refinery physical constraints, if necessary. For planners and schedulers to be effective, they must collaborate and scheduling automation enables this to occur more easily. New integration between planning and scheduling enables the sharing of assay data and production targets to guide operations more closely to the optimal plan. Working with more accurate and consistent refinery models, planners and schedulers can identify gaps and determine what needs to change in the plan to make the schedule feasible, drawing actual closer to optimal. As this becomes an iterative process, improvements can be seen in plan vs. actual, narrowing the gap.

Powerful analytics and modeling capabilities. Cost of feedstock is the single largest operational cost for a refinery, and in the current market it is critical to select the right crude slate. Traders often have limited time to make purchase decisions; having accurate information readily available to guide these de-

isions can help save refineries millions of dollars annually. Planners require tools to better analyze different scenarios. Recent advancements in the accuracy of refinery planning and scheduling models include the use of powerful analytics such as scenario evaluation tools, feedstock ranging and crude basket reduction capabilities. These best practice techniques are available with the best planning systems supported by multi-core processing for faster results, allowing several cases to run in parallel, taking run-time from hours to minutes.

Results can be visualized in familiar graphs and charts making the optimal solution easier to identify and report.

Conclusion. Refinery margins will continue to be squeezed in today’s competitive market, making narrowing the gap between the operating plan and the executable schedule increasingly important. The use of integrated planning and scheduling automation with enhanced decision support and create the efficiencies required to positively impact the bottom line. Enhanced decision support through advancements such as feedstock ranging, basket reduction, and goal programming coupled with visualization and sharing of the data and integration of engineering models will enable refineries to operate closer to optimal and improving margins by as much as \$0.10 per barrel. Narrowing the gap between the plan and actual results will help refineries remain profitable in a volatile environment and allow these refineries to more effectively compete globally. ●



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GOFF, continued from page 1

that device a reality,” Mr. Goff said. “For a large segment of the American public, the possibility exists that with a little education on their part and continued commitment to innovation and safety on our part, we can meet in the middle.”

Mr. Goff described the industry’s importance as essential, making it easier to convince the public that refining is vital to the country’s progress.

“Fuels manufacturing is the process that turns an otherwise useless barrel of oil into building blocks that power a modern and mobile society,” he said. “Without it, we don’t have a society.”

One growing challenge is affordability, he noted, given rising feedstock costs.

“But we have accepted in full and met it, despite what newspapers and cable TV say,” Mr. Goff said.

“Despite everything that goes into making a gallon of gasoline, a gallon of fuel is still cheaper than a gallon of Gatorade or a gallon of Starbucks coffee.”

Moreover, refiners have a critical and ever-increasing value to society, he said. As such, Mr. Goff believes a large portion of the American public can ultimately be convinced.

“The stone age didn’t end because we ran out of stone,” he said. “In much the same way, the refining age won’t end because we ran out of refineries or customers; not so long as the basic requirements of modern society remain intact.”

“How we serve and engage them will be among the key questions as we go forward. If we fully expect to seize these opportunities, we need to start the process now.” ●



CONFERENCE ATTENDEES applauded the introduction of Tesoro CEO Gregory J. Goff at his Tuesday morning breakfast address.

Valves for hydrogen service

Tito Sequeira, Tyco Flow Control, wants everyone to know how critical valves are for refining operation performance.

“Did you know that 60% of fugitive emissions in refineries come from leaking valves?” Mr. Sequeira asked.

Additional interesting information was shared, such as the fact that 60% of the valves pulled in turnarounds do not need service. Mr. Sequeira also noted that valve spending per barrel of refining capacity has doubled since 1995, and he pointed out that oil refineries are by far the world’s largest consumers of hydrogen (90%).

Hydrogen is a significant safety risk because of its explosiveness. It is extremely corrosive at high temperatures and pressures, and can permeate gaskets and packing materials. When this permeation happens, it is called a fugitive emission.

Mr. Sequeira also warned of the dangers of embrittlement, which typically affects lower-concentration, high-strength steels. Then there is hydrogen blistering, which is seen in low-stress steels that commonly contain voids. These voids fill with hydrogen gas, causing a buildup of pressure that eventually leads to blisters and cracking. Mr. Sequeira is a firm believer in the utilization of API

RP 941 (Nelson curves) to combat this problem.

“Metallurgy is the area of the valve that the valve industry has the least control of,” he said. “End-users generally specify the materials for the valves. Thus, end-user input is essential in regard to temperature, pressure, concentration and exposure time.”

When designing valves for use with hydrogen, Mr. Sequeira recommends the reduction or elimination of sharp edges and abrupt angles, because they cause stress concentration and embrittlement. He also noted that welds are prone to embrittlement and should be minimized.

As far as leakage goes, it is important to note that 60% of valve fugitive emissions come through leaks in the stem. Therefore, in the stem, it is important to consider the use of gasket technology and packing technology. ●



TITO SEQUEIRA, Tyco Flow Control, is an expert in valves used in hydrogen service.

EVER WONDER WHAT MAKES OUR CATALYSTS SO ADVANCED?

The image shows a person pointing at a chalkboard. On the board, there are several chemical structures and a differential equation. The equation is $\frac{dC_A}{C_A^n} = -k dt$. The chemical structures include a benzene ring with a sulfur atom, a benzene ring with a nitrogen atom, and a benzene ring with a sulfur atom and a nitrogen atom. The structures are labeled with 'R' groups and 'S' or 'N' atoms. The person is pointing at the equation.

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SCENES FROM THE 2012 AFPM ANNUAL MEETING



The team from CH2M HILL had the annual meeting thoroughly covered. Pictured here: **JOHN RIZOPOULOS, PAUL FISHER, STEPHEN ENGLEMAN** and **KURT DAVIS**.



Gulftronic's **VIC SCALCO, MATTHEW SIEGEL** and **LARRY DAGONESE** met with clients in their hospitality suite.



By the end of the night, **LINDE'S MUSICIAN** was playing the harmonica and keyboard at the same time.



HONEYWELL'S SUITE in the Seaport Tower included a live band.



THE CHAMPION TECHNOLOGIES SUITE had its version of the popular Las Vegas theme.



DUPONT offered a makeshift "casino night" on Monday to conference attendees.



KARL BARTHOLOMEW of KBC Advanced Technologies spoke to a standing-room-only audience during Monday's technical session about the regional pivot points in global refining.



NATALIA KOLDACHENKO, Chevron Lummus Global, advised AFPM attendees on how using hydroprocessing can maximize refinery profitability.



OFFICIALS WITH ALONUSA told AFPM guests about a case study on how to maximize refining profits through a lean excellence program.



CB&I's **BRUCE E. STEIMLE** discussed the successful conversion of a catalytic cracking unit to riser cracking.



The ships have arrived and its moving day at the AFPM annual meeting. We hope you had an enjoyable and productive conference.



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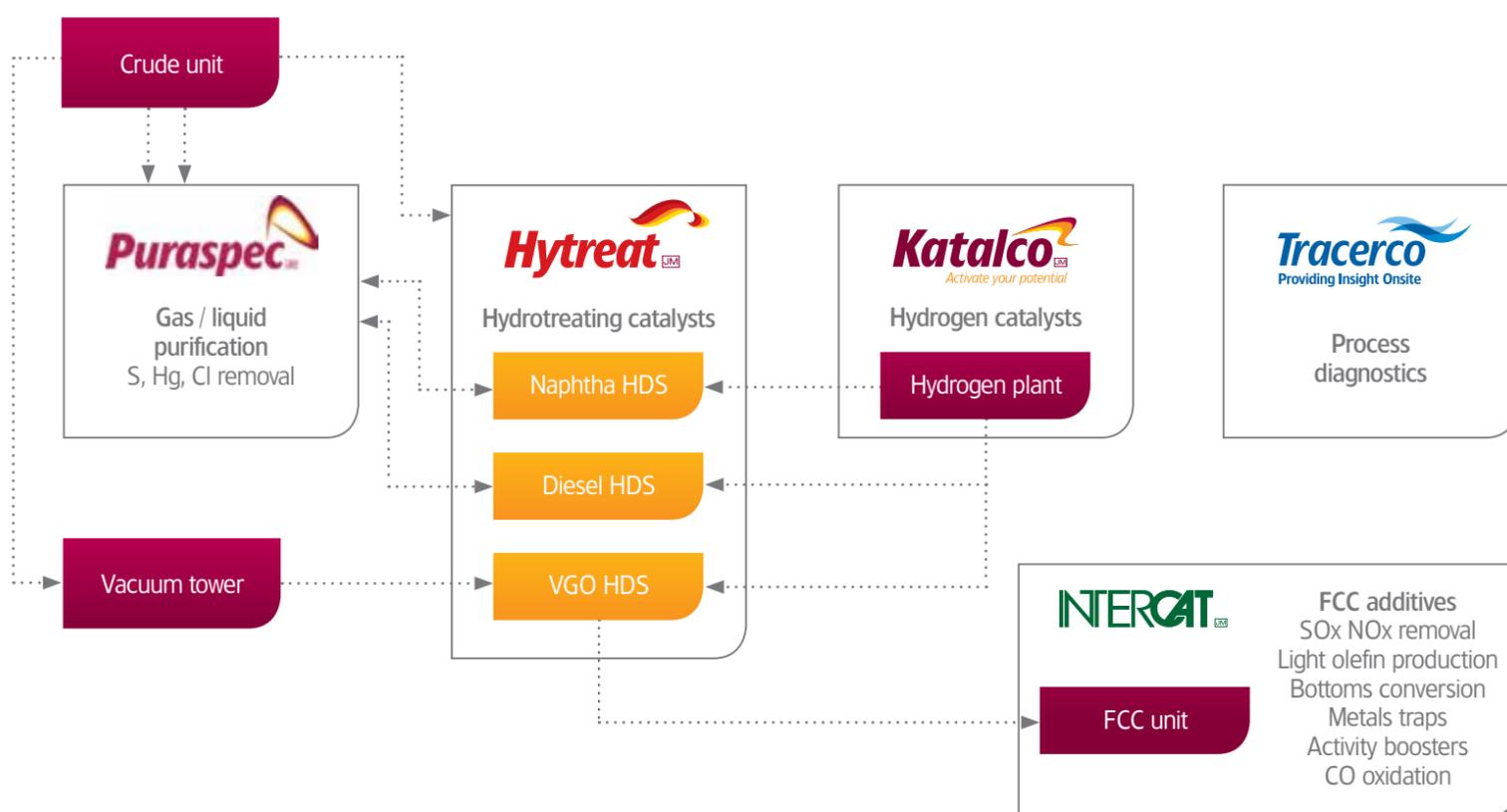
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