Refinery Operations

Engineering Solutions, Maintenance, Reliability, Automation and Equipment

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Catalyst Roundtable

Industry Experts in FCC, Hydrotreating and Renewable Fuels Technology Discuss Catalytic and Process Synergies Available for Upgrading Challenging Feedstocks Amidst Fluctuations in the Marketplace

Light olefins additives have been well proven in FCC units configured for petrochemicals production (e.g., chemical or polymer grade propylene). How can this same class of additives be used to further improve FCC economics?

Kristen Wagner, Marketing Manager, Grace Davison Refining Technologies (Kristen.wagner@grace.com): The refining industry is well versed in the use of ZSM-5 light olefins additives for the incremental production of propylene for chemical and polymer applications and butylenes for alkylation unit feedstock. However, light olefins additives are also capable of providing significant flexibility in operating the FCC unit, providing additional economic benefits for the refiner.

Grace experienced one such scenario when a refiner took an early turnaround on a catalytic reformer. The refinery was octane short and there was no opportunity to increase riser temperature. Grace recommended the use of a light olefins additive to boost the overall octane from the FCC complex. The use of ZSM-5 increases the yield of C_3 and C_4 olefins to feed the alkylation unit and any other units designed to create gasoline range material from FCC olefins. The effect of ZSM-5 on the conversion of gasoline olefins to LPG olefins can be seen in **Figure 1**.

The ability of ZSM-5 to increase the light olefins yield from the FCC is due to the size and shape of its micropores. The small pores of ZSM-5 allow rapid diffusion and cracking of low octane, linear hydrocarbons from the gasoline into LPG range olefins, leaving the gasoline richer in aromatics and hence octane value.

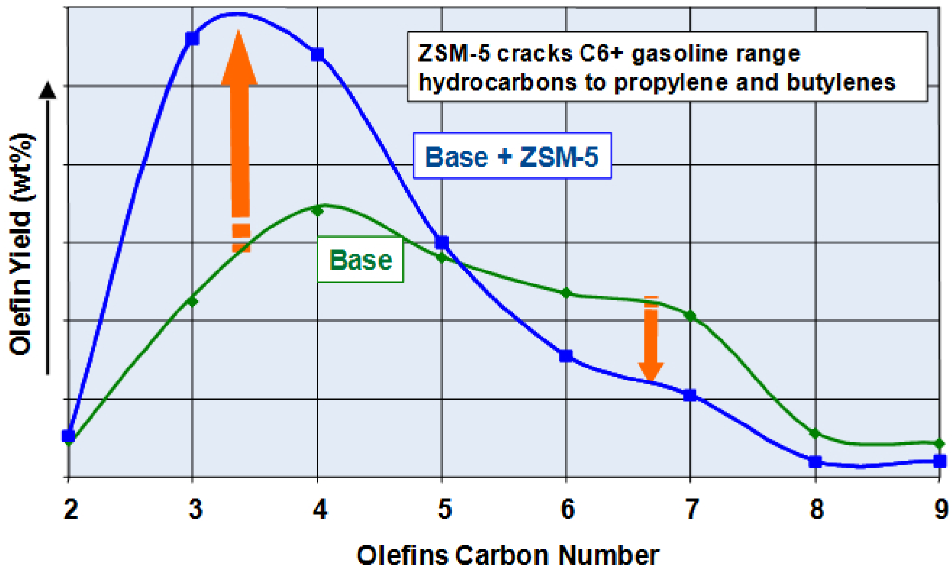

Figure 1. The effect of ZSM-5 on Olefins Distribution

As a result of ZSM-5 cracking, the incremental light olefins production from the FCC results in higher alkylate yields. Alkylate is a refinery blending stream that is high in both motor and research octane. At the same time, the yield of FCC gasoline generally drops at constant riser

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temperature, but the octane is increased, with general increases ranging from 0.3 to 0.7 numbers.

When the total octane properties of the FCC gasoline and alkylate are added together, there is an increase in octane of the total gasoline pool from the FCC complex. This is a valuable economic option when the FCC unit is running at reduced feed rates and there is available capacity in the alkylation unit. By varying the concentration of light olefin additive added to the circulating catalyst inventory, the refiner can independently optimize the riser outlet temperature at the alkylation unit maximum feed capacity. This option may be especially helpful in the fall and winter, when higher LCO yields are generally desirable.

Grace Davison is the leading supplier of high activity, high stability light olefins FCC additives. OlefinsMax®, Olefins*Ultra*®, and Olefins*Ultra*®-HZ additives are being used in over 70 FCC units worldwide. These additives continue to provide economic value for the refiner by generating incremental propylene, additional feed for alkylation and an increase in gasoline octane.

How will internal developments at Grace, such as the joint development and commercialization of Rive's zeolite technology for FCC units enhance refinery-wide operating flexibility?

Barry Speronello, Ph.D., Research Fellow, Rive Technology, Inc., (berry.speronello@rivetechnology.com):
Rive Technology and Grace Davison are commercializing advanced fluid catalytic cracking (FCC) catalyst technology that dramatically increases the yield of transportation fuels per barrel of crude oil. Rive's Molecular Highway™ technology makes traditional zeolite catalysts more capable of cracking large hydrocarbon molecules, and allows valuable primary cracked products, like gasoline and diesel molecules to more readily escape the catalyst before they are overcracked to less valuable light gases and coke.

This new catalyst is a drop-in replacement for current catalysts and will enable refiners to increase throughput and profitability without capital investment. Along with FCC catalysts based upon Y zeolite, Rive and Grace Davison plan to introduce mesoporous ZSM-5 based catalysts and additives for cracking. Laboratory progress is well along on these materials, and, if things go as expected, first results should be ready for publication by late this year or early in 2012.

Process constraints encountered in refinery operations, such as higher coker feed throughput will certainly influence strategies for upgrading hydrotreating units. In these situations, how do you work with refinery engineers in "making their job easier" when faced with these challenges and the inevitable "solutions" deadlines imposed by management?

Brian Watkins, Technical Service Engineer, Advanced Refining Technologies, brian.watkins@grace.com:
Advanced Refining Technologies LLC (ART) has spent considerable time and effort in helping to understand the differences between the need to process additional LCO, coker oils, streams from other hydroprocessing units, or various other synthetic crudes and assessing their impact on the refinery operation. This work has demonstrated that there is a significant difference in feed reactivity for a variety of different components that are not easily anticipated from the usual bulk feed analyses.

One of the major problems seen by customers is how to achieve a longer cycle by increasing EOR temperatures without the difficulty of having the product go off spec for color. ART has participated in taking numerous routine samples from the individual feed sources going to ULSD hydrotreaters in order to examine which streams are posing the greatest difficulty for the refinery. Utilizing pilot plant resources to test these individual feeds in order to provide a detailed answer to the refinery before a change to the process or equipment is made has allowed refiners to understand which streams are the most problematic and should be considered for alternate use if the economics allow it. Detailed analysis over time has allowed for changes in how petroleum is purchased or where a specific source should be placed.

Another refinery was having difficulty in maintaining the FBP of the LCO stream, and was unsure of its total impact on ULSD operations. The ability to look at a 30°F change in FBP helped the refiner to be able to better predict these changes to minimize the impact on hydrotreater performance and understand what catalyst changes needed to occur for the upcoming cycle.

In another unit that was processing SR naphtha a refiner was starting to see sudden catalyst deactivation, which was unexpected at this point in the cycle and appeared to be headed quickly towards a turnaround. Analysis of the various streams and the products, including the actual purchased streams, indicated that a particular stream was providing a very high concentration of poisons that were not expected. As a result, the refiner was able to make calculated changes to the purchase of naphtha in order to halt the need to turn around the unit. It was also discovered that some changes to the laboratory equipment accounted for the baseline shift, thus resulting in unit operation changes.

In addition to higher levels of performance with new catalyst formulations, refiners also expect the catalyst supplier to enhance the sale with recommended operating strategies for competing in the marketplace. Discuss how your approach fits into the refiner's "big picture."

Watkins:
ART has long proven the performance advantages with three major lines of hydrotreating catalyst systems. ART introduced the ApART™ Catalyst System to provide maximum HDS activity and significant upgrading of FCC feeds. This technology has been widely accepted in commercial service. As the challenges associated with meeting clean fuels regulations become more daunting, ART has continued to provide refiners with superior technology and first-class performance, as well as outstanding catalytic stability producing consistent, high quality feed for their FCC units.

The flexibility of the ApART system provides maximum HDS activity and thus lower FCC gasoline sulfur content, while providing the

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opportunity for higher FCC unit conversion at constant coke. In general, optimum ApART systems can be applied to reduce gasoline sulfur with higher gasoline yield for any specific FCC pretreater/FCC combinations. ART's understanding of the ApART system capabilities, along with its influence on the operation and performance of the FCC unit, permits these optimum solutions to be identified for the specific refiner's situation.

In keeping with refiners demand for superior technology and premium performance, ART developed the ultra high activity DX™ Catalyst Platform. DX catalysts have exceeded refinery expectations in its ability to tolerate difficult feed blends in demanding ULSD applications. Key to the technology is maximum utilization of active surface metals achieved by proprietary chelate chemistry. ART's DX series has proven its performance advantage with greater stability and exceptionally low hydrogen consumption to provide refiners with quality ULSD products. The use of ART's premium CoMo catalyst 420DX or in stacked combination with premium NiMo catalyst NDXi catalyst as a SmART Catalyst System™ provides premium alternatives for producing ULSD from a wide variety of difficult feeds.

Expanding this knowledge into the demanding area of hydrocracker pretreating, ART has also developed ways for a refiner to change the systems traditionally used in order to meet new requirements. HDN and HDA activity gains of over 25°F have been achieved. Recent introduction of 590DX has demonstrated outstanding HDS activity with extremely high HDN and HDA, which has enabled longer cycle times and improved yields. ART has been able to recommend both operation improvements and the ability to customize a catalyst system to meet the demands of the refiner.

How do recent innovations in specialty materials and analytical tools improve a refiner's renewable fuels focus? In addition, please elaborate on how Grace can help a processor turn a renewable fuels strategy into a profitability center.

Bob Riley, Commercial Development Manager, Grace Davison Renewables Technology, bob.riley@grace.com: Refiners have a number of options to consider for meeting their RFS2 obligations, including the purchase of RINs, biofuels, or the production of renewable diesel (RD). Production of RD from natural oils and greases can be a profitable means for an individual refiner or refining entity to achieve compliance, while production of RD beyond regulatory needs has the potential to generate extra margin.

The cost associated with the production of RD can be significant, and it is heavily influenced by the cost of the feed. The ability to process lower quality feeds with higher contaminants can enable a refiner to gain access to a larger pool of candidate natural oils and grease feeds. RD can be produced more profitably by pretreating the natural oils to remove contaminants that otherwise would rapidly reduce hydrotreating catalyst activity. The incorporation of Tri-Syl® silica into a pretreatment process as supplied by Desmet Ballestra S.p.A. (www.ballestra.com) yields highly efficient contaminant removal performance with very low oil loss, reducing pretreatment cost and extending downstream hydrotreater catalyst life.

Grace Davison has both catalyst and adsorbent technologies that have been specifically designed and manufactured for the conversion of natural oils and greases to RD. EnRich®HT catalysts are able to convert a range of biofeeds and have the capability to tailor the RD product properties to match a refiner's objectives. Depending on the configuration of the refinery, EnRich®HT catalysts can produce an RD product that can be blended into the diesel pool without the need for isomerization. This can provide refiners with a competitive advantage that allows them to avoid the purchase of biodiesel or alternative biofuels necessary to achieve compliance, and potentially further increase margins by trading or selling excess RD produced. ■

GRACE Davison
ART Advanced Refining Technologies

PROCESS OPERATIONS

OxyFuel Combustion for Process Heaters

Chris Leger, Praxair

A range of performance improvement strategies are being applied to process heater systems. Efforts to improve process heater and burner performance are driven by productivity goals and reduced emissions targets. In the current refining cycle, the onus on productivity has many refiners considering OxyFuel combustion, which is a set of technologies where oxygen can be safely used to replace combustion air in order to increase absorbed duty. For example, uniform temperature combustion reduces NOx emissions while flue gas minimization by way of oxygen combustion saves energy and reduces CO_2.

Praxair uses techniques involving internal furnace gas recirculation and flame dilution to limit peak temperatures and improve heat flux uniformity. Controlling flame temperature in process heaters by flame dilution and oxidant staging significantly reduces NOx emissions. Reducing flue gas volume by replacing air with oxygen also significantly improves thermal efficiency. For example, replacing air combustion with Praxair's proprietary OxyFuel burner system for process heaters reduces flue gas volume by up to Cont. page 4

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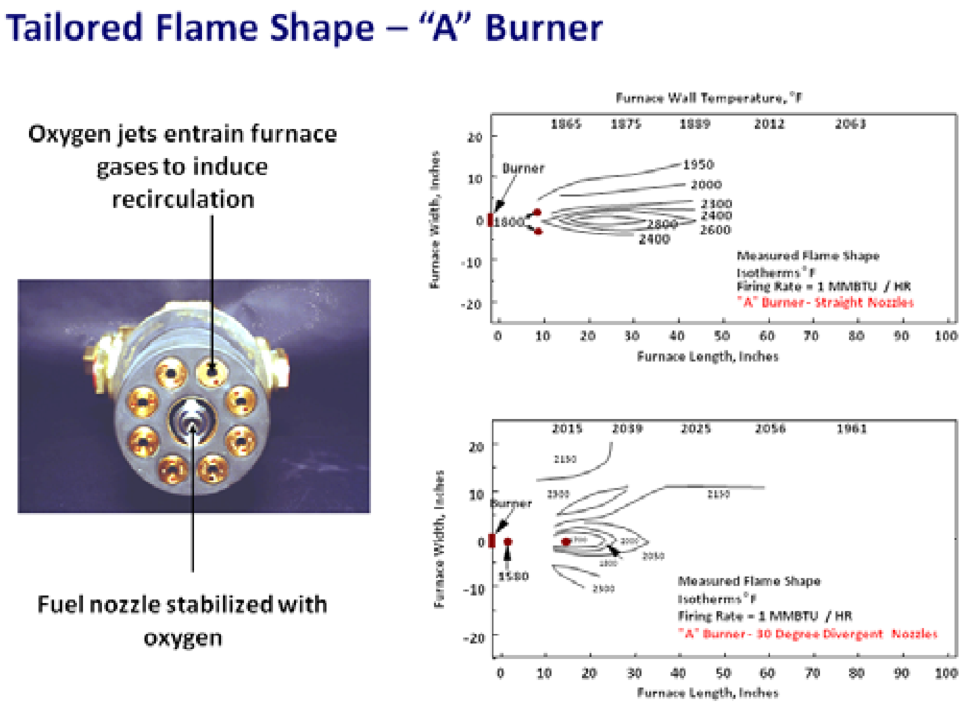

Figure 1. Tailored Flame Shape – 'A' Burner.

75%, lowering fuel consumption and CO_2 emissions by up to 20% while increasing total absorbed duty. Lower flue gas volume may lead to lower capital costs for flue gas treatment and up to 90% reduction in NOx emissions due to the absence of nitrogen in OxyFuel combustion. Burners with specially designed oxygen jets entrain furnace gases to induce recirculation as shown in **Figure 1**, thus creating a "tailored" flame shape. This technology offers the rare combination of increased productivity as well as improvements in efficiency and reduced emissions all together.

The use of oxygen in process heater applications is driven by higher throughput, environmental limits and pressures to avoid equipment costs. Refiners in several regions are increasing throughput, beginning with higher crude unit capacity. In these cases, oxygen enhancement reduces exhaust flow, fuel consumption and NOx and CO_2 emissions due to better heat flux. In addition, the need for heat recovery equipment such as air preheaters or steam coils may be eliminated and the capital cost of a new, larger heater may be avoided.

Options for O_2 Integration into Process Heaters

Oxygen integration into fired process heaters is by means of enrichment, Lancing or OxyFuel burners. Enrichment involves injecting oxygen into the combustion air. This is the simplest means of increasing productivity in a forced or balanced draft furnace, but it offers no NOx improvement. Lancing is a method by which oxygen is strategically injected directly into the combustion chamber, with the fuel/air mixture flowing through existing burners.

This arrangement gives great flexibility for improving the existing flame pattern. Staging the flame with this arrangement can result in decreased NOx emissions. OxyFuel burners, which are capable of firing the furnace without air, can be used as the sole heat source and can usually be installed between existing air/fuel burners. This gives a system which can provide the maximum productivity, emissions, and efficiency benefits using oxygen but can also revert to the conventional air burners to save oxygen cost if the heater throughput needs to be turned down.

To demonstrate the effectiveness of burner technology improvements, Praxair installed two of its proprietary 'A' Burners (**Figure 2 on page 5**) in the vacuum unit heater at a major Gulf Coast refinery. The heater

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had a nominal 70 MMBtu/hr fired duty with eight low NOx air burners already having been installed (**Figure 3**).

Monitoring the effectiveness of this test included continuous stack analysis of O_2, CO_2, NOx and CO and infrared thermal analysis of all heater tubes. Existing instrumentation was used for the remaining data collection. The test run demonstrated that oxygen improves heat distribution along the heater tube's length and overall heater efficiency at significantly reduced NOx emissions. The potential for throughput increases in such a temperature-limited heater is due to reduction of peak tube skin temperature. Some reduction in CO_2 emissions can be accredited to overall heater efficiency improvement, which also translates to fuel savings or throughput increase at constant firing rate. Further furnace tuning would yield additional NOx reduction, with minimization of air infiltration being the key.

Test results showed that in this heater, with limited efforts to reduce air infiltration, the oxygen burners could reduce NOx emissions to about 0.025 lb/MM Btu as compared to 0.050 lb/MM Btu with the existing air burners. In heaters already operating with lower NOx levels, better exclusion of air infiltration should still lead to significant NOx improvements with OxyFuel. Oxygen firing also changed the heat flux paradigm, reducing peak heat flux to 10% above average heat flux as compared to 30% above average heat flux with air firing. This translates to longitudinal flux factors of 1.1 and 1.3 for oxygen and air, respectively. Upon further evaluation of heat flux for productivity in this particular heater, Praxair's OxyFuel solutions technology allows for a 16.2% increase in heater duty before reaching the same peak heat flux limit experienced by air-fuel combustion as illustrated in **Table 1**.

Comparisons: "A" Burner vs. Lancing

While the 'A' Burner and Lancing technologies both control heat flux and reduce NOx emissions, it is important to understand and compare their implementation. Nitrogen elimination provides the largest improvement in 'A' Burner efficiency and, along with flue gas recirculation, NOx emissions Cont. page 6

Figure 2. Praxair 'A' Burner in Operation.

Figure 3. Test Image --- Under Heater.

Table 1. Evaluation of Heat Flux for Productivity (Heater example: 56 MM Btu/hr absorbed duty on Air-Fuel combustion).

	Air-Fuel	OxyFuel Solutions
Total absorbed duty	56	56
Radiant section %duty	65%	85%
Radiant section avg heat flux	10,000	13,077
Longitudinal flux factor	1.3	1.1
Circumferential flux factor	1.8	1.4
Calculated peak heat flux	23,400	20,139
Total available absorbed duty	56	65.1
Note: Duty = MM Btu/hr & Heat Flux = Btu/hr-ft2		

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are mostly eliminated. In comparison, Lancing technology reduces NOx emissions through internal flue gas recirculation and staging of the existing air burners. Improvement in efficiency is proportional to the amount of oxygen used in Lancing, which has been tested at between 15% and 30% of the oxygen required for combustion. Note that with 'A' Burner technology, air burners can stay installed, yet maximum NOx reduction is achieved with air burners sealed off. ■

Note: This article is based on a more detailed presentation from the Praxair Fired Heater Customer Seminar (September 2010). For further elaboration, contact Chris Leger, Business Development Manager (chris_leger@praxair.com).

Crude Distillation Unit Upgrades: Maximizing Profitability with Automation

Increasing crude distillation unit (CDU) efficiency is a primary objective for refiners as changes in plant-wide processing strategies are implemented to deal with narrow margins and higher process complexity. Beginning at the front-end of the refinery, CDU intermediate product quality can be improved by reducing variability. In addition, operating closer to process or equipment design constraints without exceeding these limits will result in maximum utilization and increased profitability.

In efforts to improve CDU efficiency, Emerson Process Management's Doug White, VP, APC Services, posted (www.emerson.com) an example of a European refiner targeting CDU throughput, maximum intermediate product recovery value, maximum heat recovery and improvement to overall energy efficiency. With the input from Emerson's Chief Blogger, Jim Cahill (www.emersonprocessexperts.com), additional detail concerning other recent CDU projects was discussed. In this case, incorporating technology such as embedded multivariable model predictive control (MPC) within Emerson's DeltaV Control System was an important component of the unit upgrade.

A typical refinery CDU includes fired heaters, atmospheric and vacuum distillation towers, and linked process assets (e.g., heat exchangers, pumps, strippers, etc.). Accurate evaluation of equipment constraints are required to cost effectively achieve required operating objectives. Process changes to downstream conversion units, such as the FCCU, naphtha reformer and hydrocracker typically require adjustments to CDU operations. The CDU also needs to transition smoothly and quickly during crude oil switching to minimize impact to downstream units.

In the case of the European refinery, the Emerson team, led by Project Manager Chibuike Ukeje-Eloagu, worked with the refinery's engineering and operations staff to plan and execute this CDU optimization project. The project implementation plan first involved conducting a site survey to gather data on current performance and perform preliminary step testing to understand the unit's process dynamics.

The team then designed functional, detailed test specifications for review, iteration and acceptance by the refinery project staff. After this design phase was completed, next was the build-phase where the advanced process controllers (APC), step tests of manipulated variables (MV) / disturbance variables (DV) and models was developed.

The final commissioning step was to commission the controllers, train the engineering and operations staff, and conduct the site acceptance test per the test specifications. An important final step was to benchmark the process' performance, compare against the original process data collected, and calculate the return on investment (ROI) for this optimization project.

According to the documentation posted (www.emerson.com), MPC embedded in the refinery's DeltaV control system was employed because the process had large interactions. These interactions made single and cascade loop control strategies difficult to implement and maintain over time. The process had a number of disturbances for which the model needed to account. It also took a long time for the process to reach steady state conditions. The solution was to create five APC controllers--one for each fired heater, one for the atmospheric tower, reflux drum, and stripping towers and one for the vacuum tower.

One of the key constraints in the process was the product compositions of the gas, naphtha, kerosene, light diesel, diesel, AGO, LVGO and HVGO. The traditional method had been manual measurements that were drawn and sent to the lab once per day. Chibuike's team developed regression-based inferential sensors or virtual analyzers to predict product compositions (e.g., diesel cloud point) in real time. These virtual analyzers perform inferential analysis using a regression based on product flow rates and distillation column temperatures. Predicted values are updated daily against laboratory results to help keep the virtual analyzers tuned while providing accurate predictions. The MPCs use these predicted values as constraint variables to keep the products within specification limits.

Upon MPC implementation and post-audit, the throughput was increased to a level where the downstream units actually became the bottleneck. The quantifiable results were a payback within three months. This came from increasing production of more valuable intermediate products while reducing desired product giveaway and improving heater efficiency. The non-quantified benefits were reduced operator actions to maintain steady-state operations and improved response to disturbances such as crude oil composition changes.

Over the past several years, the controllers and virtual analyzers have been in continuous use. The refiner and Chibuike's team have ongoing service agreements should immediate help or tweaks to the models Cont. page 7

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need to be made. The models are robust and tolerant of inaccuracies to a certain degree and so long as no major process modifications are made, the models have not required refitting to the process dynamics.

Other cases directly related to CDU upgrades are downloadable on Emerson Process Management's regularly updated blogs and website. This documentation points out instrument and tuning problems, such as a faulty level transmitter, and the control performance tools to gather and assess the process dynamics around the level control loop. ■

Editor's Note: This article concerning Emerson Process Management technology for optimization of crude unit performance was reprinted from Vol. I, No. 3 of *Refinery Operations*. More detailed discussions on crude unit optimization will be provided in the October **Innnovations in Crude Unit Optimization and Performance** special report.

INDUSTRY NEWS

CITGO Completes Corporate-Wide Distillate Upgrade

The completion of construction and start-up of a 42,500 bpd ULSD unit earlier this year at CITGO Petroleum Corporation's Corpus Christi, Texas refinery culminated the completion of its corporate-wide distillate upgrade. With the completion of this unit, which has been in operation since December, CITGO is now capable of producing 100% ULSD at all of its refineries.

The CITGO shareholder, Petróleos de Venezuela, S.A. (PDVSA), was involved in the project. PDVSA's research arm, INTEVEP, participated early in the ULSD process unit design, in such areas as reactor sizing, and reactor internals and catalyst selection.

"Projects such as our innovative ULSD facilities show our commitment to the environment and to the communities CITGO serves. The completion of this corporate-wide effort allows us to further contribute to a cleaner environment for all," said CITGO President and CEO Alejandro Granado. "This initiative is in alignment with the environmental principles endorsed by PDVSA, our shareholder."

With a combined crude capacity of 749,000 bpd in its three refineries, CITGO is the third largest and most complex independent refiner in the U.S. Additionally, CITGO leads the industry in coking capacity as a ratio of crude capacity, making CITGO the U.S. leader in heavy crude oils processing. ■

Oil Sands Project Completion Expected by 2012

CB&I has been awarded an EPC contract by Imperial Oil Resources on the Kearl oil sands project in Alberta, Canada. The value of CB&I's work scope is over $900 million, which includes $500 million of incremental work releases booked prior to 2011. CB&I will lead the EPC execution of the bitumen extraction plant and tank farms, as well as the design, supply and construction of additional storage vessels, all of which are expected to be completed in third quarter of 2012. ■

Pembroke Refinery Sale

Valero Energy Corp. of San Antonio, Texas, is to acquire Chevron's Pembroke refinery in Wales for $730 million. The deal, which includes marketing and logistics assets in the UK and Ireland, is to close in the third quarter of 2011, subject to regulatory approvals. The purchase includes stakes in four major product pipelines and 11 fuel terminals, a 14,000 bpd aviation fuels business, and a network of more than 1,000 Texaco-branded wholesale sites, which is the largest branded dealer network in the UK and the second largest in Ireland. ■

Heavy Residue Hydrocracking Project

Technip was awarded by Burgasneftеproekt EOOD (a Lukoil engineering subsidiary) a lump sum services contract, worth approximately €70 million, for the phase 1 of a heavy residue hydrocracking complex to be built at their refinery located in Burgas, Bulgaria.

The contract covers the detailed engineering and procurement services for a 2.5 million tons/year residue hydrocracker based on Axens H-Oil process, as well as amine, sour water stripper and hydrogen production units. Technip's operating center in Rome, Italy will execute this contract, which is scheduled to be completed in May 2013. It follows the successful execution by the Group of the front-end engineering design (FEED) contract. ■

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McKee Refinery Crude Unit Expansion

Valero Energy Corporation recently announced plans to expand the crude unit capacity of its McKee refinery by 25,000 bpd. The refinery will process West Texas Intermediate crude oil from Midland to feed the increased charge rate. The expansion project, which will take place over the next three years, will increase the amount of crude oil available to be processed at the McKee refinery to 195,000 bpd.

The expansion plans follow the previously announced Panhandle crude gathering system expansion project, which is nearing completion. That project involves looping an existing pipeline from Valero's storage facility in Perryton, Texas, as well as building additional pump stations and storage facilities to bring more locally produced crude to the McKee refinery.

"These expansion plans will enable Valero to capitalize on the production of West Texas and locally produced crudes," said Joe Gorder, Valero's Executive Vice President and Chief Commercial Officer. "The McKee refinery will have more flexibility and more options, and that benefits Valero as well as the surrounding area." ■

Crude Throughput Increases at Moscow Refinery

As of 2010 year end, the crude throughput at the Moscow Refinery reached 10.147 million tons, which exceeds the planned targets by almost 350 thousand tons, according to reports from Gazprom Neft. In view of the refinery's changeover to a two-year repair cycle, 2010 is comparable with 2008 in terms of the processing unit running calendar time. From May through June last year, the refinery's bulk processing units of the "big ring" underwent capital repairs.

In 2010, output of light oil products reached 57.17% (5.801 million tons). The increase in the share of high-octane gasoline in the production pattern made 2.1% as compared with 2008. The Moscow Refinery projects further growth of throughput in 2011.

Starting from January 2011, the Moscow Refinery launched the production of diesel fuel for domestic supplies that meets the requirements of Class 4 Technical Regulations. Usage of Euro-4 diesel fuel in automobiles substantially increases the lifetime of engines, enhances the technical specifications of vehicles, and enables reduction of vehicle emissions.

"Start of production of the diesel fuel for domestic supplies that meets the requirements of Class 4 Technical Regulations at the Moscow Refinery is the first step towards implementation of the target for improvement in the quality of the refinery's production. Besides, we see it a significant contribution into the ecological development of Moscow and the region as a whole", - Deputy CEO for Logistics, Processing and Sales of Gazprom Neft Anatoly Cherner stated.

In addition, it was noted that The Gazprom headquarters recently hosted a working meeting between Alexey Miller, Chairman of the Company's Management Committee and Alexander Khoroshavin, Governor of the Sakhalin Oblast. The meeting included discussing the opportunities for constructing an oil refinery in the Sakhalin Oblast. ■

R&M Budget for ConocoPhillips Includes Safety and Reliability Focus

ConocoPhillips recently reported that its 2011 capital program for refining and marketing (R&M) is approximately $1.2 billion, with about $1.0 billion for its U.S. downstream businesses and the remaining $0.2 billion for international R&M. These funds will be used primarily for projects related to sustaining and improving the existing business with a focus on safety, regulatory compliance, efficiency and reliability. ■

Energy Efficiency Strategies

Repsol YPF has registered with the United Nations its La Plata refinery industrial project as a Clean Development Mechanism (CDM), the first of its kind in the world. CDM is a tool laid out in the Kyoto Protocol, allowing the development of emissions-reducing projects which favor sustainable development and the implementation of clean technologies in the countries where the investment is made.

The project carried out by Repsol at its Argentine La Plata refinery will increase energy efficiency by reducing the demand for fuel oil and natural gas, allowing an annual emissions reduction of approximately 200,000 tonnes of carbon dioxide.

Repsol has developed a comprehensive strategy to combat climate change, part of which is the development of CDMs as an efficient Cont. page 9

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way of achieving emissions-reduction objectives, as well as promoting investment in investigation, innovation and technical improvement in the countries in which the company operates.

Repsol's climate-change strategy recently won recognition as being amongst the world's best by the Climate Disclosure Leadership Index (CDLI) and the Climate Performance Leadership Index (CPLI). ■

EDITORIALLY SPEAKING

Capital Investment Increases with Higher Levels of Unconventional Crude Processing

Rene Gonzalez, Editor
Refinery Operations

According to the latest International Energy Agency (IEA) World Energy Outlook (WEO) report, the IEA now sees all forms of oil, conventional and unconventional, hitting a high of 99 million bpd by 2035, including 3.0 million bpd of 'refinery gains.' However, this represents a growth rate in oil of only around 0.5% per year between now and then.

This means that over the next 25 years, the global economy will have to make do with less than half the rate of growth in oil that it enjoyed over the prior 25 years. The IEA noted that conventional crude oil peaked in 2006. Any gains from here are due to contributions from unconventional oil and natural gas-to-liquids. Under no scenario envisioned will future growth in fossil fuel supplies be equal to prior rates of growth.

Energy from here on out is going to be significantly more expensive. Between 2008 and 2035, total energy demand grows by 36%, or 1.2% per year, according to the IEA. This is significantly less than the 2% rate of growth seen over the prior 27 years, and renewable fuels will be contributing very little to the overall energy landscape, just 14% of the total. 93% of all the demand increase comes from non OECD countries (mainly China and India). Oil remains the dominant fuel (although diminishing in total percentage).

How can projected oil growth slow down to only 0.5% per year when we all know that China and India have been growing their oil consumption by massive percentages in the recent past? It is expected that China, India and other non-OECD countries will be increasing their consumption by rates much higher than 0.5%. It therefore stands to reason that some other countries, primarily OECD countries, will have to consume at negative rates in order for the equation to balance. Of course, recent environmental disasters such as last summer's Gulf of Mexico oil spill and the current nuclear reactor crisis in Japan may have predicated some reduction in energy consumption in those respective regions.

However, just as it seemed that the world was running out of oil and gas, giant oil fields were discovered off the coasts of Brazil and Africa, and Canadian oil sands projects expanded so fast, they now provide North America with more oil than Saudi Arabia. In addition, the U.S. has increased domestic oil production for the first time in a generation, such as with the Eagle Ford Shale formation stretching across vast areas of Texas.

It is nonetheless important to note that it's not the amounts that matter (e.g., 100 years of natural gas available in U.S. at current rates of consumption), but the rates at which the oil can extracted. In any event, no matter how efficient the upstream industry is in exploiting tar sands, shale oil and other unconventional hydrocarbon sources from deep offshore or extremely tight onshore formations, the rate at which these hydrocarbons can be economically upgraded at downstream processing facilities is a major challenge.

Processing these unconventional hydrocarbons requires more hydrogen, higher conversion temperatures and higher overall plant complexity to yield clean transportation fuels at the other end. In between the front end and back end of the plant, higher amounts of corrosion and fouling are to be expected with the types of heavy crudes that are being added to the refinery crude diet, such as the higher percentages of heavy Canadian crudes being processed by Midwestern refiners in the U.S.

It therefore stands to reason that oil companies will be compelled to increase their downstream capital and operating budgets to accommodate whatever types of low quality crudes that they can get. Looking at budget outlays of refiners that that many of us have access to, it looks like 2011 looks to be neither a bumper year, nor one of drought, in terms of downstream capital expenditures. ■

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CALENDAR OF EVENTS

MARCH

20-22, *NPRA Annual Meeting*, National Petrochemical and Refiners Associatio, San Antonio, Texas, +1 202 457 0480, www.npra.org

27-31, *ACS Spring 2011 National Meeting & Exposition*, American Chemical Society, Anaheim, California, +1 508 743 0192, www.acs.org.

30-31, 14th Annual ARTC Meeting, Singapore, Incisive Media & Global Technology Forum, +852 3411 4829, www.gtforum.com

APRIL

3-6, *The Middle East Downstream Week, 12th Annual Meeting*, World Refining Association, Paris, +44 (0) 20 7067 1800, www.wraconferences.com.

11-12, Process Safety Management of Chemical, Petrochemical & Refineries Conference, Houston, +1 312 540 6625, www.marcusenvansch.com.

13-16, *6th Russia & CIS Bottom of the Barrel Technology Conference & Exhibition*, Euro Petroleum Consultants, Moscow, +44 (0) 20 7357 8394, www.europetro.com.

MAY

2-6, *Coking Safety Seminar*, Coking.com, Galveston, Texas, +1 360 966 7251, www.coking.com.

17-18, *China Downstream Technology & Markets Conference & Exhibition*, Euro Petroleum Consultants, Tianjin, +44 (0) 20 7357 8394, www.europetro.com.

24-27, *NPRA Reliability & Maintenance Conference & Exhibition*, NPRA, Denver, Colorado, +1 202 457 0480, www.npra.org.

JUNE

13-14, *The Global Catalyst Technology Forum*, Euro Petroleum Consultants, Dubrovnik, Croatia, +44 (0) 20 7357 8394, www.europetro.com.

15-16, *9th International Bottom of the Barrel Technology Conference*, Euro Petroleum Consultants, Dubrovnik, Croatia, +44 (0) 20 7357 8394, www.europetro.com.

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