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Optimizing FCC Operations in a High Rare Earth Cost Market: Part II

Highlights of Recent Grace FCC Webinar Focusing on Unit Operation and Profitability when Reformulating FCC Catalyst to Lower Rare Earth

FCC unit constraints of course need to be taken into consideration when designing a catalyst. Typical operating constraints include air blower and catalyst circulation limitations and near-maximum wet gas compressor capacity (e.g., WGC at 97%). Catalyst property assumptions are shown in **Table 1** for a VGO fed unit. The objective is to design a low rare earth (RE) or zero RE catalyst to replace the more expensive RE-based (e.g., 2.6 wt% RE_2O_3) catalyst .

Table 2 shows the corresponding operating conditions taking into account catalyst circulation and air blower constraints in this particular FCCU. Economics show butylenes being attractive due to volume expansion.

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Table 1. Fresh catalyst properties, additions and Ecat activity.

Catalyst	BASE
RE2O3, wt%	2.6
Zeolite SA, m^2/gm	220
Total SA, m^2/gm	290
Catalyst Additions, TPD	5
Ecat Activity	74

Table 2. Base yield and operating conditions.

Feed Temp., °F	600
Reactor Temp., °F	992
Regenerator Temp., °F	1325
Cat/Oil	Base
Air Blower	Base
Wet Gas Compressor	Base
Dry Gas, scfb	214
C3=, Vol%	6.3
iC4, Vol%	3.1
C4=, Vol%	7.3
Gasoline, Vol%	54.9
RON/MON	92.5/80.5
Slurry, Vol%	4.5

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Table 3 shows the economics for this case with a moderate LCO incentive while butylene (C_4=) is attractive due to the previously noted volume expansion. These economics favor high liquid yields and bottoms cracking.

Reformulating catalyst to 0.7 wt% La_2O_3 (Note: La is the RE typically formulated into the zeolite) may be a practical minimum to lower RE, as shown in **Table 4**, where zeolite surface area is increased to 260 m^2/gm for maximum activity. With this low RE formulation, catalyst addition needs to be doubled to 10.0 tpd just to maintain Ecat activity at 74. A lower Ecat activity is not acceptable for this particular unit due to circulation constraints and targeted reactor temperature.

Reactor temperature will need to be reduced to 985°F (from 992°F) with the low RE exchanged zeolite formulation (**Table 5**) to control LPG production. Otherwise, the unit will quickly approach WGC constraints. Feed temperature also needs to be reduced by 10°F to remain within circulation and air blower constraints. Low RE catalyst will also increase dry gas production in spite of reactor temperature reductions. More importantly, slurry yield for this particular FCC unit increases primarily because reactor temperature was reduced to operate within the WGC constraint.

Designing a Competitive Low Rare Earth Zeolyte

In terms of total profitability for the case shown in Table 5, the unit is actually losing 14 cents/bbl with the low RE-exchanged zeolite. Although though RE_2O_3 content is reduced by about 75%, thus lowering catalyst cost on a $/ton basis, the daily cost ($/day) actually increases by 30% because low RE catalyst addition rates double.

Realizing that the higher daily costs need to be reversed if low RE catalyst is to prove effective, a broad portfolio zero-to-low rare earth REpLaCeR™ series of catalyst has been commercialized. In this series, the REMEDY™ FCC catalyst for VGO applications can be formulated with near- zero RE zeolites (i.e., RE_2O_3 reduced by 90% relative to RE base catalyst) using proprietary materials and manufacturing for stabilization, while delivering similar activity and stability as traditional RE-based catalysts. In one particular case, the REMEDY™ catalyst (with just a trace of RE) performance is compared to a base catalyst as well as a low RE catalyst (**Table 6 on page 3**). The stabilized REMEDY™ zeolite achieves Ecat activity similar to the RE base catalyst with only a 5.0 tpd addition rate.

At an activity similar to the RE base catalyst, REMEDY™ reduces daily costs by 30% (**Table 7 on page 3**). For example, a 50 cents/bbl increase in profitability over the base catalyst translates to a $9.0 million/yr increase in profitability for a 50,000 bpd FCC --- at lower dry gas production than both base and low RE formulations, as well as higher butylene yields.

The reactor temperature needs to be reduced to 990°F because REMEDY™ is somewhat more LPG selective than the base catalyst when operating against the WGC constraint. More importantly, the 4.5 vol% slurry yield in this case was preserved because the reactor temperature only had to be reduced by 2°F relative to the base catalyst,

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Table 3. Economics favoring high liquid yields and bottoms cracking.

Product Value	$/bbl
Dry Gas	55 ($/FOE)
C3=	85
C4=	105
iC4	80
Gasoline	109
Road Octane Barrel Credit	0.5 (Base 88)
LCO	115
Slurry	65

Table 4. Reformulating to low rare earth (RE) while maintaining Ecat activity under catalyst circulation constraints.

Catalyst	Base	Low Rare Earth RE)
RE2O3, wt%	2.6	0.7
Zeolite SA, m^2/gm	220	260
Total SA, m^2/gm	290	330
Catalyst Additions, tpd	5	10
Ecat Activity	74	74

Table 5. Low rare earth (RE) yields and operating conditions.

Catalyst	BASE	Low RE
Feed Temp., °F	600	590
Reactor Temp., °F	992	985
Regenerator Temp., °F	1325	1318
Cat/Oil	Base	Base
Air Blower	Base	Base
Wet Gas Compressor	Base	1.03 * Base
Dry Gas, scfb	214	220
C3=, vol%	6.3	7.1
iC4, vol%	3.1	2.7
C4=, vol%	7.3	7.8
Gasoline, vol%	54.9	53.2
RON/MON	92.5/80.5	93.4/80.9
Slurry yield, vol%	4.5	4.8
*Profitability, $/bbl	Base	-0.14
Note: Profitability includes total catalyst cost.		

whereas the low RE catalyst required reducing reactor temperature to 985°F, that nonetheless resulted in a higher slurry yield.

FCC Catalysts for Light to Heavy Feeds

The FCC catalyst portfolio shown in (**Figure 1** on page 4) includes the REpLaCeR™ series developed for processing light feeds such as VGO and hydrotreated feedstock, as well as heavier feeds, including resids:

- AURORA® is a high zeolite-to-matrix (Z/M) catalyst primarily designed for processing VGOs
- MIDAS® is a low Z/M catalyst for maximum bottoms reduction
- GENESIS® LX blends AURORA® and MIDAS® capabilities for formulation flexibility and optimum activity and coke selectivity, while GENESIS® combines IMPACT™ and MIDAS® capability for ultimate formulation flexibility
- REpLaCeR™ series includes ResidUltra™, REACTOR™, REDUCER™, REMEDY™ and REBEL™:
- ResidUltra™ is an alternative to the high rare earth IMPACT® metals trapping catalyst originally designed for resid processing, leveraging its RE content as a vanadium and nickel trap. ResidUltra™ has 40% less RE than IMPACT® and is applicable to most resid applications
- REACTOR™ is a zero RE, high Z/M catalyst using the proprietary Z-22 Technology for higher olefins production
- REBEL™ is a low Z/M, RE-free catalyst with bottoms reduction capability similar to MIDAS® and incorporates the proprietary Z-21 Technology
- The zero-to-low rare earth REMEDY™ combines the Z-21 and Z-22 technology and is mainly used towards VGO feed processing as previously discussed
- REDUCER™ is a low RE technology for resid feed applications.

Table 6. Fresh catalyst properties, additions and Ecat activity.

Catalyst	Base	Low RE	REMEDY™
RE2O3, wt%	2.6	0.7	*Trace
Zeolite SA, m^2/gm	220	260	250
Total SA, m^2/gm	290	330	320
Catalyst Additions, tpd	5	10	5
Ecat Activity	74	74	74
** Note: RE2O3 reduced by 90% relative to RE base catalyst.*			

Table 7. Optimized yields and operating conditions.

Catalyst	BASE	Low RE	REMEDY™
Feed Temp., °F	600	590	598
Reactor Temp., °F	992	985	990
Regen. Temp., °F	1325	1318	1324
Cat/Oil	Base	Base	Base
Air Blower	Base	Base	Base
Wet Gas Compressor	Base	1.03 * Base	1.03 * Base
Dry Gas, scfb	214	220	211
C3=, vol%	6.3	7.1	7
iC4, vol%	3.1	2.7	3
C4=, vol%	7.3	7.8	7.9
Gasoline, vol%	54.9	53.2	53.7
RON/MON	92.5/80.5	93.4/80.9	93.4/80.9
Slurry yield, vol%	4.5	4.8	4.5
*Profitability, $/bbl	Base	-0.14	0.5
**Note: Profitability includes total catalyst cost.*			

Table 8. Refinery "A": REMEDY™ at 40% turnover over GENESIS® LX.

	GENESIS® LX	REMEDY™
Cat-to-Oil Ratio	6.9	6.8
Conversion, wt%	72	72
Hydrogen, wt%	0.19	0.14
Total Dry Gas, wt%	1.8	1.6
Propylene, wt%	7.4	6.4
Isobutane, wt%	4.8	4.3
Total C4=’s, wt%	8.3	7.5
C5+ Gasoline, wt%	43.3	46
LCO, wt%	20.1	20.9
Bottoms, wt%	7.9	7.1
Coke, wt%	4.1	4.2

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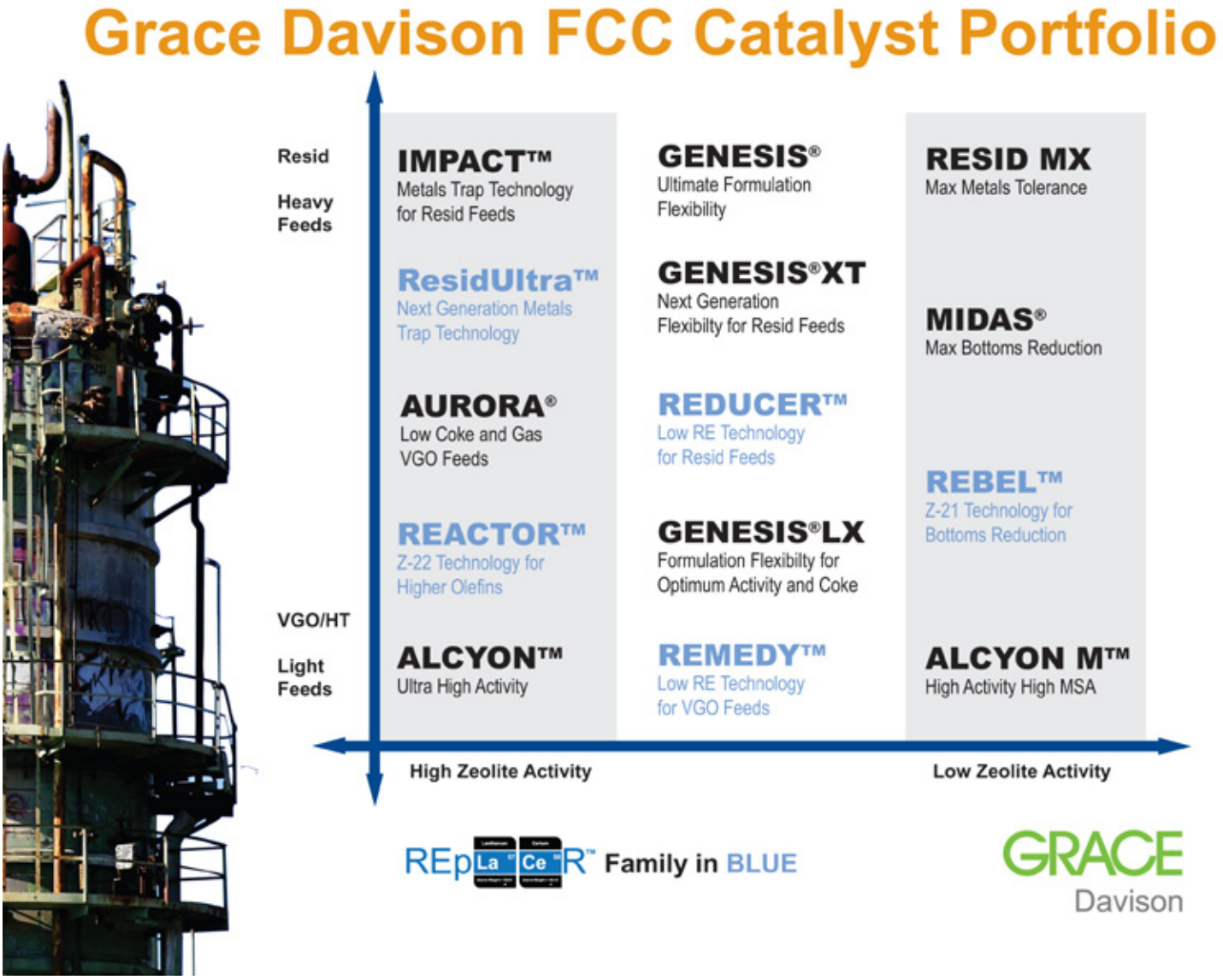

Figure 1

REACTOR™ and REBEL™ are the foundation of the REpLaCeR™ series of catalyst. The high Z/M REACTOR™ Al/Sol catalyst's Z-22 Technology is an improvement over the Z-14G zeolite technology widely used in the 1990s. It matches activity and selectivity of equivalent RE-based Al/Sol formulations. There are currently 10 commercial applications since commercial production began in the second quarter of 2011, with additional applications expected to be announced soon.

The activity and selectivity of low Z/M REBEL™ catalyst, formulated with Grace alumina and Z-21 zeolite, is equivalent to the activity and selectivity of RE-based high Z/M MIDAS® catalyst. Commercial production began at about the same time frame as REACTOR™ and there are currently seven commercial applications.

Refinery Processing VGO

The REMEDY™ catalyst system replaced the GENESIS® LX in one particular refinery with a VGO fed FCC unit. This particular unit also uses OlefinsMax® ZSM-5. ACE data using commercial Ecat at equivalent catalyst addition rate and similar metals contamination for both catalysts is shown in (**Table 8**. on page 3) The data shows that REMEDY™ has about 40% turnover at almost the same C/O ratio as GENESIS® LX with equivalent conversion (72 wt%). What this really means is that REMEDY™ has the same activity as GENESIS® LX. Also note less dry gas production and less hydrogen consumption for the REMEDY™ catalyst. The higher gasoline yield with REMEDY™ can be attributed more to the relative amount of ZSM-5 that the refiner used (for a variety of reasons), rather than the switch to REMEDY™ catalyst. Perhaps the most important observation is that the bottoms yield is reduced while the coke yield is about the same as GENESIS® LX.

The REMEDY™ Ecat MAT activity was within the range of the base catalyst, as demonstrated graphically during the recent Grace FCC Webinar. REMEDY™ rare earth content was reduced by about 50% in comparison to the GENESIS® LX formulation.

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Refinery Processing Resid

In a resid FCCU at 100% change out, 20% of the catalyst inventory was replaced with REDUCER™ to allow the refinery to process atmospheric tower bottoms (ATBs). The unit then began to run at slightly lower rate, but nonetheless allowed for processing higher ATB volume, thus increasing the CCR rate to 0.4 t/hr relative to the base, as a result of higher ATB volumes.

Operating conditions suggest the unit is performing well with REDUCER™. The C/O ratio and ROT were a little higher (C/O = 1.5 t/t; ROT increased 7.0°C) relative to the base, while the regenerator temperature was 2.0°C lower in spite of the higher reactor temperature. In addition, there was no change in the H_2/CH_4 ratio and slurry yield actually decreased by 2.8 wt% on a fresh feed basis due to improved catalyst circulation capability, and at the same coke burn rate as the base catalyst.

Grace Davison's current reference list for zero and low RE catalyst technology demonstrate that RE-free catalyst technologies are performing well even after replacing base catalyst that were quite high in RE content (e.g., 3.5 wt% RE_2O_3 at 444 ppm Ni, 1171 ppm V & 0.37 wt% Fe).

In other resid applications with relatively high metals content, RE content was reduced from 30 to 80%. For example, a 3.5 wt% RE_2O_3 catalyst system was reduced to 30% RE-free catalyst (metals content: 857 ppm Ni, 826 ppm V & 0.28 wt% Fe), and a 1.0 wt% RE_2O_3 catalyst system was reduced to 80% RE-free catalyst (metals content: 356 ppm Ni, 1282 ppm V & 0.81 wt% Fe).

Market Acceptance

In conclusion, zeolite activity, selectivity and stabilization are critical for economical FCC operations. Grace Davison is seeing rapid market acceptance with the use of proprietary stabilization compounds with unique processing characteristics capable of providing catalysts that are just as active and stable as RE-containing catalysts. In addition, the proprietary Z-21 and Z-22 Technology adds stabilization to the catalysts' zeolite. To be sure, rare earth simply cannot be pulled out of the zeolite, but the industry will continue to demand stable and selective zero-to-low RE catalyst solutions that are critical for economical FCC operations. ■

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PROCESS OPERATIONS

DilBit Corrosivity Becoming More Apparent

Laboratory and field analysis conducted by several research organizations such as the Alberta Government's Energy Resources Conversation Board (ERCB) and oil field service companies have noted that DilBit (diluted bitumen) derived from tar sands oil is significantly more acidic and corrosive relative to conventional crudes. While this aspect and its corrosive effect on pipeline networks and "front-end" refinery operations has been carefully monitored by the industry, many refiners continue to face unexpected processing challenges with DilBit, especially in the crude/vacuum unit. DilBit corrosivity is generally based on the following characteristics:

- DilBit has high chloride salt concentration, which can lead to chloride stress corrosion in high pressure pipelines
- Diluted bitumen contains 15 – 20 times higher acid concentrations than conventional crude, according to information available from the Canadian Association of Petroleum Producers. Higher temperatures accelerate corrosion. An accepted pipeline industry rule of thumb is that the rate of corrosion from the acids and other chemicals found in DilBit doubles with every 20°F temperature increase
- Some refiners have also found DilBit to contain higher quantities of abrasive quartz sand particles and alumino-silicates
- As with other heavy feeds, sulfur in DilBit also contributes to corrosivity via the sulfide stress corrosion cracking effect. According to one source that has not yet been fully substantiated, the Canadian sourced DilBit processed by refiners contains five to ten times more sulfur than benchmark crude. ■

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Naphtha Based Steam Crackers Benefit from Better Feed Pre-Treatment

High efficiency liquid-liquid coalescers and filters used to treat liquid or gas hydrocarbon feeds in ethylene plants were found to increase the steam cracker productivity and lower emissions by decreasing the decoking frequency and protecting ethylene cracker furnaces. According to documents available from Pall Corportation, major benefits of using high efficiency liquid–liquid coalescers and filters include reduction of fouling in the cracking coils, extension of furnace run length between de-coking, increasing furnace tube life and reduced emissions. Moreover, this technology also enables ethylene plants to use more contaminated, alternate feedstocks, such as refinery light cat-cracked naphtha. ■

More Middle Distillate Production and Less Fuel Oil Production

Indian refiner Mangalore Refinery and Petrochemicals Ltd (MRPL) may boost middle distillate exports by about 80% and halt fuel oil exports from 2013/14 once it completes expanding capacity, its managing director said. According to a *Reuters* news agency report from September 6, the state-run refiner is raising the capacity of its refinery in southern India by 27% to 300,000 bpd to process cheaper heavy-sour grades with high acid content to lift profitability and improve yield. Indian refiners have recently shifted to a wider variety of crude feedstock sources, including heavy crudes from Venezuela and Mexico.

MRPL will commission a new crude unit in January-February and gradually start up other units, including a diesel hydrotreater (DHT), fluid catalytic cracker (FCC) and delayed coker by June-July, Basu said. "In early 2013, it will operate at 100 percent capacity," he said.

MRPL currently exports one-to-two fuel oil cargoes of 80,000 tonnes each per month, mostly into East Asia, may halt shipments from that year. "There will not be any fuel oil exports…We will be exporting fuel oil only if the margins are better on it," he said. ■

Paradip Refinery Processing Higher Volumes of Latin American Crudes

Indian Oil Corp , the country's biggest refiner, plans its first major purchases of Latin American crudes for its new 300,000 bpd Paradip refinery its head of refineries, B. N. Bankapur, said at the end of August. Paradip refinery in eastern Orissa state is designed to process 60% Kuwait type grades and 40% Maya type crude. "We can process Venezuelan crude, we can process Latin American crude … All heavy grades can be processed. We will be looking at buying Latin American grades for processing at Paradip," Bankapur said. ■

Bongaigaon Refinery Completes Diesel Hydrotreater Project

Industrial Info Resources India reported on September 6 that Indian Oil Corporation Limited's Bongaigaon Refinery has completed its $365 million diesel hydrotreater addition. The project kicked off in early 2008 and was initially scheduled for completion by the end of 2009. However, several construction deadlines were missed. ■

INDUSTRY NEWS

Petrobras' Comperj Complex Configured for Petrochemicals

Brazil-based energy producer Petrobras has reconfigured its Complexo Petroquimico do Rio de Janeiro (Comperj) project, reflecting the company's addition of a second refinery and the use of ethane feedstock.

Petrobras also revealed proposed capacity figures for several petrochemicals to be produced at the complex. Under the previous plans, Comperj would rely on one refinery to produce feedstock naphtha for its downstream chemicals.

In addition, Comperj would use the resulting feedstock to produce 600,000 tonnes/year of polyethylene terephthalate (PET). Under the new plans, Comperj will have two refineries and a natural gas treatment plant, which will provide the complex with ethane feedstock. Petrobras made the changes so it could meet rising demand in Brazil.

In addition, Comperj will not immediately begin PET production. Instead, it will produce the PET intermediary paraxylene (PX). That PX feedstock will go to the Petroquimica Suape complex in northeast Brazil, satisfying half of that facility's feedstock needs. The Suape complex will produce 700,000 tonnes/year of purified terephthalic acid (PTA), the feedstock for PET.

Under the latest timeline, the first refinery train will begin by 2014. It will have a capacity of 165,000 bpd. The second train will start in 2018.

An FCC will also start in 2018. A steam cracker and a polypropylene (PP) train will start production in 2016, plus polyethylene (PE), styrene, EG and other chemical units. The second PP train will start in 2018. Production of PTA and PET could start after 2018.

Among refinery products, Comperj will produce 180,000 bpd of diesel; 40,000 bpd of kerosene and jet fuel. ■

More Propane Dehydrogenation Units Coming Onstream

Fujian Meide Petrochemical Co. Ltd. selected UOP LLC to provide key technology to help meet the growing Chinese demand for propylene, according to a September 8 UOP announcement. The new propane dehydrogenation (PDH) unit at the facility will use UOP's C_3 Oleflex ™ technology to produce propylene. UOP will provide engineering design, technology licensing, catalysts, adsorbents, equipment, staff training and technical service for the project at Fujian Meide's facility in Fujian City, Fujian Province, China. Fujian Meide Petrochemical Co. Ltd. is a fully owned subsidiary of China Packing Group Company Ltd., which is headquartered in Fuzhou City, Fujian Province, China.

The unit, expected to start up in 2014, will produce 660,000 metric tons of propylene annually. It will be the largest PDH unit in the world to date. China's propylene consumption accounts for more than 15% of worldwide demand and is growing at about 5 to 6% per year.

Since the technology was commercialized in 1990, nine C_3 Oleflex units for on-purpose propylene production have begun operation, with the 10th unit scheduled to start up in Russia in 2012. Earlier this year, UOP announced similar projects with Zhejiang Julong Petrochemical Co. Ltd. and Jiangsu Haili Chemical Industry Co. Ltd, both located in China, and Abu Dhabi Oil Refining Co. (Takreer), located in Abu Dhabi. ■

Russian Refining Sector Investment in Doubt

An editorial published earlier this summer in the Eurasia Daily Monitor Volume: 8 Issue: 151 by Sergei Blagov noted that many Russian oil companies appear reluctant to increase investment in modernization of the refinery sector. Instead, Russian oil producers have been building small "mini-refinery" outlets, despite governmental criticism. In addition, Blagov noted that state-run Rosneft pledged to invest 600 billion rubles ($21.5 billion) to modernize its refineries by 2015. The company's modernization program includes plans to build

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30 new production facilities, and upgrade 20 existing units. Blagov also noted that Gazprom's subsidiary Gazpromneft promised to invest around 350 billion rubles ($12.5 billion) to upgrade its refineries by 2018. There is speculation as to whether this amount of downstream investment will actually come to fruition. ■

Sunoco Selling its Two US East Coast Refineries

Philadelphia, Pennsylvania based Sunoco, Inc. announced on September 6 that its plans to exit to the refining business and begin a process to sell its refineries located in Philadelphia and Marcus Hook, Pennsylvania. Sunoco will pursue all options to sell its refineries, but if a suitable transaction cannot be implemented, the company intends to idle the main processing units at the facilities in July 2012.

"We have made progress in increasing the efficiency of our refineries over the last several years, but given the unacceptable financial performance of these assets, it is clear that it is in the best interests of shareholders to exit this business and focus on our profitable retail and logistics businesses, which have higher returns, growth potential, and provide steady, ratable cash flow," said Lynn L. Elsenhans, Sunoco's chairman and chief executive officer.

In connection with the decision to exit refining, the company expects to record a pretax noncash charge of between $1.9 billion and $2.2 billion in the third quarter of 2011 related to impairment of the plant and equipment in the refineries. In the event the processing units are idled, additional pretax charges of up to $500 million, primarily related to contract terminations, staffing costs and severance, may be incurred. ■

BP Whiting Refinery Mega-Project Still Scheduled for 2013 Completion

It was reported in early September that the planned start-up of a replacement crude distillation unit at the BP Whiting refinery in the state of Indiana (USA) has been pushed back two months, according to sources familiar with the refinery's operations. According to several sources, BP will start the new No. 12 Pipe Still on October 2012 instead of August 2012 as previously planned. BP spokesman Scott Dean said the company doesn't comment on turnaround or maintenance activities. However, Dean said the Whiting refinery's multibillion-dollar modernization project is on track to be completed in 2013. The project is currently about 66% complete.

The No. 12 Pipe Still, which is the refinery's largest, is being reconfigured so it can accept more heavy sour crude oil. The 405,000 bpd refinery benefits from its proximity to Canada and the pipeline infrastructure in place to transport crude oil from the province of Alberta. To handle impurities from this type of crude, the modernization project also includes installation of a new coker and improved equipment to remove and capture sulfur from fuels. ■

China's National Development and Reform Commission Project Updates

A September 2 report in *SZ Energy News* was that China's investment in the oil-refining industry jumped 17.1% year-on-year to RMB 69.6 billion in the first seven months of this year, according to the latest statistics released by the National Development and Reform Commission.

In July, the industry received RMB 11.8 billion of investment, 25.8% less than in June. The output value of the oil-refining industry reached RMB 257 billion in July, up 32.6% year-on-year.

The country started the construction on 395 oil-refining projects in the first seven months, 14.1% less than in the same period of 2010, and completed 204 projects during the period, up 2.5% year on year.

The oil refining sector processed 34.49 million metric tons of crude oil in July, 5.9% more than in the corresponding period of last year.

The output of oil products climbed 4.4% year-on-year to 22.16 million metric tons in July. The figure included 6.54 million metric tons of gasoline and 13.99 million metric tons of diesel, up 3.4% and 4.3% year on year, respectively. The country produced 1.63 million metric tons of kerosene in July. ■

Skeptics Question Two Potential European Refining Projects

The sale in mid-August of Germany's Wilhelmshaven oil refinery after the plant sat idle for two years and the revival of a project to build a new plant in Britain surprised traders, who said they saw little economic rationale for either one. According to a *Reuters* report, Private Dutch group Hestya Energy recently said it could restart the second-biggest German refinery after buying it from U.S. group ConocoPhillips , which had cancelled plans to upgrade the plant and put it up for sale over a year ago.

GE Oil & Gas said on August 11 it planned to build an oil refinery in Britain in a joint venture with a small UK firm, after a similar project in the same location in Teesside failed a few years ago. Analysts have said they see no argument for adding new capacity in Europe. Almost 20% of European capacity is currently unused. Petroplus's 117,000 barrel-per-day Teesside refinery was shut in 2009, and the plant now operates as an oil terminal. ■

Ras Tanura Clean Fuels and Aromatics Project

Jacobs Engineering Group Inc. announced August 31 that it has been awarded the second phase of the Ras Tanura Refinery Clean Fuels and Aromatics Project located in the Eastern Province of Saudi Arabia. This award is under the Saudi Aramco General Engineering and Project Management Services (GES+) Contract. Jacobs is executing the project from its office in al-Khobar, Saudi Arabia.

The scope of services for the Clean Fuels and Aromatics Project includes front end engineering design (FEED) services for both inside battery limits (ISBL) and outside battery limits (OSBL). In addition, the project includes modifications to the refinery to comply with expected future environmental regulations. ■

New Hydrotreater at PetroChina's Jinzhou Refinery

A report in the September 2 issue of *SZ Energy News* noted that PetroChina Co Ltd's 150,000 bpd Jinzhou refinery plans to add a 1.0 million tonne per year (tpy) gasoline hydrotreating unit in October to reduce sulfur content and produce better quality fuel. The Jinzhou refinery, located in the northeastern province of Liaoning, last month finished upgrading a continuous reformer to 800,000 tpy from 600,000 tpy and completed two-month maintenance of a 1.3 million tpy hydrocracker. ■

Ghana's Only Refinery Planning Upgrades

A September 6 report in Ghana- based ESI-AFRICA.com said that the country's 45,000 bpd state-run Tema refinery has been compelled to shut its main crude distillation unit, after running out of feedstock nine days earlier, sources with knowledge of the plant's operations revealed to *Reuters* on September 5. It is understood that the Tema facility requires upgrades to be able to run the domestically produced oil and generally relies on imports from Nigeria. It is expected that the facility will eventually source most of its feedstock from Ghana's new offshore Jubilee oil field. Meanwhile, the Tema facility will need to depend on "sporadic" supplies of crude cargoes from Nigeria until refinery complexity is upgraded and crude supply from the new Jubilee field is stabilized. ■

New Iraqi Refinery

Cairo-based private equity firm Citadel Capital has won a contract from the Iraqi authorities to build an oil refinery in the country, according to a recent *Reuters* report. The facility, which will have a production capacity of 150,000 bpd, will take three years to design and four years to construct. ■

EDITORIALLY SPEAKING

A View to 2012

Rene Gonzalez, Editor
Refinery Operations

Now that the summer driving season is over and refiners ponder future margins opportunities (or lack of), we can probably expect to see a few more facilities in Europe and North America change ownership. It doesn't appear that the two remaining Sunoco, Inc. refineries on the US East Coast, with a combined 531,000 bpd crude processing capacity, will remain in operation after July 2012. There are no apparent investors who have shown interest in buying either one of those refineries/terminals (to date). As discussed in this issue's Industry News, there are at least two facilities in the European refining market that could change ownership.

From an editor's perspective," sitting on the fence" watching the industry, some of the most interesting developments to watch going into 2012 include the emphasis on "transitional" process complexity compelled by:

- Processing a wider variety of "cheap" feedstocks with unpredictable chemistry
- Cost effective integration of refinery/petrochemical value chain.

It's no secret that geopolitical shifts and "security of supply" have compelled many refiners to process a wider variety of discounted feedstocks (API gravity < 28) in order to leverage margins spreads between feedstocks such as diluted bitumen and benchmark crudes. However, refiners from India to the American Midwest seem to be running into bigger processing challenges than what they bargained for. Crude units are shutting down after just 22 months of operation instead of planned four-year run lengths primarily due to unexpected corrosion in overheads and fouling in preheat trains. Indian refiners only until recently began to process significant quantities of Venezuelan Merey and Mexican Maya crudes. Now they are running into the same corrosion and fouling problems that US Gulf Coast refiners encountered back in the 1980s.

As the north-to-south Keystone pipeline project from Canada to Cushing terminal comes to fruition, and US Midwest and Gulf Coast refiners process large volumes of bitumens, it is expected that the major processing challenges already being reported by some refiners running these crudes will become even more widespread in the next few years. The challenge to severe corrosion encountered with these Canadian feeds will be better dealt with by the process improvements made by Canadian upgraders, midstream processors and more sophisticated two-stage desalting and crude/vacuum unit redesigns.

Another area where processing changes are accelerating is at the back-end of the refinery with the emphasis on producing higher volumes of petrochemical grade propylene. The refinery shift from fuel oil production to distillate production, and now to petrochemicals production is most evident in the Asian refining market.

New and revamped FCC units have been designed with appropriate catalyst systems to increase petrochemical grade propylene. As the Chinese market is now accountable for 15% of the global propylene market, we are now seeing high capital investment in propane dehydrogenation units (PDH) for on-purpose propylene production, as there is inadequate propylene production from refinery FCC units. The major PDH licensors saw stagnant sales in PDH units between 2000-2010 due to high investment obstacles. However, recent improvements in the technology and persistent market growth (in spite of the current recession) has activated this industry. For example, UOP just recently announced licensing of a new 660,000 mtpy PDH unit based on their C_3 Oleflex ™ technology at Fujian Meide's facility in Fujian City, Fujian Province, China (see Industry News).

To be sure, these areas of emphasis will be discussed more thoroughly in conferences scheduled for this Autumn and Spring 2012, as well as in upcoming issues of *Refinery Operations*. ■

Calendar of Events

SEPTEMBER

22-23, *Russia & CIS Refining Technology Conference & Exhibition*, Euro Petroleum Consultants, Moscow, Russia, +44 (0) 20 7357 8394, www.europetro.com.

28-29, *3rd Annual World Refining Technology Summit 2011*, Cerebral Business, JW Marriott, Houston, Texas, USA, +91 95409 91022/+91 95409 91011, m.vayas@cerebralbusiness.com, www.cerebralbusiness.com

OCTOBER

9-12, *NPRA Q&A and Technology Forum,* ational Petrochemical & Refiners Association (NPRA), San Antonio, Texas USA, +1 (202) 457 0480, www.npra.org.

11-13, *Central & Eastern European Refinery & Petrochemicals 14th Annual Meeting*, World Refining Association, Gdansk/SOPOT, Poland, +44 (0) 207 067 1818, www.wraconferences.com.

NOVEMBER

1-2, *Downstream Asia 2011*, The Energy Exchange, Singapore, www.theenergyexchange.co.uk.

7-10, *Sulphur 2011*, CRU, Houston, Texas USA, +44 (0) 20 7903 2300, www.sulphurconference.com.

8-10, *Invensys North America OpsManage'11 Conference*, Invensys Operations Management, Nashville, Tennessee, USA, opsmanage@invensys.com, www.iom.invensys.com.

Nov. 29 – Dec. 1, *ERTC 16th Annual Meeting*, Global Technology Forum, Barcelona, Spain, +44 (0) 207 484 9700, www.gtforum.com.

Nov. 29 – Dec. 2, *Refinery & Petrochemicals in Russia & the CIS Countries 15th Annual Roundtable*, World Refining Association, Geneva, Switzerland, +44 (0) 207 067 1818, www.wraconferences.com.