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- 7-9 Nov – San Antonio, Texas, USA

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KBC Visits Client in ASIA

KBC visited SK Energy senior management in early September to discuss development of the working relationship between our companies.

(Photo Left to Right: KB Kim – VP SK Energy; JS Kim – KBC Korea Business Development; David Turner – KBC, EVP Business Development, Asia; George Bright – KBC CEO; Tony Wood – KBC, Business Development Director Japan & Korea)

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KBC Driving Excellence
3rd Quarter 2007
Helping Clients Achieve Operational and Capital Excellence

Assessing Unit and Model Performance

by Eric Streit and Gloria Chukman

Monitoring unit performance is integral to optimal refinery operation. Regular monitoring of refinery units improves unit performance, reduces operational problems, assists in catalyst evaluation, and improves planning decision-making.

In addition, optimal refinery operation requires an accurate and up-to-date Linear Program (LP) model. The vectors used in the LP can be generated by running an accurate and up-to-date unit kinetic model.

KBC has created a novel new technology within Petro-SIM™ that combines unit performance monitoring and kinetic model validation along with LP vector generation in one system. Our system provides a consistent, flexible, and easy-to-maintain platform over a sophisticated analysis system, which has recently been installed at two US refineries.

Unit Monitoring with a Kinetic Model

By integrating a unit monitoring application with a kinetic model, engineers can use the model to help evaluate plant data quality. If there is a deviation between a model-predicted and field-measured value, a problem may have occurred in the unit causing its operation to change. The unit engineer can then check the unit performance to determine if the deviation was caused by a data quality problem or if something significant has changed in the unit itself.

In addition, a system that regularly runs the kinetic model and compares the results with process data provides continuous validation of the process model. The process model can then be used to perform "what-if" analyses on a unit and generate vectors for an LP with a higher degree of confidence than a process model not validated against actual unit performance. Having an LP based on validated kinetic models allows refinery planners to make the most economical decisions possible for the refinery.

Evaluating and Screening the Data

Addressing plant data evaluation is the first step to setting up a monitoring system. Petro-SIM accesses plant data from the process historian, screens out poor quality data, and uses the data to run a unit kinetic model. Although the system relies on several components to perform these functions, the resulting tool is easy to use and maintain.

Several parameters can be calculated to help evaluate the data for a given unit. If enough of these parameters are outside acceptable ranges, the data set is determined to be of low quality, and it can be discarded. Alternatively, engineering judgment can be used to modify the process data to get a parameter within the acceptable range (such as adjusting unit feed rate to close the mass balance).

Running the Kinetic Model

Once the screened plant data is input to the kinetic model, the model predicts the performance of the unit based on the current model calibration. The product yields and qualities predicted by the model are then compared to the screened plant data. This comparison serves two purposes. Firstly, it helps identify bad data points in the data set, and, secondly, it shows how well the kinetic model represents current unit operation.

Within the KBC system, the most important items predicted by the model are labelled as Model Performance Indicators (MPIs). These parameters are tabulated to allow the user to quickly evaluate how well the model predicted the unit performance.

Trending the MPIs versus the screened plant data over time gives an indication as to how well the current unit calibration represents unit operation. As the unit ages, the prediction from the model will begin to diverge from the actual plant results. When the disparity between the prediction and the actual data is large enough, the kinetic model can be recalibrated.

Evaluating the LP Submodel

An LP models the entire refinery and consists of many individual unit submodels, Best Practice refiners use detailed unit kinetic models as the basis for creating the LP submodels.

Continued on pg 2

KBC offers a comprehensive range of consulting, implementation, and training solutions to provide sustainable competitive advantage to our process industry clients worldwide.

OUR SERVICES INCLUDE:

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- Capital Project Support

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- Energy
- HSE
- Reliability, Availability, & Maintenance
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In This Issue...

FEATURE STORY

Continued from pg 1

In Petro-SIM, the LP submodel for the unit calculates predicted product yields and qualities given inputs based on the screened plant data just as the kinetic model does. These results can then be compared to actual screened plant data in the same manner as the kinetic model. When the predicted yields and qualities from the LP submodel no longer provides a sufficient match with plant data, the LP submodel needs to be regenerated.

To regenerate the LP submodel, the validated kinetic model is run with step changes in a series of defined independent variables. The response of the dependant variables from the kinetic model are then used to set up the vectors used in the LP.

System Structure

In the KBC technology, an interactive Excel® interface allows the user to manipulate the program and view the results. The structure for the screening and evaluation of plant data, KPI calculations, LP submodel communications and the kinetic model are all built within Petro-SIM™. Although all of the calculations are done inside Petro-SIM, the user can access all of the functions required from Excel.

With this system, Petro-SIM writes all of the process data and model results to a relational database. Code within the Excel template reads the information from the database and presents it in an easy-to-read formatted structure.

The Excel interface is also used to pass information required for screening the plant data (such as a minimum acceptable value for a given tag) into Petro-SIM, modifying the results of the data screening and re-running the kinetic model accordingly. Conversely, the Petro-SIM model can be modified and the Excel interface is updated with the results of the new model run. As a result, simple modifications to the plant data are easily done by the unit engineer.

The Excel interface displays all the pertinent information used in the monitoring process in an easy-to-read, tabular format. In addition to presenting the raw and screened process data, the Excel interface tabulates the KPIs, MPIs, and Data Quality Parameters for a given run.

All runs are stored in the relational (SQL) database, so trending the information over time is very simple. With the click of a button, the engineer can quickly plot any of the parameters present in the Excel tables. Two US refineries have benefited from the installation of this new system; the units involved include three diesel hydrotreaters, a naphtha reformer, a coker and two FCCs.

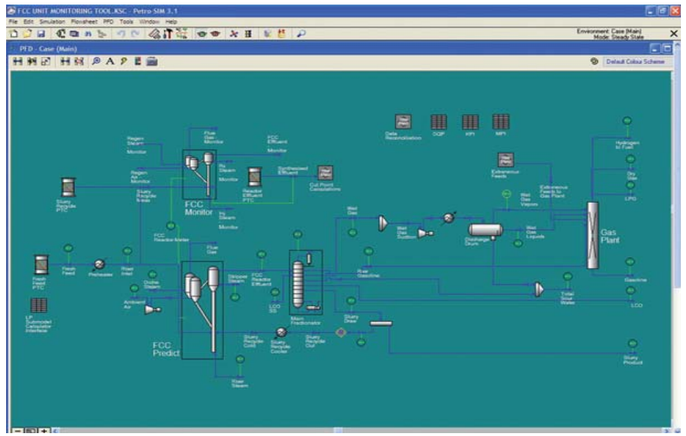
Value and Benefits

There are numerous benefits associated with using the KBC Unit Monitoring application. Running the Unit Monitoring Tool (UMT) once per week helps alert unit engineers to potential problems on the unit. These problems are identified by the deviation of model-predicted results from actual unit performance. Since the UMT puts an emphasis on good plant data, the quality of the laboratory and process data can be expected to improve over time.

In addition, the weekly validation of the unit model gives the unit engineer a kinetic model that can be used for "what-if" studies. The model can be used with a high degree of confidence, because it has been validated versus actual plant data each time the application is run.

Perhaps the largest benefit of this system comes from the continuous validation of the unit LP submodel. With an accurate submodel, the LP can make better decisions on crude oil and feedstock selections, and it runs the units to maximise profitability.

Petro-SIM PFD for FCC Unit Monitoring Tool



EVENTS

15th Asia Petrochemical Summit

4-5 Sept – Phuket, Thailand

Paul Kennedy, KBC Executive Vice President – Asia Operations, will present "Refinery/Petrochemical Complex Process and Energy Optimization Using Rigorous Simulation."

North African Oil & Gas Summit

5-6 Sept – Paris, France

Mr Neil Atkinson, KBC Market Services Senior Staff Consultant, will present "More Demand, More Crude Oil, More Refining?" World oil demand is expected to increase by at least 20 million b/d in the next 25 years. This paper will discuss the prospects for higher crude oil production during this period and whether refinery capacity will be available to make the products we need.

Refinery Technology Meet

20-22 Sept – Kovalam, India

Jagadesh Donepudi, KBC Director of South Asia Business Development, will present: "The Dismantling of the Administrative Pricing Mechanism, Surge in International Crude Oil Prices and Refining Margins, Phased Implementation of Environmental/Clean Fuel Regulations and Entry of Private Sector Refineries Have Catalyzed the Growth of the Safe, Reliable, and Profitable Refining Culture in India."

RRTC – 7th Russia & CIS Refining Technology Conference & Exhibition

27-28 Sept – Moscow, Russia

Mr Andy Hoyle, KBC Consultant, will present: "Understanding and Improving the Energy Efficiency of an FCC," which will cover:

- Refineries face tough challenges to reduce energy consumption
- FCC is one of the main units the refinery should focus on when targeting energy reduction
- Energy efficient features in four major categories: (1) Flue Gas Train (2) Shaftwork & Power Generation (3) Steam Consumption and (4) Main Column Heat Removal

NPRA Q&A and Technology Forum

9-12 Oct – Austin, Texas, USA

This conference addresses real problems and challenges facing refiners today with Q&A, plant automation, safety, and principles and practices sessions. Bob Powell, KBC VP of Software Sales, will present "Performing Accurate Refinery Configuration Studies to Address the Upcoming EPA Benzene Reductions."

ERTC Petrochemicals 2007

15-17 Oct – Brussels, Belgium

Mr Douglas Hutton, KBC Senior Staff Consultant, will present: "Complex-Wide Hydrogen Network Optimisation." Samsung Total Chemicals (STC) operates an ethylene and aromatics complex at their Daesan site in Korea, where they export excess hydrogen from their processes to a neighbouring refinery. This paper describes the further optimisation of their hydrogen system.

CEE 10th Annual Roundtable

16-18 Oct – Vienna, Austria

Mr Zoran Milosevic, KBC Senior Staff Consultant, will present "Energy Efficiency Program Identifies Significant Opportunities for Improvement in Performance without Capital Investment."

KBC Market Services formerly PEL

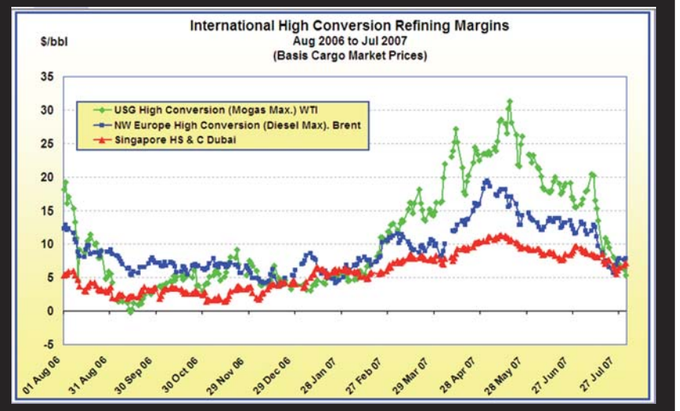
REFINING MARGINS

by Richard Warner

High conversion margins have fallen sharply in all markets since the peaks in May – most dramatically in the US Gulf. As US refinery utilisation belatedly moved above 90% in late May, the exceptional tightness of the US gasoline market, which had fed rampant speculative activity and underpinned the extraordinary surge in margins, began to ease. Combined with the growing output of middle distillates, this has steadily worked to allay fears of product supply tightness in the US. Meanwhile, crude values have continued to strengthen until recently with the result that margins have been steadily squeezed lower. In the US, the unusual and particular weakness in the WTI crude price, which had helped push USGC margins above $30/bbl in May, has evaporated as stock levels at Cushing have returned to more normal levels. The result of this is that the margin had slumped to barely $5/bbl by the end of July.

In NW Europe, the collapse in gasoline prices in the US fed quickly through to Rotterdam values with the result that NW European crack spreads also declined sharply after May. However, middle distillate prices have been supported by strong European demand for diesel and abundant arbitrage opportunities for gasoil cargos – especially into the Med higher sulphur diesel market. With traders continuing to scour the European markets for fuel oil material to ship to Asia, this has seen European margins hold up more successfully than those in the US Gulf – even as they fell sharply. Summer maintenance in the North Sea and continuing disruptions to similar quality Nigerian crude exports have boosted prompt physical crude prices, which has also helped drag margins down. Although margins at high conversion refineries have remained positive at around $5/bbl, by the end of July less complex refineries were struggling to break even and a number began cutting runs.

In Singapore, HS & C refinery margins also held up comparatively well and were partially insulated by weakness in Dubai crude. Furthermore, strong Asian demand for gasoil/diesel and fuel oil held up margins, despite the weakness of light end prices caused by the growing softness of the US gasoline market. With the less complex nature of refining in the region, margins have generally held up well recently due to high fuel oil prices. However, the particularly buoyant conditions evident earlier in the year, when margins were pushed up to over $10/bbl by exceptionally strong naphtha (due to shortages of LNG in the region), have gone. Gasoline prices have now evaporated, and they are unlikely to return any time soon. As a result, HS & C margins are expected to average around the more normal level of $5/bbl.



FEATURED PROJECTS

Petro-SIM™ *Express* & FCC-SIM Simulation Data for Training Simulator

Omega Simulation Company Ltd
Japan

In October 2006, Omega Simulation Company Ltd. Japan (OSC), subsidiary of Yokogawa Electric Corporation, contracted KBC to provide FCC-SIM simulation data for their Training Simulator. The model was calibrated based on design data from OSC's client, and more than 20 prediction case results were submitted to OSC. The use of FCC-SIM enables OSC to produce training simulators that can accurately mimic real units before the real FCC unit is in operation.

In November 2006, OSC contracted KBC to simulate the FCC reactor and regenerator with gas plant in Petro-SIM *Express*. The result of the base case simulation in Excel format from Petro-SIM *Express* was delivered in February 2007. In March 2007, KBC leased Petro-SIM *Express* and FCC-SIM to OSC, and a training course was conducted in Tokyo.

OSC is pleased with the time saved by using the data from FCC-SIM and Petro-SIM *Express* on this project. With Petro-SIM *Express* and FCC-SIM, OSC has access to many refinery properties, and OSC is able to generate data for their dynamic simulator, Visual Modeler. This will improve OSC's project margin and schedule.

Global Optimisation of a Hydro-Skimming Refinery

Petroplus Holdings AG
Teesside, UK

Petroplus is a long-time customer of KBC software and consultancy services. The Petroplus refinery at Teesside is a 117K bbl hydro-skimming refinery that runs predominantly a single crude feed, because it is uniquely located near the oil field. The refinery focuses on optimising the CDU cut points and feed rates to the hydrotreaters in order to make the final products within specification. Since the refinery processes a single crude feed, there is no need for an LP model, and Petro-SIM is used to fully optimise the refinery. The independent variables of the optimisation are the CDU cut points and feedrates to the hydrotreating units. The constraints of the optimisation are the capacity limits of the hydrotreating units. Below the global optimiser sits the non-linear blender with its local product constraints.

The combination of both optimisers provides an optimum global solution that is used to regularly check that the process is fully optimised.

The benefits of using Petro-SIM instead of an LP model are many-fold, since it can be used for multiple purposes. Apart from the day-to-day optimisation, the client has used it successfully for several case studies and those are summarised as follows:

- Optimise the main product draws for a change of crude rate
- Remove constraints by using shadow pricing provided by the blender
- Quantify the benefits of Naphtha production to an RVP limit using physical property data from Petro-SIM
- Review the effects of increased stripping steam on Fuel Oil yield
- Select alternative feeds and conduct benefit analysis