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Refiner's EDGE

Helping Clients Improve Profits and Achieve Pacesetter Performance

At KBC, we focus on improving our clients' competitive position through innovative business solutions, allowing clients to achieve superior returns on their invested capital and achieve pacesetter status within their industries.

Our services include:

- Yield Optimization
- Energy Improvement
- Petrochemical Services
- Clean Fuels Impact Reviews
- Reliability, Availability & Maintenance
- Planning & Scheduling
- Unit Specific & Refinery-wide Process Simulation
- Change Leadership
- Implementation Services
- Technical Services
- Upstream & Downstream Risk Management
- Integration Services
- Benchmarking
- Capital Project Review/ Due Diligence
- Design Services
- Unit Specific Studies
- Strategic Planning
- Business Risk Management Consulting

KBC

START-UP OF VISBREAKER REVAMP PROJECT ADDS LOW CAPITAL COST UPGRADING TO PO NAFTAN REFINERY

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PO Naftan's Novopolotsk Refinery is located in the Republic of Belarus and is a major producer of fuels, lubes and aromatics for the domestic and export markets. Current throughput is 7-8 million tons per year compared with a nameplate capacity of over 25 million tons per annum. Consequently, the refinery has been engaged in an ongoing program to improve performance and profitability. One of the principal policies of the refinery is to implement only relatively small projects of moderate capital investment with short payback periods, ideally one to two years.

Cooperation between Naftan and KBC began in 1991 with a contract for operating performance optimization of a crude distillation unit. Since 1991, KBC and Naftan have maintained an ongoing relationship, with a number of other contracts undertaken on several of the refinery units.

As a result of the understanding of the Naftan site gained through KBC's continual involvement, KBC was able to propose ideas to improve the refinery profitability. One idea identified was for a potential low capital cost project to convert redundant primary fractionation capacity to cracking service in order to upgrade fuel oil to distillate products.

Feasibility Study

To further evaluate this idea, KBC began a study in 1997 to assess the technical and economic feasibility of converting an existing primary fractionation unit, AVT1, to a visbreaking unit and/or a straight run vacuum gasoil (VGO) thermal cracking unit.

The feasibility study on revamp of the AVT-1 unit showed that it was both feasible and commercially attractive to convert the unit to both visbreaking and thermal cracking service. This approach gave the best balance of fuel oil upgrading and project capital cost.

The crude unit furnace of the AVT-1 (P1) was of suitable capacity for visbreaking 1.0 million tons per year of vacuum residue, and the vacuum furnace (P2) was of the correct capacity for thermal cracking of 0.6 million tons per year of VGO. The cracked products from both furnaces could be separated in existing fractionators with modified internals.

The heat exchanger network of the visbreaker and thermal cracker would mainly utilize the existing AVT-1 heat exchangers, although with some significant rearrangement of exchanger services.

The financial benefits for the revamp come from upgrading to higher value products. Table 1 shows the feasibility study estimate of the yield structure in winter operation. The estimated annual profit improvement from the revamp was $26 million per year. The project capital cost, estimated on a Western European material and labor cost basis, was around 25% of the cost of an equivalent grass roots unit and gave a simple payback time of less than one year.

Local sourcing during procurement and construction helped to significantly reduce the costs, further reducing the project payback period.

Continued on pg. 2

Table 1
Visbreaker/Thermal Cracker Revamp
Project Predicted Yields

	Tons / hr of Refinery Fuels Products Produced from Atmospheric Residue		
	Before	After	Δ
Gas	-	7.1	+7.1(2)
Gasoline	-	10.8	+10.8
Diesel	-	47.3	+47.3
Vacuum Gasoil	8.1(1)	-	-8.1
Fuel Oil	317.5	260.5	-57.1
Total	325.7	325.7	-

(1) Usually Blended into Fuel
(2) Used in the Visbreaker / Thermal Cracker Furnaces

Process Design and Project Implementation

Based on the results of the feasibility study, PO Naftan decided to develop the project further. During 1998 and 1999, KBC was commissioned to carry out the process design of all of the technology areas of the revamp, including the cracking furnaces, soaker drums, quench systems and fractionator flash and wash zones. Both visbreaker and thermal cracking revamps and start-ups were completed in 2000.

Visbreaker Performance

Following start-up of the visbreaker, performance test runs were undertaken in October and November 2000 in order to assess how the performance of the unit compared to design.

During the first test run, the furnace was being operated at a low furnace outlet temperature of 445°C. This is a low severity operation; the temperature being below the normal design operating temperatures of 453°C for summer operation and 458°C for winter operation and well below the maximum severity case operating temperature of 464°C.

The second test run was performed at a higher severity, with a furnace outlet temperature of 452°C. The overall yields for the second test were compared with the design heat and material balance cases in Table 2.

Table 2
Comparing Overall Yields With Design
And Heat And Material Balance Cases

	8th Nov. 2000 Test Run Performance	Design Summer Operation	Design Winter Operation	Maximum Severity Operation
Feed Rate t/h	129.4	120.4	175	175
Furnace Outlet Temp.°C	452	453	458	464
Soaker Outlet Temp.°C	432	437	440	445
Fractionated Yields Wt% on Visbreaker Feed				
Gas + LPG	1.0	2.25	2.5	2.9
Naphtha	4.1	2.15	2.4	2.8
Gasoil	7.2	12.45	13.5	15.2
Visbroken Residue	87.7	83.15	81.6	79.1
Naphtha / Gasoil TBP cutpoint °C	180	150	150	150
Gasoil / Residue TBP cutpoint °C	315	360	360	360

The test run performance was analyzed using KBC's VISTOP visbreaker performance monitoring and optimization software. VISTOP can be used to analyze the furnace and overall unit performance. It can also be used to simulate the fractionator and to vary the cut points of the fractionator product streams, allowing direct comparison and reconciliation of the stream yields and properties on an equal boiling range basis.

For example, during the November test run, the actual yield of visbroken residue at 87.7 wt% on feed was higher than the design operation due to the low 315°C final TBP cut point of gasoil drawn in the fractionator. The residue viscosity was lower than the design figure. The VISTOP analysis allowed the different operations to be compared with a consistent 360°C TBP cut point basis.

Table 3
Reconciled Yield Data Obtained From
The VISTOP Analysis

	8th Nov. 2000 Test Run Performance	Design Summer Operation	Design Winter Operation	Maximum Severity Operation
Furnace Outlet temp.°C	452	453	458	464
Standard Cut Yields Wt% on Visbreaker Feed				
Gas	0.45	0.53	0.58	0.68
LPG	0.55	0.98	1.08	1.27
Naphtha (C5-200°C)	4.5	4.73	5.22	6.14
Gasoil (200-360°C)	10.3	10.61	11.48	12.81
Visbroken Res.(360°C+)	84.2	83.15	81.64	79.1
Wt% Yield of 360°C- Material (Guarantee Parameter)	15.8	16.85 14.4(g)	18.36 15.7(g)	20.9
Viscosity of Fractioned Visbroken Res.(cst@80°C)	184 (315°C+cut)	984 (360°C+cut)	636 (360°C+cut)	679
Visbroken Res. P Value 1	1.9	1.7	1.5	1.4
Visbroken Res. KBC Aromatic Blending #1	5.8	54	50	48

(1) Naftan measure fuel oil stability 'P' value by a test method using mixtures of heptane and toluene as solvents. In this test, the volume is determined of 3 different toluene / n-heptane mixes that can be absorbed into a given volume of fuel oil before the asphaltenes come out of solution. The results of the test being expressed as a Peptisation or 'P' value which is related to the volume of pure heptane that can be absorbed before asphaltenes are precipitated. The results of the test have also been expressed in KBC's measure of fuel oil stability, Aromatic Blending Number or ABN.

The minimum 'P' value requirement for stable fuel oil with the Naftan test method is 1.4, equivalent to a KBC ABN of 48.

This analysis confirmed that the guaranteed yields for both summer and winter operation were exceeded by the November test run, even though the test run operation was at a lower furnace outlet temperature, and hence lower severity, than design.

Although actual naphtha yield was higher than design, due to a C5-180°C boiling range naphtha being drawn during the test run, rather than the C5-150°C range used in the design heat and material balance cases. Underlying naphtha yield is similar to design.

The VISTOP analysis also showed that the viscosity reduction achieved was slightly greater than predicted and that the stability of the product was also better than predicted.

The operation of the unit could be further improved by increasing furnace outlet temperature, since the fuel oil stability margin was high in both test runs. In November, P-value was 1.9 versus a minimum requirement for stable fuel oil of 1.4. Some further visbroken gasoil could also be economically recovered to the diesel pool.

Optimizing the simulation of the test run operation indicated the optimum furnace outlet temperature to be 460°C, giving a finished fuel oil ABN of 50.5 (Naftan P value of 1.52). In fact, the furnace outlet temperature could be increased further while maintaining stable fuel oil. However, KBC recommend to not exceed the temperature, at least during the first run, if the design run length before decoke is to be assured.

Operating at 460°C furnace outlet temperature gave a yield of 360°C minus material of 20-wt%, well in excess of the guarantee values. The furnace successfully achieved its furnace run length requirement before a decoke of 9 months by July 2001.

Conclusions

The KBC visbreaker/thermal cracker project fully met Naftan's policy to focus on cost effective revamps of modest investment. KBC significantly increased refinery upgrading at low capital cost with a payback of less than one year.

Conversion of primary fractionation units to visbreaking or thermal cracking facilities represents a possible low cost upgrading modification for many refineries with excess distillation capacity.

At Naftan, KBC's proprietary Visbreaker and Thermal Cracker design technology, together with our independence and approach, has enabled the successful implementation of the project and has allowed the visbreaker to achieve performance fully in line with design expectations.

Knowledge Makes The Difference

KBC Executive Symposium

Peter Close, one of KBC's founders, presenting at the Executive Symposium

The 2001 KBC Executive Symposium was held in July at Royal Lytham St Annes, located in the north of England. Delegates travelled from all over the world to engage in a mixture of presentations and workshops on the theme of 'Making a Profit in a Changing Environment'.

Refiners must constantly keep abreast of new developments in the current climate of tighter government specifications and reduced profit margins in order to maintain competitive advantage. Over the three day conference, industry-leading speakers gave insight into 'Why', 'What' and 'How' to achieve change and improve profit, covering their regional challenges.

The conference began with a fascinating view on the future of global change from a leading futurist, Professor Richard Scase. Mr. Sergio Lattanzio from ANCAP, Uruguay, then followed to share the supply and demand balance issues in South America. The next presentation from Mr. Hiroji Adachi addressed NMOC's company restructuring, how acquiring and rationalizing their facilities changed their profitability, and what they are doing with KBC to make profit improvements. Mr. Maxim Alenov from Tyumen Oil Company, Former Soviet Union, then described the situation in central Europe and the upcoming technologies affecting their profit potential.

The second day focussed on solutions for achieving change with case studies from KBC's Profit and Maintenance Improvement Programs, as well as ways to add value across the Refinery/Petrochemical interface. Through technological advances, we presented KBC's expanded offerings and introduced our internet-based technical services and remote consulting, followed by the capabilities of HYSYS.Refinery, our refinery-wide simulation tool developed through KBC's alliance with Hyprotech.

The final day concentrated on implementing change and sustaining benefits, including how implementation services and longer-term technical services provide extended and sustainable solutions.

Delegates also enjoyed a mixture of social activities including: an afternoon at the Open Golf Championships; a KBC Client Golf Tournament; a gala dinner held at the elegant Hoghton Tower, an ancient stately home once host to William Shakespeare; and the final evening, an auction at a local art gallery. The experience was educational as well as enjoyable.

From our client feedback, the most important aspect of the KBC Symposium was the ability to interface with industry peers from around the world and exchange experiences and successes in our ever-changing market. From KBC's prospective, we valued the chance to understand the needs and concerns that affect our clients' ability to adapt to changing business environments and prosper in these challenging times.

KBC Risk Solutions

Services

- Risk Based Concept Selection
- Business Venture Risk Analysis
- Close On-project Risk Support
- Risk-based Appraisal of Concepts for Upstream Development
- Risk/Safety Based Support for Major Upstream Project Developments
- Strategic Risk Management
- Process Safety Management
- Process Hazard Analysis/Revalidation
- Safety, Health and Environment Audits
- Emergency Management Systems/Software
- Incident Investigation
- Human Factor Analysis/Job Task Design
- ISO 14000 Program Development
- Risk-based Triple Bottom Line Analysis
- Engineered System Design
- Safety Integrity Levels

In January 2001, KBC incorporated the formerly independent risk consultancy, Risk Solutions, to expand our consulting services beyond the downstream hydrocarbon processing industry. Specializing in risk-based engineering and safety support for upstream and downstream projects, Risk Solutions had considerable experience in providing consulting services and advice to a broad range of operators and contractors worldwide, with a proven track record of increasing safety, availability, and profitability for clients. It was truly a perfect fit for KBC.

In supporting our varied client list, KBC Risk Solutions (RS) has brought expertise in all stages of an asset life cycle; from conceptual design through plant commissioning and operations, to abandonment, removal and remediation. KBC RS has been involved in the development and use of quantitative risk analysis, design safety, loss prevention & control skills in some of the largest onshore and offshore projects worldwide. In the application of such assessments and analyses to each project, KBC RS have been able to achieve significant savings while enhancing safety through a proactive risk management approach.

Though a main element of previous business, the focus of KBC RS has not been limited to upstream. KBC RS has undertaken some of the most successful projects for refineries. Through the use of economic risk analysis, KBC RS has assisted clients improve unit onstream factors by 10%. One client received a USD 1 million annual reduction in insurance premiums as a result of an extensive process safety management program developed by KBC Risk Solutions.

Much of the success of KBC Risk Solutions has been due to the clarity of its reporting, optimum use of in-house software models and programs to obtain accurate results, and its ability to complete jobs within budget and schedule. For more information on Risk Management Consulting, contact Paul Ceeney, KBC Risk Solutions Business Line Leader, at 281-293-8200 or pceeney@kbcat.com.

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