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ABSTRACT BOOK

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National Oil & Gas Authority

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Innovation & Technology

Abstract Title: Haldor Topsoe's Advances in Catalysts for Hydrocracking Pre-treatment and ULSD Production

Author: **Søren Mikkelsen, Haldor Topsoe**

Now, more than ever, refiners are forced to search for the absolute top tier NiMo catalyst for their medium to high-pressure ultra-low sulfur diesel or hydrocracking pretreat units. Despite tremendous improvements in the catalyst technology within the past couple of decades, ultra-low sulfur fuel legislation and the shift towards maximizing diesel production from VGO hydrocracking pose new challenges.

Topsoe has developed the TK-611 HyBRIM™ and TK-6001 HySwell™ catalysts for hydrocracking pretreatment and ultra-low sulfur diesel production. The combination of the catalysts enables refiners to obtain maximum aromatic saturation, resulting in increased volume swell and higher operating profitability.

The key to boost the aromatic saturation, lies within removal of nitrogen from the feed, since nitrogen limits both aromatic saturation, density reduction, and volume swell. The TK-6001 HySwell™ is developed specifically for this purpose. When used in hydrocracking pretreatment and ultra-low sulfur diesel applications, the TK-6001 HySwell™ catalyst is able to remove 99,9% nitrogen from the feed, making it possible to achieve a significant increase in volume swell and the amount of low sulfur diesel produced.

TK-611 HyBRIM™ is a cost-efficient, alumina-based catalyst with the highest possible activity. In fact, TK-611 HyBRIM™ offers 25% higher HDS and HDN activity than its successful predecessor TK-609 HyBRIM™, which has been sold to more than 160 units worldwide. Since the introduction in 2016 TK-611 HyBRIMTM has been sold to 45 units, both hydrocracking pretreat and ultra-low sulfur diesel applications.

For the optimal balance of hydrogen consumption, the TK-6001 HySwell™ catalyst should in industrial applications be utilized in combination with the TK- 611 HyBRIM™ catalyst.

The presentation will include the catalyst development steps of the new hydrotreating catalysts TK-611 HyBRIM™ and TK-6001 HySwell™, as well as present case stories from units running with these catalysts, showing significant optimized performance

Abstract Title: First Integrated Hydrocracker-DHT Unit in ME - Its Design, Challenges and Benefits

Authors: **Alok Srivastava - Advanced Refining Technologies (ART), Keshav Nagarhalli – ORPIC, Talal Al-Rawahi - ORPIC**

Hydrocracking unit (HCR) is one of the most versatile and profitable units in a Refinery which converts heavier oil fractions from Vacuum Column or other secondary processing unit like Coker to valuable distillate products. Diesel Hydrotreating unit (DHT) is necessary for any Refinery to produce a low sulfur product to meet market requirements. Both these units have considerable capital expenditure. ORPIC has recently commissioned an integrated unit having both Hydrocracker and DHT sections within the same unit.

This unit is one of the few of its kind in the world and the first in the GCC, designed by Chevron Lummus Global (CLG, a Joint venture of Chevron and CB&I). The two-stage HCR and DHT share common recycle gas, fractionation, light ends recovery (LER), liquefied petroleum gas (LPG) treating, fuel gas treating, and make-up hydrogen sections.

The unit is designed to maximize Mid Distillates while processing straight run Vacuum Gas Oil from Vacuum Distillation (VDU) unit and Cracked feedstock from the Delayed Coker Unit (DCU). Hydrocracker operates at about 60 wt% conversion with unconverted oil feeding to downstream RFCC and overall Diesel product from the unit meets Euro V specifications.

This paper describes the benefits in the capital and operating cost with this design, challenges faced during the commissioning and initial operation of the unit and actions taken to mitigate them.

The unit completed a successful test run and is currently running smooth. Technical Support is provided by Advanced Refining Technologies (ART, a Joint venture of Chevron and Grace) to maximize the profitability of the unit with regular unit data reviews and other support.

Abstract Title: New Innovative Approach to Increase Isomerization Throughput and Octane Booster

Author: **Edward Griffiths, KBR**

The once-through conversion of a traditional fixed bed light naphtha isomerization unit is limited by the reaction equilibrium. Overall unit conversion can be achieved by use of a recycle stream of primarily n-paraffins, a typical example of which is the use of a de-isohexanizer (DIH) column to separate the recycle stream as an n- hexane rich middle cut, with the overhead isomerate and bottom product “drag stream” sent to gasoline blending. Even the simple addition of a DIH is capital and energy intensive and the isomerate product quality is limited to around 88 RON. Any incremental feedstock processing demands place stress on the system resulting in lower isomerate octane.

KBR’s MAX-ISOM™ technology uses a unique catalytic distillation column design to generate high conversion of n-paraffins to iso-paraffins in a single column. While the technology can operate as a stand-alone isomerization unit in its own right, it also offers a unique revamp opportunity to already constrained recycle isomerization units. MAX-ISOM can be placed downstream from the DIH column of a traditional recycle isomerization unit to process the middle and bottom products. The DIH column becomes a binary split column, thereby reducing energy consumption, and the volume of fresh feed to the existing unit can be increased by up to 40% due to removal of the recycle stream. Furthermore, overall isomerate octane will be boosted due to high conversion achieved in the MAX-ISOM column.

The MAX-ISOM column contains beds of isomerization catalyst separated by fractionation zones. High conversion of n-hexane and methylpentanes is achieved by exploiting the relative volatilities of the reactants and products and through internal recycles. This paper will include a case study to demonstrate the throughput and product quality gains offered by MAX-ISOM in a revamp flow scheme.

23rd October | 11:00 -12:00

Improvements

Abstract Title: Fuel Oil Conversion Project at Kuwait Petroleum International RaM Refinery: Strategic Response to 2020 Challenge

Author: **Xander de Jong, Kuwait Petroleum International**

IMO 2020 will cause a dramatic shift in the demand of marine fuels used globally from High Sulfur Fuel Oil (HSFO) to 0.5% sulfur marine fuel (ULSFO). As the IMO 2020 is an international regulation, refineries in all corners of the world will be impacted. According to the BP 2016 Statistical Review of World Energy distillate production (excluding kerosene and jet fuel) was 28 million bpd and fuel oil production was 8 million bpd half of which is marine fuel.

Key price differentials for refiners will likely change markedly in 2020, producing significant changes in processing strategy for many refiners:

Distillate prices will increase markedly relative to high sulfur residual fuel products.

Vacuum residue yield and sulfur content will cause crude price differentials to widen between low and high sulfur crudes.

After IMO becomes active in 2020, only ships fitted with an on-board scrubber can continue to use HSFO. Currently only few ships have on-board scrubbers and it is not clear how many ships will invest in this technology.

From a refinery perspective, the best option to move away from the bunker fuel market depends on configuration, location, markets and strategy. The following technologies are available:

Delayed Coking Unit (DCU) is used in many refineries combined with hydrocracking for residue conversion. The DCU will produce significant amounts of coke which is a low value product.

In the Flexicoking process, the produced coke is converted in-situ to power.

Solvent Deasphalting (SDA) with Hydrocracking of the produced Deasphalted Oil (DAO). With the modern catalyst systems, it is possible to remove the high metal content and handle the high CCR content of the DAO.

Gasification can handle highly viscous and unstable residues. The gasification process can be used to produce power but it is also possible to produce synthesis gas or hydrogen.

Moving bed hydrocrackers (Ebullated-bed or Slurry-Phase) can be used upgrade the bunker fuels to clean fuels. Kuwait

Petroleum International and ENI jointly own Raffineria di Milazzo (RaM refinery). With the upcoming IMO regulations and declining demand of bunker fuels for power generation, the Milazzo refinery has started the last step in the deep conversion project which is aimed to achieve 0% fuel oil production.

Deep conversion projects started in RaM in the late 90's with the construction of an LC-Finer (Vacuum Residue Hydrocracker with ebullated bed technology),

Hydrogen production and Sulphur recovery units. In 2015, a comprehensive revamping of FCC unit was implemented (FCC Resid max) in order to maximize feed

including DAO to further increase conversion.

To finish the deep conversion projects the following is studied: the SDA unit is fed with LC-Finer Vacuum or Atmospheric Residue. The DAO product is sent to the

FCC unit and the remaining residue (pitch) is fed to the gasification unit that produces syngas, which is converted to hydrogen.

This presentation gives an overview of the local business environment, underlying strategy and projects that were already implemented leading to the final configuration.

Abstract Title: Capturing the Maximum Value from The Bottom Of The Barrel

Author: **Gurminder Singh, Shell**

For most refiners, finding ways to reduce their exposure to the fuel oil market has become a strategic imperative. Their future competitiveness is at stake. Although there is a wide range of potential responses, the capital investment required and the economic case for each can vary enormously.

Shell Global Solutions has conducted numerous investment studies to help identify the best responses for Shell refineries and for those of its customers around the world. These evaluations are highly complex. There is certainly no one-size-fits-all solution, as a range of factors has an influence, including the refiner's existing configuration and the amount of capital available.

Often, Shell finds that the technologies providing the highest residue conversion, which include slurry-phase residue hydrocracking and flexicoking, may not be the smartest investments. Their capital expenditure can be extremely high. Better returns can often be achieved with less capital-intensive integrated solutions. These include, for example, installing:

- A solvent deasphalting (SDA) unit and revamping the hydrocracker to increase the conversion of fuel oil to distillates
- An SDA unit and modifying the residue gasification unit to handle the heavier stream
- Deep-flash technology in the vacuum-distillation unit to lift more and better-quality vacuum gas oil and reduce high-sulphur fuel oil production

This presentation will describe how refiners can evaluate which response option will offer the most compelling economic case for their specific situation. Real-world case studies will illustrate the approach. The presentation will also explain why refiners should consider the impact that each solution would have on their crude flexibility. Being able to process a flexible crude diet can lift a refiner's margin by up to $1/bbl but some technologies, such as SDA, can enhance crude flexibility, whereas others, such as delayed coking, can restrict it.

Abstract Title: Heavy Oil Upgrading Strategies for Improved Refinery Economics

Author: **Gary Brierley, Honeywell UOP**

Tightening MARPOL regulations and the continuous challenge to improve refinery economics are driving refiners to consider converting vacuum residuum into higher value products. Heavy oil conversion strategies are unique to each refiner and not all solutions require substantial investment. Instead, a staged approach is necessary to address market uncertainties. These potential strategies can range from low cost separation technologies to make feed for existing assets or more capital-intensive plans for significant conversion of vacuum column bottoms. Honeywell UOP's portfolio of heavy oil conversion technologies can provide a unique solution to fit a refiner's needs. This presentation will discuss potential options to meet tightening MARPOL specifications, as well as improve gasoline and propylene production. Technology solutions such as the integration of an RCD and RFCC unit, Uniflex MC and SDA will be highlighted.

23rd October | 15:00 - 16:30

Digitalization

Abstract Title: KNPC's Smart Refinery: Maximo Oil & Gas Enterprise Solution

Author: **Nabeel Haidar, KNPC**

The Kuwait National Petroleum Company has implemented and heavily customized Maximo's Oil & Gas enterprise solution to allow its core business processes to be fully automated, a step towards the company's goal of achieving a truly "Smart Refinery".

Maximo Oil and Gas brings together traditionally separate business functions into a single integrated platform that combines the most common business systems and departments such as finance, commercial, maintenance, and operations.

The project's implementation covers 7 KNPC sites with over 300 training sessions for 2562 users from maintenance, operation and HSE.

Some of the main components of the solution include Electronic work permits, Operator's logs, Risk Assessment, Work Conditions, Defect Elimination, and Failure reporting. KNPC is one of the first companies in the Gulf region with Electronic Work Permit implementation inside Maximo's Asset Management System.

One of the major challenges with implementing the solution was the standardization of business processes across various KNPC refineries and migrating all of them into a single platform. Additionally, transforming the work permit infrastructure into an electronic system instead of the previous manual methods.

Utilizing this solution, the KNPC reduces the data transfer rates from 25 days to 3 days, the invoice cycle times from 100 days to 8 days, the purchase cycle times from 200 days to 20 days and improves the procurement cycle immensely. In addition, the company decreased the time needed to complete asset maintenance and enhanced its work order preventative-maintenance versus corrective-maintenance ratio [PM/CM ratios (8,000/ 2,000) prior to Maximo (2,000/ 35,000)], and the average Material in Transit cost has been decreased dramatically from 16million KD to less than 2million KD.

Future plans include upgrading to Maximo 7.6, which would introduce the latest technologies such as IoT (Internet of Things) where data collection will be fully automated, including analytics, preventative maintenance, and even predictive maintenance by utilizing AI technologies.

Abstract Title: Fault Detection and Diagnosis in Chemical Processes Using Big Data Analytics

Author: **Dr. Mohamed Bin Shams, University of Bahrain**

Modern industries today deal with different automated systems that can generate a huge amount of data and store it in a historical database. As these big data continues to accumulate, there has been a significant focus on finding and obtaining actionable insight from it. These massive amounts of industrial data are characterized by being correlated (most likely in a nonlinear manner), of low signal to noise ratio and usually with many missing measurements in all measured variables. Yet, this data is capable to reveal many useful information e.g. for detecting and identifying process faults. In this project, a big data analytics tool called Kernel Principal Component Analysis (KPCA) was used for fault detection. A new fault identification strategy based on the power series

approximation of the kernel functions was investigated and tested. The speed of computation was also studied and enhanced especially with regard to the calculation of the principal components and the contribution plots. KPCA was applied and tested using a simple case study as well as a subset of the faults in the Tennessee Eastman Process (TEP). The kernel principal component analysis shows a superior proficiency compared to its linear counterpart.

Abstract Title: Sensor Data Analytics based on DNV GL's Anomaly Detection Tool using Linear Regression Models

Author: **Jorn Veenstra, DNV GL Oil & Gas**

In downstream installations and plants, more and more sensors are being installed that monitor all kinds of properties of a process, generating large numbers of data which are hard or impossible to monitor properly by a human. DNV GL developed an anomaly detection tool which is based on linear regression models. The purpose of the tool is to find anomalies in the 'big data' domain and to point the attention of the process engineer towards these anomalies. Meanwhile, this tool has been implemented at a large power station in The Netherlands, where the data of 200 sensors are being analyzed periodically. The analysis is supporting the process engineer in handling large numbers of data and predicting malfunctioning of equipment at an early stage.

How does it work?

The anomaly detection tool algorithm decides for every sensor if the behavior found within the sensor data in the selected time window matches with the behavior found within the subsequent time window. If behavior starts to deviate, a trend is detected and characterized by either increasing/decreasing values or an increasing/decreasing spread of the values, such as increasing outliers. The focus of the anomaly detection tool is rather on increasing/decreasing trends and trend breaks over longer periods of time: weeks, months and even years, rather than on anomalies developing suddenly over a short period of time.

Figure 1 below shows the design of the algorithm. The input is sensor measurements of the selected sensor and measurements of the two independent variables, in this case for the Power Plant these were 'streamflow' and 'cooling tower temperature'.

Figure 1 below shows the design of the algorithm. The input is sensor measurements of the selected sensor and measurements of the two independent variables, in this case for the Power Plant these were 'streamflow' and 'cooling tower temperature'.

Firstly, for the selected time window the data is smoothened according to the corresponding smoothing interval. Secondly, a linear regression model of the sensor based on the independent variables ‹steam flow› and ‹temperature› is created for every week/month/year in the time selection window. Finally, a trend detection test will decide whether the model is significantly changing over the weeks/months/years.

The algorithm is applied to all selected sensors in the plant's database at the same time. The analysis will run weekly, monthly and yearly on a fixed date and time. The Anomaly Detection Tool shows always the newest week, month and year analysis.

Furthermore, a handy tagging and reporting function have been added to the tool: this enables the process engineers to tag and document false positives (no real problem but detected as an anomaly) or anomalies that are known but not resolved yet.

Benefits to the plant owner

DNV GL's Anomoly Detection Tool is a big data analytics tool which enables the process engineers to strongly improve their detection of anomalies in the vast number of data generated by multiple

sensors in the plant or facility they operate. This will reduce the plant owner's operation and maintenance costs considerably by preventing sudden malfunctioning of equipment and possible shutdown of the plant.

23rd October | 15:00 - 16:30

Innovation & Technology

Abstract Title: A New Olefins Selective Cracking Catalyst for Maximum Propylene Production from FCC Units

Author: **Yaming Jin, Saudi Aramco**

Propylene from gasoline producing FCC processes accounts for approximately one-third of the world propylene production. More FCC propylene production is desirable to partly counter the escalating propylene demand, which is expected to increase by 3.6% on average for the coming years.

Light olefins production from conventional FCC units can be improved by increasing the unit operating severity such as higher cracking temperature and/or higher catalyst to oil ratio. These approaches are simple and effective but demand robust catalysts and are subjected to metallurgy limitation. In addition, higher operating severity typically leads to over cracking, decrease in gasoline production, and increase in dry gas yield. The Aramco R&D Center has been collaborating with JGC Catalysts and Chemicals Ltd. (JGC C&C) in developing new propylene selective FCC catalysts that can be deployed in FCC units to improve propylene yields without significantly altering the normal unit operating conditions.

A highly olefins selective FCC catalyst technology, CANFCC, was jointly developed by Aramco R&D Center and JGC C&C. The CANFCC catalyst technology targets to optimize operation economics of the integrated FCC units, in which high olefin yields, especially propylene, are desirable. The key to the technology is an innovative metal inserted USY zeolite, which is tailored to be the active component of olefin selective FCC catalysts.

The cracking reactivity of the CANFCC catalyst was tested under conditions of three application scenarios including a typical gasoline producing mode, a high propylene production mode, and a high severity cracking mode, using lab scale reactors such as an advanced catalyst evaluation (ACE) reactor and a microcavity testing (MAT) reactor. Additionally, pilot plant tests were carried out in an integrated catalyst circulating riser rector to evaluate CANFCC's performance for potential commercial deployment cases. CANFCC shows higher propylene yield for all tested application scenarios.

In this paper, we will present the detailed test results and discuss the perspective of commercial applications of CANFCC catalyst.

Abstract Title: Blockchain Technology in Oil & Gas Sector

Author: **Qais Y. AlDoub, Kuwait Integrated Petroleum Industries Company (KIPIC)**

Blockchain is changing the near future of Oil and Gas supply chain. The technology behind cryptocurrency is evolving in the industry, and it's becoming a reality. In the presentation/paper, a mixed of methodologies were used including analysis of the literature, expertise, practices, workshops to asses Blockchain business requirements for KIPIC and all of its integrated petroleum industries including al-zour refinery, petrochemical factory and LNG (liquefied natural gas).

A Blockchain is a digitized, decentralized, public ledger of all cryptocurrency transactions. Originally developed as the accounting method for the virtual currency Bitcoin, Blockchains – which use what›s known as distributed ledger technology (DLT) – are appearing in a variety of commercial applications today. The Blockchain database is shared across millions of computers simultaneously, with the public, and data stored remains incorruptible. This is done through breaking down data in records into fragments which is then stored in multiple server locations. While the database is decentralized, and all economic transactions are accounted for and authenticated at every touch point, known as 'nodes.' Data can only be altered when there is an agreement among a majority of these nodes. This agreement ensures that records cannot be hacked or violated – and any change in the record is automatically made public across the entire network. Oil and gas market, with their ever-growing concern to struggle with price fluctuations, has found an innovative technology in Blockchain which can now meet the acceptable margin of costs. The energy sector can potentially benefit from the supply chain, purchase orders, payment invoices and validation of documents before the final delivery of goods. All these can be managed through the ledger which gets updated in real time and is synchronized across all platforms in no time. Supply chain, proof of origin, managing the assets can be done without the need of a central intermediary.

In conclusion, Blockchain has the potential to revolutionaries the entire oil and gas industry, many companies in the region are testing the technology into their system or assisting the business requirements as in the case of KIPIC.

Abstract Title: Direct Catalytic Cracking of Crude Oils to Produce Petrochemicals Feedstock

Author: **Gnana Pragasam Singaravel, ADNOC**

Direct catalytic cracking of Murban (MBC) and Upper Zakum (UZC) crude oils has been evaluated over a simulated equilibrium catalyst (E-Cat) in a realistic short contact time Resid test (SCTRT). The unique features of the unit makes an excellent tool for catalyst development, screening, and testing of residual feed and solve limitations of micro activity (MAT) and advanced fluid cracking (ACE) testing units by instantaneous mixing of catalyst and feed. The E-Cat has been prepared in the laboratory by deactivation method using cyclic deactivation unit (CDU) with the spiked organic metal contaminants in heavy gas oil by crack on metals to achieve the required amount of nickel and vanadium content. The E-Cat blended with olefin additive zeolite catalyst tested in an SCART unit cracking at 1 second. The first time, we are using this innovative method of producing light olefins from direct cracking of crude oils using SCTRT. The performance evaluation of the E-Cat reaction conditions is: temperature between 630 and 700°C; metal content around 8300 ppmwt; 10% olefin additive and catalyst/oil ratio between 5 and 8. The conversion increases with the increase of temperature and catalyst to oil ratio for Murban and Upper Zakum crude oil.

Key words: RFCC, catalytic cracking, olefin additive, light olefins

Key bullet points:

- Catalytic evaluation of light and heavy resid oils are evaluated over lab deactivated equilibrium catalysts
- Extended parameters for the prediction of yield patterns between the crudes and their products cuts

23rd October | 15:00 - 16:30

Improvements

Abstract Title: Pilot Plant Study for Hydrocracker Catalyst Selection

Author: **Harbeyah Al-Enezi, Kuwait National Petroleum Company**

Historically in KNPC Hydrocracker catalyst was procured based on competitive bidding. The selection of successful bid was based on catalyst manufacturer›s predicted yield and catalyst life estimate. However, this approach has certain limitations. Often, operating companies face surprises and constraints with selected catalysts not meeting assured performances. There could be a huge financial risk to the companies if new catalysts are not delivering expected conversion and selectivity. It will be not be an easy process and too late to rectify the situation. Hence, KNPC decided to test all shortlisted catalysts in independent third-party pilot plant testing facilities under similar process environment.

Hydrocracking catalyst shall be balanced in attributes like activity, selectivity and minimize over cracking. Third party pilot plant evaluation for all catalyst systems brings clarity to catalyst deactivation profile. Some catalysts can be very active in SOR and deactivate faster leading to a loss in product yields prematurely. Pilot plant testing avoids companies to become a trial ground for new catalysts. It will help in analyzing the effect of changes in feedstock qualities. Prior information on catalyst selectivity through pilot plant testing will improve the short and long-term planning of the companies. Pilot plant test results will make Catalyst evaluation an easy and objective process with minimal uncertainties.

Because of better selectivity of the winner catalyst, selected through pilot plant testing, mid-distillates production increased by ~5.5 %. This paper discusses in detail the pilot plant methodology, protocol, and actual commercial unit improved performance with the selected catalyst.

Abstract Title: Next-Level Hydrocracker Flexibility: Unlocking High Performance in Today's Turbulent Markets

Author: **Simon Cackett, Shell**

Volatile margins and declining demand in traditional fuel products in key markets combined with increased competition from new and very efficient refining capacity make this one of the most challenging periods that the industry has ever known.

Among the many options that refiners can take to maintain or enhance their competitiveness, three are emerging that leverage the hydrocracker's flexibility. These will be explored in this paper:

1. Processing heavier, cheaper crudes

2. Processing non-standard feeds

3. Exploiting the enhanced margins in lubricant base oils or petrochemicals in some markets

Introducing such changes, however, without risking reliability or product quality issues, requires an in-depth understanding of a wide range of issues, from corrosion control and metals removal through to hydrocracker process configuration and the implementation of the right catalyst system.

So, in this presentation we will describe:

1. The challenges imposed by heavier, cheaper crudes and how to mitigate them. Such crudes are typically high in total acid number, aromatics content, metals, and nitrogen. Consequently,

a refiner may need to consider using more active pretreatment catalysts and catalysts that have both higher activity and selectivity. It will likely need to take other steps too, such as using special metallurgy, corrosion-inhibiting chemicals, and guard catalysts, and introducing appropriate controls on the crude blends.

2. Novel configurations that have enhanced hydrocrackers' contributions to overall refinery margin. These include a coker–hydrocracker line-up, which can result in zero fuel oil production and provide robustness in crude flexibility; a solvent deasphalter–hydrocracker line-up, which can be one of the lowest capital cost options for residue conversion; and a hydrocracker–base oils line-up in which the process configuration and the application of the right catalyst system are important to maximizing both the yield and the quality of the final base oil products.
3. How some leading refiners have leveraged the flexibility of their hydrocrackers and the value this has had on their bottom line. The presentation will include case studies on Grupa LOTOS' deasphalted oil hydrocracker and Hyundai Oil bank's lubricant base oils project.

The information in this presentation could help refiners to adapt their units to handle extreme feeds or to capture new business opportunities in petrochemicals or lubricant base oils, both of which could transform the economics of their assets.

Abstract Title: BAPCO Hydrocracking Unit: A Decade of Success

Author: **Velmurugan Venkatesan, BAPCO**

The Bahrain Petroleum Company (Bapco) is 100% owned by the Government of the Kingdom of Bahrain and operates the Bahrain Refinery. The refinery, which started up in 1936 with a capacity of just 10 MBPD and was the first in the Arabian Gulf, is geared towards maximizing middle distillates. Over the last 82 years the facilities have been regularly revamped and new units have been added. Today it is a world-scale, complex refinery with a capacity of 265 MBPD and incorporating many of the latest process technologies, including hydrocracking.

In 2007, Bapco commissioned its Low Sulphur Diesel Production (LSDP) Complex, the heart of which is a 60 MBPD VGO Hydrocracking unit (1HCU). It is a 2-stage unit with recycle, licensed by Chevron Lummus Global (CLG). Since then, 1HCU has been a success story due to Bapco's unwavering commitment to identify opportunities for innovation and improvement in design, operation and performance. Success has been built on in-house knowledge and expertise and close collaboration with catalyst vendors and the process licensor.

Even before the 1HCU design had been finished, Bapco saw the opportunity for a Group 3 lube base oil unit (LBOU), which could be fully integrated with the hydrocracker to increase refinery competitiveness and profitability. The LSDP Complex was successfully commissioned in 2007, followed by state-of-the-art LBOU in 2011.

In early 2010, in a challenge to conventional thinking, we implemented an innovative change to the 1HCU process configuration, by routing fresh HVGO feed directly to the second stage reactor, resulting in a novel approach, and the only unit in the world with this configuration and a downstream LBOU. The benefits of the unique configuration were confirmed by the licensor, and resulted in better quality products and overall better performance.

In our pursuit for further improvement, we also recognized the need to increase the 1HCU catalyst cycle length from 2 to 3 years. This was achieved in collaboration with the catalyst vendors through extensive pilot plant testing and catalyst development to establish the right catalyst system for Bapco. The overall benefit has been one less catalyst changeout shutdown in the 6 year turnaround and inspection (T&I) cycle, delivering significant savings.

Over the last 10 years, we have relentlessly maintained our efforts to improve yields and product qualities through unit optimization and working with catalyst vendors to get better catalysts.

The most recent changes to the 1HCU catalyst system have led to an increase in middle distillate yield while meeting the key properties of the LBOU feedstock. This move also created operational flexibility and helped improve overall refinery economics.

The main aim of our presentation is to share our experience over the last decade in maximizing the benefit of our main profit center viz. 1HCU. We show how improvements in process efficiency are driven by process engineering expertise, knowledge and understanding and that in-house process engineering expertise and close collaboration with vendors and licensors are the foundation of innovation and value creation.

24th October | 08:30 – 10:00

Integration

Abstract Title: Refinery and Base Oil Plant Synergy - BAPCO›s Successful Venture in Lubricant Development, Testing and Commercialization

Author: **Mohamed Ahmed Hejres, BAPCO**

Objective:

The objective of this presentation is to share Bapco's experience in industrial lubricants product development, and the methodology undertaken for the substitution, development, and introduction of its products in its own operational facilities.

Discussion:

Bapco's newest business venture, Bapco Lubricants, has been driven primarily through a desire to diversify its existing business portfolio, and to also move through the value chain. The initialization of the project occurred concurrently with the inauguration of the Lube Base Oil Unit in 2011, which produces Group III synthetic lubricant base oil (a joint venture with Neste of Finland).

The decision was made in 2016 to extend Bapco's lubricants portfolio to industrial products, which constitute a significant market share in lubricants sales. An opportunity was captured for collaboration between the different maintenance sections operating in Bapco and Lubricants product development in order to develop and introduce industrial products piloted at, and operational in Bapco's own facilities. Similarly, in 2015, the Frontier (Heavy Duty Diesel Engine Oil) group was first tried on the company's vehicle fleet before market introduction.

Bapco operates a 267,000 barrels per day refinery with supporting facilities consuming approximately 200 tons of lubricants per year. The outcome of an initial demand by use survey determined 5 major product groups targeted for development; these were Turbine Oils, Hydraulic Oils, Specialty Engine Oils, Greases and industrial Gear Oils, altogether encompassing 78% of total company demand.

The development process was steered through a working group comprised of lubricants product development and the concerned specialists in each area of application for the different product groups. For refining units the concerned parties were Integrated Machinery Inspection (IMI), while marine products were developed in collaboration with Marine Engineering, representing Bapco's marine vehicle fleet.

After developing the required products and acquiring the necessary approvals, 6-month trials were then performed for each product category, moving first from the least to the most critical equipment. All introductions were made only after the completion of proper Management of Change (MOC) procedures as well as extensive external trials and approvals.

Results:

Eight product categories were developed and improved through collaboration with Bapco's own maintenance teams including Turbine Oils (Bapco Rotor), Industrial Gear Oils (Bapco GL), Industrial Hydraulic Oils (Bapco Caleno), specialty diesel engine oil (Bapco Frontier LMO), Poly-urea grease (Bapco Tashim PU), Specialty Engine oils, Thermic Fluids (Bapco Thermic) and compressor oils (Bapco Velox).

Having acquired the necessary approvals and clearances, the above products groups are currently undergoing extensive testing and monitoring in field trials at Bapco's own facilities and changeover to Bapco's Lubricants is expected to be completed by October 2018.

Benefits of the presentation:

This presentation aims to share our experiences in developing industrial lubricants and the challenges faced when introducing and testing new products in sensitive and critical operations in industrial facilities. We also aim to show the benefit Bapco has gained from internal collaborations, achieved by utilizing the experiences of the company's maintenance teams.

Abstract Title: Profit Pivot Points in a Refinery-Petrochemical Integrated Complex

Author: Nick Kinnis, MCDERMOTT

The recent industry trends in refineries have focused on improved quality of transportation fuels and alternate outlets for products as petrochemical feedstock. On the petrochemical side, there has been a surge of new steam cracker projects with the majority processing abundant low-cost ethane feed or naphtha. To maximize profitability, refineries are studying options for petrochemical integration. Several new projects have been announced around the world for integrated refinery/petrochemical complexes. Other major refiners are considering Crude to Chemicals projects with various levels of crude conversion to chemicals.

This paper examines the objectives and strategies available with the latest innovative technologies to maximize refinery profitability via petrochemicals. An integrated refinery/petrochemical complex has several profit pivot points that can make or break a project. On the Refinery Side (Feed Preparation) for a petrochemicals complex, the hydrocracker plays a pivotal role in terms of feed and product flexibility and producing an optimized intermediate stream for downstream petrochemicals. The second vital pivot point is the mixed feed steam cracker and the third pivot point is the C4/Pygas train. These 3 areas are frequently designed independently and with little consideration for the potential impact on the other areas. A coherent design and operational strategy will enable these pivot points to work in unison and provide the opportunity to maximize profit across the cycles of crude, petrochemicals and energy prices.

Abstract Title: Refining and Petrochemical Integration: Highway To Success

Author: **Emilie Rousseau, Axens**

In the Middle East, the glory days of ultra-cheap, plentiful feedstocks and a huge competitive advantage are drawing to a close. The North American shale gas revolution was a game changer that provided low-cost ethane to the US petrochemical industry and China with its coal to chemicals technology has become more self- sufficient.

On the other side, a global trend based on various studies shows that petrochemicals growth will be much higher than that of transportation fuels. It is expected to see a petrochemical global growth at about 4% per year compared to about 1% for fuels.

Thus, the need for swift and transformative change is underway. More and more projects are

announced and planned in the Middle East and signal the current trend for oil companies to rely more on chemicals and less on refining for fuels to drive future growth.

Refiners are increasingly assessing options to further upgrade their products into petrochemicals by increasing conversion and by implementing technologies to produce more valuable chemicals such as olefins and aromatics.

Integrating Refining and Petrochemicals offers several advantages to the refiners by:

- Gearing up for the change for conducting business in the coming years
- Expanding into higher growth markets
- Mitigating risks related to raw material and product price variations
- Improving asset profitability

However, these Refining to Petrochemicals projects which are large and complex need to be assessed and different routes can be taken to lead to success.

In that paper, the author will review the different possible schemes for integrated refining and petrochemical projects. We will review the right technologies that help to achieve the objective of moving towards petrochemicals and the opportunities they can bring around upgrading the bottom-of-the-barrel.

THE CASE STUDIES

Examples will be given for the choice of the best solution for process configuration to meet the growing demand for petrochemical products while meeting some demand in clean transportation fuels meeting new specifications linked to the looming environmental regulations. In particular, this paper will detail the largest crude to paraxylene project in Asia for Hengli which includes a complete suite of technologies to maximize residue conversion to produce heavy naphtha and further upgrade it to paraxylene.

A second example will show how S-Oil has chosen a novel technology to further upgrade its atmospheric residue into valuable products and in particular into propylene while minimizing its fuel oil production.

24th October | 08:30 – 10:00

Abstract Title: Finding the Optimum Coal to Methanol Process Design: A Simulation Case Study

Author: **Siddig Seedahmed Siddig, King Fahad University of Petroleum and Minerals**

During the recent years, CO2 utilization has become an important segment of the carbon capture and storage (CCS) technology for the reduction of CO2 emissions. This is an attractive approach since the captured CO2 can be converted to useful chemicals which not only helps to curtail the CO2 levels but also presents an economic benefit. One of the CO2 utilization routes is its conversion to methanol which can be used as a fuel or serves as a feedstock for the production of other valuable products such as methyl tertbutyl ether (MTBE), acetic acid, formaldehyde, dimethyl ether (DME) and methyl based esters. Presently, almost the entire methanol production is done from the catalytic conversion of synthesis gas which is a blend of CO, CO2, and H2. The synthesis gas can be produced from various sources; however, the majority of large-scale syngas is derived from the reforming of the natural gas. Considering the availability and price fluctuations of the natural gas, alternative feedstock such as coal and biomass is under investigation for the production of syngas.

This study is focused on the production of methanol from the CO2 captured from the coal gasification process. Various design alternatives have been developed to perform the process intensification while maximizing the methanol production process efficiency. Rigorous simulation models have been developed using the Aspen Plus to compare the alternative designs performance in terms of energy requirement, methanol production, and carbon emissions. A reasonable flowsheet of each unit has been developed for all the alternatives in order to simulate the models to have realistic results. The methanol produced is set to have mole purity above 98 %.

The base case design is shown in figure 1, where the coal is fed to the gasification unit to produce the syngas. The acid gases, H2S and CO2, are then removed from the syngas using a physical solvent. The cleaned syngas is shifted in the water gas shift (WGS) reactor to increase the H2 content of the syngas which is then fed to the methanol section where CO2 and H2 reacts to produce methanol.

Abstract Title: Reliable Operation Window for Variable Speed Driven Pumps

Author: **Ahmed Al Kubaish, Saudi Aramco**

Through this initiative, we have introduced a new practice to operate Variable Speed Driven (VSD) pumps using Reliable Operating Window (ROW) Chart, connected to DCS, by which we can explicitly identify the operating region in term of Best Efficiency Point (BEP) as well as the best configuration at different levels of operation demands. As a result of following ROW chart, Ras Tanura Refinery (RTR) recognized significant energy and cost savings besides the major reliability improvement.

This idea in simple words is a chart called the Reliable Operating Window (ROW) Chart, where we have combined three critical variables (Speed, Flowrate, and BEP) on it. Using Row chart, we can easily answer the following 3 questions in term of reliability: 1- Where we are? 2- Where we should be? 3- How to get there? It so easy and clear in the chart to know what the preferred region is and what to do if you are not on it. You just need to know the number of pumps running in parallel, the discharge flowrate of each pump, and each pump speed of rotation. Furthermore, the ROW chart can be easily reflected to DCS in order to automate the operation.

Following the ROW chart in operating VFD shipper pumps in RTR, has resulted in major reliability improvement, since the pumps are now running almost all the time in the preferred region with low vibration levels and high rotor stability. On top of that, RTR recognized the significant energy and cost savings as the total power consumption was reduced to more than 24%, saving $100,000 to $250,000 per year depending on the system flowrate requirements. Furthermore, ensuring these critical pumps are running reliably within the preferred region will provide tremendous maintenance cost avoidance and enhance the equipment availability, since unscheduled major pump shutdown will be avoided.

This operating practice is applicable to any VSD pumping system connected in parallel inside ARAMCO or outside. Moreover, the objectives and benefits of this initiative are aligned with RTR's and Aramco's corporate strategy to save energy & cost as well as to improve reliability.

Abstract Title: Pressure Energy Recovery Practical Case Study in Yanbu Refinery

Author: **Raad Mulla, Saudi Aramco**

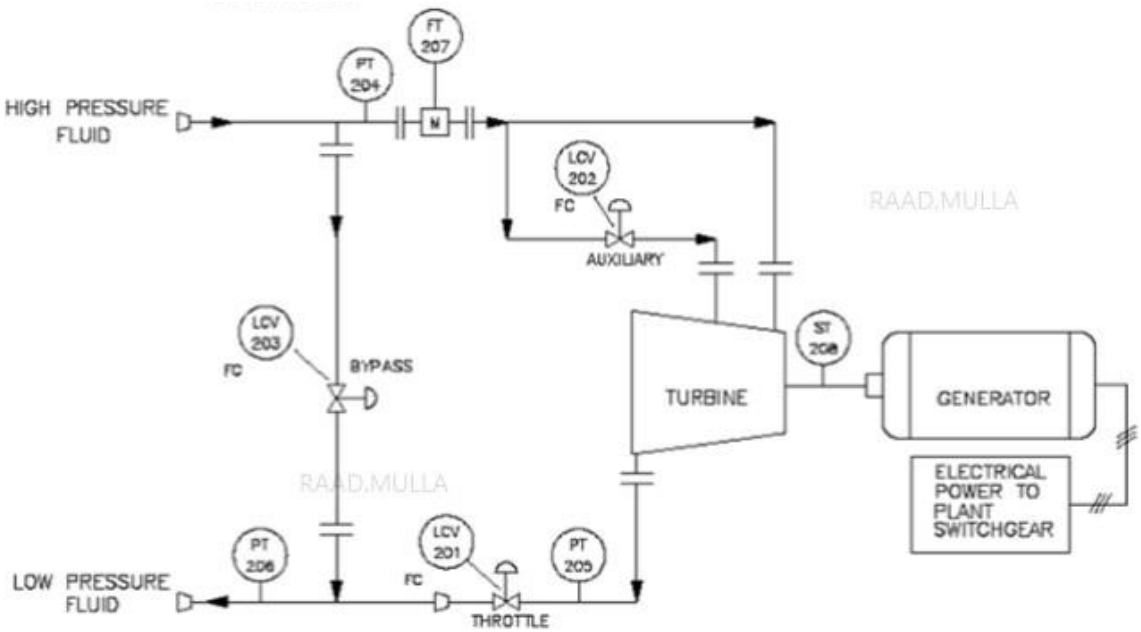
Yanbu Refinery (YR) has five different locations in the process where the pressure is being dropped dramatically using angular valves. These locations are allocated and involved in four different processes, each encompassing one step of the production process. The processes include Diesel Hydrotreating, Amine regeneration, and Naphtha Hydrotreating. In order to utilize this

pressure drop to produce energy, this case study is assessing the power and energy loss as well as discussing the applicability of using new pressure energy recovery technologies to utilize this wasted energy. In addition, the energy loss monetary value for YR not utilizing this available source of energy was conducted. At current energy rates, the total loss is $772,825 per year and the estimated annual saving assuming 80% efficiency of energy recovery is $618,260. The energy price used to calculate this value was obtained from P&CSD at a value of $53/MWh. The Aramco energy rate value has been used in this report despite the fact that YR was charged by Marafiq (Electrical Company in Yanbu) at a lesser value, around $48/MWh for the year of 2016. This is because Marafiq increases its rate on a year-to-year basis. Hence, Marafiq energy rate in 2017 is expected to increase to $50-60/MWh.

Out of the five potential sites, only two can be redeemed economically viable given the current electricity costs with the pay-back period between 3-10 years. The two sites are location #2 between the high-pressure cold separator (V05-D-005) and the low-pressure cold separator (V05-D-006); location #4 between the DHT separation and Stripper Section. The initiative requires a capital investment of $2-3 MM, and this includes all equipment cost, site, and utility upgrade to handle the additional capacity, pre-operation, and start-up costs, and electrical analyzers attached. One aspect to highlight in the capital cost is that the reverse-pump cost is around $1.1 MM per unit. In terms of environmental benefits, the utilization of energy recovery technologies at these two sites would reduce YR's indirect fuel oil burning by 4541 barrels annually, which would reduce YR's carbon footprint by 7200 tons of CO2-equivalent/year. The total energy saved as a result of implementing energy recovery technology on those two sites is 8,519.8 MWh per year, which would decrease the YR Energy Intensity Index (EII) by 0.54.

The concept of energy recovery can be applied to any process streams at high pressure or temperature, especially for those containing combustible materials such as hydrocarbons. Energy can be recovered through differential temperature between the inlet and outlet stream of a specific equipment, through heat exchangers, or differential pressures as well, through pumps and turbines.

In conclusion, high-pressure drops in Yanbu refinery processes take place in five main locations, two locations in Area II, three locations in Area III. The pressure drops occur in the five locations across angular valves. These angular valves can be replaced by reverse running pumps or specially designed turbines to optimize the energy utilization of Yanbu refinery.



24th October | 08:30 – 10:00

Improvements

Abstract Title: Boiler Chemical Injection System Design Modification for More Effective and Optimum Operation

Author: **Albara A. Al-Harbi, Saudi Aramco**

Refineries will have Fired Utility boilers and Waste Heat Boilers in Process Areas with Chemical Injection Systems, to ensure Boiler/Steam and Condensate System integrity. Yanbu Refinery had several issues with existing chemical injection system including injection of diluted chemicals, mal distribution of chemicals, injecting at several areas, and absence of redundant reliable system. Refinery converted these challenges into opportunities in line with a water conservation road map to reduce water consumption for a healthy environment. Accordingly, refinery redesigned boiler chemicals injection system to inject neat chemicals with the centralized system as compared to the earlier decentralized system. As part of reconfiguring chemical injection, Neutralizing Amine, used as Corrosion Inhibitor for the condensate system, was relocated from steam header to deaerator storage drum. Furthermore, Phosphate chemical, used as a scale inhibitor, was relocated on boiler feed water pump discharge. This improved chemical treatment from better chemicals distribution and helped in eliminating off-spec results in daily monitored samples. It also saved 10,000 m3 water annually, from reduction in boiler blow downs, and reduced chemicals usage. Moreover, all chemical injection pumps in process areas were stopped, thus reducing operator's potential exposure. In conclusion, Yanbu Refinery Management efforts to going beyond design, with thrust on promoting employee innovation skills, resulted in multiple benefits apart from improving system integrity.

Abstract Title: New Crude Heater for Better Efficiency, Reliability and Environmental performance

Author: **Raj Ghetia, BAPCO**

Fired heaters are the largest consumers of energy in refineries and any improvements in fired heater efficiency and performance can deliver substantial energy savings and improve profitability. Also, ensuring the process safety, reliability, and environmental performance of fired heaters is vital to sustaining overall profitability.

Bapco's Bahrain Refinery has 45 fired heaters, many of which are old and inefficient. Since many of these heaters will be decommissioned as part of the Bapco Modernization Program, there is no economic justification to replace them.

However, the No.5 Crude Distillation Unit (5CDU), which has three fired heaters which were commissioned in 1943, will be retained and the case for their replacement is financially attractive. Hence, in 2016, Bapco launched an initiative to replace them with a single, high efficiency fired heater.

5CDU heaters are now 75 years old and operate at a thermal efficiency of only 60%. The coking rate in the heater tubes is also unacceptably high and the heaters are required to be shut down between Turnarounds for decoking. Maintenance costs are high, NOx emissions are higher than desired and the instrumentation for monitoring and control is inadequate. The new heater will enhance overall performance by significantly reducing the fuel gas consumption, increasing operational availability allowing a six year run between Turnarounds, reducing maintenance costs, lowering the NOx emissions and improving operability and control.

Through our initial process engineering studies, we identified and assessed the opportunity to replace the 5CDU heaters. Further detailed work was done with other engineering disciplines, including Bapco's furnace specialist, and in close collaboration with consultants and heater vendors, to obtain a more accurate economic evaluation. The project was endorsed by Bapco's independent technical consultant and approved by our decision makers.

The Front End Engineering Design (FEED) was completed during 2016 followed by the award of the Engineering, Procurement & Construction (EPC) contract in 2017, with the target commissioning in Q2 2019. Tie-ins were done during the December 2017 Turnaround to minimize future downtime for heater commissioning. The new heater and associated equipment have been ordered and are under construction at the vendor's fabrication site.

The aim of our presentation is to describe our rigorous approach to the heater replacement project and share our experience in overcoming the many challenges we faced during FEED and EPC, including the design, selection, planning and scheduling for the installation on the existing plot space, as well as the lessons learned. We also cover the details of the expected performance (per design) of the new heater.

The presentation also underlines the importance of Process Engineers in initiating such projects and collaborating with the Project Engineers to drive this forward to completion, working as part of cross-functional teams. The understanding and application of process engineering principles is critical for ensuring that we can extract the maximum return from ageing units, and our successes highlight the need to develop and maintain in-house expertise and experience, especially when it comes to maximizing the performance of existing units.

Abstract Title: 3D TRASAR Technology Application for Improved Crude Distillation Overhead Chemical Injection

Author: **Mahmoud Alkahlout, Saudi Aramco**

Introduction:

Aligning with Saudi Aramco Operational Excellence element #12 under «innovation and continues improvement». Saudi Aramco Riyadh Refinery has successfully implemented a new Automation System of Crude Distillation Tower Overhead Chemicals (3D TRASAR TECHNOLOGY). Along with fully in house designed and executed the associate piping, electrical, and civil requirements. The Crude Distillation Tower Overhead Chemicals are Filming Amine, Neutralizing Amine, and Caustic. The three chemicals respectively play essential roles in forming layers to protect the Crude Unit Equipment's integrity, adjusting the pH to its neutral stage, and removing Organic Chloride. Currently, the three chemicals are adjusted manually based on three lab samples a day. However, since crude chemistry can fluctuate rapidly, where it is estimated that 90% of corrosion issues occur during 10% of operating time, the current practice expose the Crude Unit equipment's to fouling as a result of over dosage of chemicals and corrosion as a result of too little dosage. Therefore, the new Automation System is designed to automatically adjust dosage of the three chemicals based on a minute by minute online reading of iron level, pH, and Chloride level.

Objective:

The new Automation System aims to reduce the average and standard deviation of Iron level, pH compliance, and Chloride level via injecting the three chemicals based on the Crude Unit Overhead System demand. As a result, enhance the Crude Unit Overhead System KPIs compliance to above 90%, which means a better control of overhead corrosion. Therefore, extend the Crude Unit equipment›s lifetime, avoid unplanned shutdowns, reduce maintenance cost, and reduce the Crude Unit chemicals consumption by around 40%. In addition, reduce human error in samples testing which can significantly affect the tests accuracy.

Method:

Earlier before taking the decision to adopt the new Automation System. A self-assessment was conducted on the Crude Unit Overhead Chemicals in order to evaluate the performance of the Crude Unit Overhead System. The assessment covered the Overhead Chemicals consumption, maintenance cost, KPI compliance, corrosion control, and feasibility of the new project. Once the decision was made to proceed with the new Automation System, the design and execution of the new associated piping, electrical cables, and civil work were all done in house in order to reduce the project cost. Furthermore, the 3D TRASAR and the associated new pumps were all secured and installed on site, and rental fees started later once the system was fully commissioned.

Results:

The volume of data gathering with new Automation System allowed for a more flexible operation along with a real-time improvement in the management of corrosion control. The new Automation System allowed for injection of the correct amount of chemicals at the exact moment of demand. In addition, improvement of the overhead chemicals KPI was achieved with compliance of above 90% in comparison to 80% during manual mode. Along with reduction in Caustic and Neutralizing Amine consumption by 35% and 10% respectively.

Conclusion:

The large degree of variation in the Overhead System KPIs was resolved after the installation of the Automation System. The new system fills the monitoring gap between the De-salter and the Crude Unit Overhead System by providing a minute by minute adjustment and a real-time reading.
The Automation System has improved the corrosion control of the Overhead System and the fouling issue which is a result of over dosage of chemicals. The automation mode has met its objective of reducing the average and standard deviation of iron level, pH compliance, and Chloride level. Therefore, improved the KPI compliance to above 90% and reduce the Overhead System Chemicals Consumption.

24th October | 13:00 – 14:30

Integration

Abstract Title: Petrochemical Integration: Essential to Middle East Refining?

Author: **Alan Gelder, Wood Mackenzie**

Introduction:

The Middle East refining capacity has expanded rapidly over recent years, such that the region will shortly be a net exporter of all clean products. The region is in the middle of an investment wave that will add a further 2.5 million bpd of capacity by 2023, so the commercial success of the Middle East refining sector is increasingly reliant as its role as an exporter of clean products to global markets. Many of these new projects are competitively advantaged, as the refineries process heavy/discounted crude in sophisticated configurations. Such advantages have typically been valued at US$3 – 4/bbl. However, the global refining landscape continues to evolve, and we expect it to get more challenging for export-oriented refiners, as:

Increased vehicle fuel efficiency standards are decoupling oil demand growth from GDP growth, particularly in China

Asian refining capacity is growing strongly, with China's capacity additions outpacing demand growth

The new Asian capacity additions are sophisticated refineries with strong petrochemical integration. This petrochemical integration improves the competitive position of these refineries and typically overcomes the crude feedstock advantage available to Middle East refiners.

This presentation will address the following topics to highlight the importance of petrochemical integration to both existing and new Middle East refineries:

Global refined product demand growth, with a focus on the gasoline dilemma, as its growth is expected to plateau and then decline, with the Middle East competing with the global refining industry to place barrels into Asia

Commodity chemical growth – projected to continue at levels far greater than transportation fuels, but the sector thrives off monetizing low-cost gas-based cost feedstocks

Value uplift from refinery – petrochemical integration, reflecting the recent benefits of such configurations in Asia in terms of margin but also "molecular management" to optimize value, as fuels and chemicals markets are interlinked but typically not fully synchronized.

Competitive position – can refinery/petrochemical integration in Asia overcome the Middle East refinery advantage of local discounted feedstock?

Long-term sustainability – what are the lessons from Europe, a region that has experience of being under sustained threat of closure?

Abstract Title: Profitable Schemes to Maximize Refinery Profits Post 2020

Author: **Ujjal K. Mukherjee, MCDERMOTT**

The immediate future of refineries producing transportation fuels only is beset with uncertainties. Globally, refined products such as gasoline and diesel is growing in the range of 0.5 to 1.5%. Despite the emissions that has seen a steady progression of major cities banning diesel cars in the near future, Europe still continues to be a major consumer of diesel and an exporter of gasoline. China is exporting diesel. India is also exporting diesel although this market will be a major consumer of diesel over the next decades as road infrastructure sees dramatic improvement and the GDP continues to rise at a pace of around 7%. Barring sudden local environmental restrictions such as those we see in Western Europe, diesel is intimately tied to the GDP growth of a country, unlike gasoline that is very much linked to personal consumption. Gasoline consumption will experience downward pressure with more Electric Vehicles and especially hybrids entering the automobile sector, but most global projections do not see the overall impact of EVs and hybrids exceeding about 5000 barrels/day by 2030 or roughly 5% of the overall petroleum products market; gasoline demand in 2030 is still expected to be around 30 million barrels/day. The last major transportation fuel is jet fuel and this fuel will see a modestly upward growth, especially near major airports. Even as the demand for transportation fuels flattens, post-2020 MARPOL Annex VI will put further pressure on those refineries that do not have advanced residue upgrading technologies or at the very least, a Delayed Coking unit. The price of high sulfur fuel oil will see a marked drop well below the crude price line as outlets for high sulfur fuel oil dry up.

Existing refiners have a limited number of options to stay in business. The revamps that they do will have to be competitive against new refinery projects that will be designed with either the capability to produce ultra-low sulfur fuel oil or to eliminate bottoms altogether with sophisticated residue conversion units. This paper examines strategies to maximize the use of existing assets in existing refineries in a Post 2020 world. Suggested revamps to further enhance profitability are also highlighted. Case studies will highlight the economic impact of the various strategies.

Abstract Title: Opportunity Through Synergy in Kuwait Refinery and Petrochemical Plants

Author: **Ahmad Al-Failakawi, Kuwait National Petroleum Company (KNPC)**

Kuwait National Petroleum Company (KNPC) currently having a crude processing capacity of 727,000 BPD, which will be increased to 800,000 BPD by 2019 post Clean Fuels Project (CFP), Petrochemical Naphtha production is about 166,000 BPD. Kuwait Paraxylene Production Company (KPPC) established in the year 2009 as a joint venture between Petrochemical Industries (PIC), Kuwait National Petroleum (KNPC) and Qurain Petrochemical Industries (QPIC), KPPC buy the petrochemical Naphtha feedstock from KNPC and sell KNPC the co-products Hydrogen, Butane, and Light Naphtha. Both KNPC and KPPC facilities are located within the radius of 5 Km, which envisaged greater opportunity in the integration of its Refineries with KNPC has recently increased its share to 60%.

The main objective of this synergy is as follows:

- Better management of KNPC Naphtha and KPPC feedstock / co-products
- Upgradation of Kuwaiti Hydrocarbon Value
- Improve the performance of KNPC & KPPC
- Expand KNPC's Business downstream
- KNPC is supply approximately 2.7 MMTPA of P.C. Naphtha rich in Aromatics to KPPC and receive the following re-turn streams:
- Light Naphtha 1.0 MMTPA which are being exported by Mina Abdullah Refinery
- Hydrogen 70 MMSCFD with high purity used in Refineries for Cracking / Hydrotreating
- Butane 170 TPA rich gas processed in Mina Al-Ahmadi Refinery LPG plant

The integration of KNPC and KPPC added great value to Kuwait Hydrocarbon chain as well it is better placed in handling highly volatile Naphtha market and in reducing the effect of the predominantly lower cracking margin of Naphtha. Establishment of KPPC has a strategic importance, which resulted in capturing some pie of high-value Petrochemical Market and easy management of refinery feedstocks and re-turn streams from Petrochemical plant.

The Petrochemical products market is highly fluctuating however, integration of KNPC & KPPC is protecting Kuwait's Refining Business and increased the margin of Petrochemical Plant through better sale value of its above by-products. Establishment of Petrochemical plant alongside of Oil Refineries helps in reducing the feedstock transportation cost, storage cost and finally hazards arising during transportation. KNPC transfers the naphtha via a dedicated 24" pipeline and integrated the by- products transfers to the existing system.

We will share our experience in establishing the synergy between KNPC and KPPC in the presentation.

24th October | 13:00 – 14:30

Energy

Abstract Title: Towards Sustainable operations in Kuwait Integrated Petroleum Industries Company (KIPIC)

Author: **Hannan Bader Mohammad Alqanai, Kuwait Integrated Petroleum Industries Company (KIPIC)**

Introduction

In recent years, the oil industry has encountered a sharp decline in the market price of oil and gas whilst maintaining the high demand. This rise in operations to fulfill the market demand will definitely trigger complexities and place some constraints on the environment. Therefore, it was time for Kuwait to think more progressively and use its resources to enhance the future and create a better life for the next generations. The inspiration of integration was born and ready to build and fully optimize the world's best-integrated facility. The integration of refinery and petrochemical facilities together with Liquefied natural gas import terminals with regasification facilities went on to become KIPIC. Proactive methods have been taken were the features in the design and processes of these facilities will use the best available technologies and utilizing expertise to ensure sustainability and negligible environmental impacts.

Key Features

For sustainable operation, the KIPIC downstream oil sector of Kuwait has worked on design features and operating phases in their projects by utilized the best available technology that address air, water, waste, and noise. The following measures highlight key ongoing environmental initiatives shaping KIPIC.

Ensure environmental design Features are included in the projects to meet local regulations and international standards.

Establishment and Implementation of Environment Management System (EMS) to minimize pollution and achieve continual improvement.

Establishing, and implanting the KIPIC Road map towards the implantation of Health Safety Security and Environmental Management System.

Develop, monitor and control environmental leading indicators.

Corporate Social Responsibility with the continuous engagement of key stakeholders: Contractors, Regulators, Communities and educational & research institutions.

Provide Environmental awareness and involvement, of KIPIC employees and stakeholders.

To contribute positively and effectively to the economy of the State of Kuwait.

Conclusions

The downstream sector in Kuwait will be experiencing a major shift in the way Oil is refined, which will have significant benefits over a period of time on the environment. During the conception of KIPIC, the idea of sustainable development has been in mind and a target that is meant to achieve. The establishment of the integrated company that handles refinery, petrochemical, and LNGI import and export facilities is a full cycle process that will achieve both economic benefits and sustainability.

The environmental friendly supply of Low Sulfur Fuel Oil and gas that will be produced is aimed towards Kuwait's demand for energy by using the Best available technology in order to meets the requirements of MEW (Kuwait Ministry of Electricity & Water), while complying with the environmental objectives of the State of Kuwait. Meeting the Energy demand, Continuous improvement of Environmental Performance and striving to make more possible for Kuwait, its people and its economy are essential for sustainable development of KIPIC facilities.

KIPIC has set out a strategy to achieve the desired output in a sustainable manner with negligible environmental impacts. This could only be achieved though collaboration, commitment, and involvement of government, industry and stakeholders.

Abstract Title: Innovative solutions for Resid upgrade and improved refinery margins

Author: **Ian Elgey, KBR**

Among the various bottoms upgrading technologies, Veba Combi Cracking (VCCTM) provides the ultimate flexibility with high residue conversion. With the implementation of the impending MARPOL bunker fuel oil restrictions, crude oil availability and prices, as well as fuel oil markets will be greatly impacted. These fluctuations will allow refiners with flexible bottoms upgraders to maximize profits by taking advantage of opportunity crudes and high sulfur fuel oils on the market. The VCC technology relies upon thermal cracking in a hydrogen environment for residue conversion, easily achieving 95% conversion without regard for the feed introduced to the unit.

What makes the VCCTM even more advantageous is the different options available for the second stage fixed bed reactor. This reactor can be tailored to exploit the existing assets within the refinery. Options range from no second stage, hydro processing to produce on-spec diesel, to full conversion of VGO to diesel and lighter, and even maximizing naphtha for petrochemicals production via Olefins or BTX value chain. VCC technology has been recently commercialized for two Coal and Coal tar based units in China and operating since 2015. The third unit at TAIF refinery, located in Nizhnekamsk Russia, is commissioned in 2017 and currently in the second phase of startup, illustrates the flexibility of the unit design to fit refiners' needs. The TAIF unit not only converts the vacuum residue, but it hydrotreats SR VGO, and adjusts VGO conversion in the second stage in order to fill the existing FCC Unit. This configuration allows for the production of Euro-V quality diesel from the VCC Unit, and also increases the gasoline yield from their FCC.

With the oil market fluctuations destined to arise in the coming years, refiners should look at ensuring they have feed flexibility and conversion options in their bottoms processing in order to maximize profits.

Abstract Title: Towards Energy Efficiency and Profitability - Unlocking Hydrocracker Full Potential Through Operational Adjustment

Author: **Mahmoud Ibrahim, Saudi Aramco**

With the ever-growing worldwide energy consumption, industry leaders are putting more emphases & efforts in maximizing energy conservation while reducing the environmental footprint of their facilities. In refining industry, hydro processing plants are considered one of the major energy-intensive processes. they utilize the extensive amount of steam, power, and heaters combustion gas that is generated from non-renewable resources. A multi- disciplinary team has performed a detailed analysis to study the effect of shifting the gas to oil ratio in the hydro processing plants' reactors while meeting the desired catalyst life, activity and product specification. The study was implemented to a hydro processing facility (specifically hydrocracker plant) in Ras Tanura Refinery in Saudi Arabia, reveled promising results through optimizing the gas to oil ratio by 20 %, which increased the cash margin by more than $5 MM/yr. With virtually zero capital investment and only by operational adjustment, the optimized hydrocracker plant has managed to reduce its energy

requirement of steam and fuel gas by 33% & 15% respectively. Additionally, the hydrotreating/ hydrocracking reactors life-cycle were extended, while enhancing the reliability of the recycle gas compressor. Similar studies can be implemented in hydro processing facilities across the industry in order to improve energy efficiency, extend asset life, minimize maintenance costs while developing more environmentally friendly process solutions.

24th October | 13:00 – 14:30

Improvements

Abstract Title: Asset Performance Management in Digital Era

Author: **Daniel Rodas, Baker Hughes, a GE Company**

New maintenance technology has saved organizations billions of dollars in labor and spare parts costs by streamlining their operations, as approaches have evolved from reactive, to preventive, to predictive maintenance. Operators of Industrial equipment – especially equipment that needs to run 24 by 7, want to increase equipment *availability*, or “uptime” when the equipment’s not

being serviced. And *reliability*, which is the probability that the equipment will operate the way it should when it’s needed.

There are seen four key areas where firms struggle in reaching these goals.

- Modern equipment and systems generate volumes and volumes of data. As a result, many firms only have the resources to dig into the data after issues have occurred, rather than use the data as a real-time indicator of how to operate the business.
- While some equipment failure modes become more likely as equipment ages, most failures occur randomly and are independent of time.
- At the same time, firms are under constant pressure to cut costs. To eliminate the fat in their maintenance strategy – but after successive cuts, it’s not clear there’s any fat left. How does an operator evaluate the risk impact of additional cuts or investments? How do they know their asset strategies are prioritized optimally and they’re making the best preventative maintenance choices for a given spend level?
- Firms need help understanding how to not replace people with technology, but to combine process, people, and technology, in the right way, to deliver greater outcomes than otherwise possible.

Asset performance management (APM) concept encompasses the capabilities of data capture, integration, visualization and analytics tied together for the explicit purpose of improving the reliability and availability of physical assets. APM includes the concepts of condition monitoring, predictive forecasting and reliability-centered maintenance (RCM).

Effective APM is driven by analytics and rooted in integrated business work processes. It contextualizes data to create actionable information by looking across multiple sites to find patterns and opportunities for improvements. APM uses data management, pattern recognition, predictive analytics, artificial intelligence, and machine learning to make downstream companies more productive, improving asset reliability while reducing operational costs and risks.

It’s no simple task to achieve, but there are downstream companies, which drive transformational value by:

- Combining both IT data (like historical work orders) and OT data (like machine sensor data) to

create a complete view of asset health. This holistic view of real-time data, alarms, events, and other operational data provides the organization with a clear picture of asset performance and a single-source of truth.

- Using advanced analytics and “digital twin” models to predict equipment failures before they occur. The digital twin is a computer model of how the equipment should operate. A statistically significant deviation in how the equipment is actually operating is a warning sign of potential downtime. These analytical techniques can help companies move from break-fix and time-based maintenance to condition-based strategies which simultaneously eliminate unnecessary maintenance and improve equipment reliability.
- Ensuring compliance with ever-expanding regulatory requirements. APM helps to ensure asset integrity and compliance by monitoring changing risk conditions.
- Implementing maintenance strategy development tools to help understand the reliability, risk, and cost tradeoffs of different maintenance approaches. Break-fix, preventative, and predictive techniques each have different pros and cons, and each has a place in a comprehensive maintenance plan. A robust framework can help industrial firms understand the effects of different equipment failure modes and how their maintenance plans address–or don’t address–them.

APM is more than technology. It’s a unified strategy that assists people, processes, and systems to work together toward sustained operational excellence.

Abstract Title: Leveraging Benchmarking for Continuous Improvement Towards Operational Excellence

Author: **Dr. Srinivas Badithela, ADNOC Refining**

Oil and Gas Industry is experiencing a challenging period due to various uncertainties and Market Dynamics. Profit Improvement, Operations Optimization, and Operational Excellence have been the focus areas of the continuous improvement process at ADNOC. Reliable key performance indicators are extremely important for Performance Monitoring and Performance Assessment. Baseline assessment required for a rigorous bench marking assessment involved various key stages starting from defining the performance indicators, defining the baseline, collecting reliable performance data, bench marking the performance through a comparative assessment and identification of performance improvement areas. ADNOC Refining has been involved in periodic Bench Marking Assessments of relevant identified areas in close coordination with external agencies. In 2017, ADNOC Refining has carried out and implemented a rigorous Maintenance and Integrity bench mark assessments with in- house expertise as part of an ADNOC Group level effort. This paper outlines some of the key aspects of Maintenance and Integrity Bench Marking Assessment process, provides a brief summary of ADNOC Refining assessment results.
A conceptual framework of implementation for all ADNOC Refining operating facilities along with an integrated approach for Operational Excellence is presented.

Key Words: Operational Excellence, Key Performance Indicators, Bench Marking Assessment and Continuous Improvement

Abstract Title: SASREF Reliability Transformation

Author: **Ahmed Ismail, Saudi Aramco Shell Refinery (SASREF)**

Saudi Aramco Shell Refinery caught global attention recently vindicating its commitment and persisting Resilience delivering the best performance in all measurable spheres of Reliability Transformation.

The bottom-up the journey to change, in short span, focused on inducing reliability mind set, work processes and Asset Life cycle Enhancements setting the stage for SASREF to see new heights for years to come.

The unending reliability turn over journey started back in 2015 is precisely summed up in the slide pack going to be shared. Does this stop here? When it comes to reliability improvement, the answer lies in “more is less.

As a result, the company won Emerson Best Reliability Program of the Year in October 2017, competing with 53 global organizations. The organization values its human resource development supported by behavior-based program aimed at inculcating Reliability culture in the DNA of the workforce to achieve and sustain operational excellence through persisting Reliability culture enhancing programs

24th October | 15:00 – 16:30

Innovation & Technology

Abstract Title: Journey Towards Hydrocracker Operational Excellence Through Strategic Collaboration

Author: **Deepak RD, Shell Criterion**

In a lower for longer oil price scenario in the upstream, the downstream oil industry is also under pressure to maximize margins. The oil scenario provides us with a great opportunity to extract maximum output from every unit in the refinery. Hydrocracker units, that sit in the heart of refining not only adds value through quality products but also can help lower your bottom of the barrel and improve yields of more valuable products through its flexibility. The challenge here is a continuous improvement to improve mid-distillate yields while maintaining the cycle life.

SASREF is on this continuing journey with its Licensor (Shell Global Solutions) and Catalyst Vendor (Criterion) where it maintained its mid-distillate yields at its hydraulic limits during this lower for a longer period. i.e., From cycle to cycle, SASREF is utilizing a combination of flexible catalyst system along with good reactor Internals and collaboration to install lower active cracking catalyst system to improve its mid-distillate selectivity as well as its product quality while maintaining the required cycle life. SASREF is also identifying limits within the unit at the same time and addressing it to maintain its position as one of the world’s most competitive refineries.

In the current cycle, SASREF has improved its mid-distillate selectivity by 1.2 times and is on a journey to further significantly boost its mid-distillate selectivity. At the same time, it is also gearing to improve product quality by consistently producing Euro-V diesel. This has been possible due to SASERF working closely with Licensor and Catalyst Vendor. In this study, we see how refiners can benefit from a similar journey of long-term collaboration to help maximize margins not only from cycle to cycle but also within the cycle

Abstract Title: K-SAAT – A Break-through Solid Acid Alkylation Technology

Author: **Edward Griffiths, KBR**

Globally, the demand for cleaner-burning gasoline blend components is increasing while demand for gasoline is declining. This increase in demand for cleaner-burning gasoline is driven primarily by environmental mandates and high-performance engines. Alkylate, isomerate, ethanol, and ethers represent the cleaner-burning gasoline blend components. Among these, alkylate is the ideal clean

fuel component because it has a high-octane rating, exhibits low vapor pressure, low sulfur levels, no aromatics or olefins. Alkylate is currently produced using either sulfuric or hydrofluoric acid as the catalyst. Both acids are dangerous and can lead to corrosion-induced accidents and impede firefighting efforts. Solid acids have for many years promised safer and cleaner alkylation. The poor stability of most solid acids, however, have resulted in expensive processes with complex reactors and large catalyst inventories, making them uncompetitive with liquid acid technologies.

After years of development, a new solid-acid catalyst technology ExSact has reached the point of outperforming these liquid acids. The engineered solid-acid catalyst has been designed to give over 24-hr cycle-times, robust resistance to typical poisons, the ability to handle a variety of feedstocks, a simple adiabatic fixed-bed reactor design and regeneration using hydrogen. The ExSact catalyst forms the core of a safe and efficient K-SAAT process that generates high-octane alkylate without the dangers and costs associated with liquid acid technology. K-SAAT reactors can be used to replace/debottleneck existing liquid acid alkylation reactors by reusing the existing recovery system (DIB/Debutanizer).

The stable catalyst performance greatly simplifies the overall process design, which reduces the capital cost of the alkylation plant, while lowering energy consumption. KBR has licensed K-SAAT units to Haike Ruilin Petrochemical Co. Ltd. and Luoyang Aiyou Chemical Co. Ltd., both in China. The Haike unit is slated to start up in Q1 2018.

Abstract Title: Addressing Base Oil Color and Stability Issues Using UOP HPNA RM Adsorption Technology

Author: **Rajesh Sivadasan, Honeywell UOP**

Following the trend of higher performance engine design for achieving better fuel economy and low temperature performance, requirements for engine oils have become more restrictive with a shift to lighter viscosity multi grades necessitating higher quality base oils to meet the specifications set by OEM's. Producing a low- viscosity and low-volatility lubricant requires a high viscosity index (VI) base stocks. High oxidation and thermal stability are obtained by using base stocks containing minimal amounts of unstable aromatics and heterocyclic contaminants. Formulations based on base oils from a fuels hydrocracker bottoms may be more cost effective than other high-quality base oils like PAOs or base oils from GTL technology to meet these requirements.

Hydrocracking in general is a well-suited process technology to impart molecular transformation of vacuum gas oil (VGO) of appropriate boiling range required for production of high-quality lube base stock and is utilized in many refineries around the world. This process operates at relatively high pressures and high temperatures converting the aromatic components to naphthenic and paraffinic components producing base oils with better color, oxidation stability, thermal stability, and cold flow properties.

In the process of upgrading VGO, small amounts (ppm levels) of heavy poly-nuclear aromatic compounds (HPNA's) are formed. HPNA's are seven or more fused aromatic rings which, if not managed properly, may lead to color degradation and/or oxidation stability issues in base oil. In addition, HPNA management becomes more critical in production of heavier grades (6 - 12 cSt) of lubricating oils because HPNA's generally concentrates in this boiling range.

Based on the needs of refiners producing lower viscosity base oils to avoid color/oxidation stability issues, UOP carried out an extensive study with different base oil stocks to find out the root causes that could lead to color issues by developing specialized analytical technique. A pilot plant study was also undertaken to determine if the UOP's patented HPNA RM carbon adsorption modules can be deployed to remove the HPNA's and the color bodies. UOP will present the processing options of heavier grade base oils for addressing color/stability issues

24th October | 15:00 – 16:30

Digitalization

Abstract Title: Demystifying Digitalization Challenges Towards Successful Downstream Industry Deployment

Author: **Dr. Pratap Nair, Ingenero**

The Digitalization of Manufacturing is the next Industrial Revolution in the making, often referred to as Industry 4.0. Its basis includes digital assets, such as the Digital Twin, which is based on technologies and concepts that include Big Data Analytics, IoT, AI, Advanced control, Optimization, predictive analytics and adaptive analytics.

The Digitalization technologies and concepts have varying relevance to the process manufacturing industry and applying the appropriate technologies enable the ability to capture significant profit improvement. Combining the applicable technologies in the right way adds tremendous insight to improve operational effectiveness. Companies leveraging digital technologies to simplify automate and optimize operations beyond levels that operating paradigms allow, will be at the forefront of transforming the industry and ensure success even in volatile market conditions.

The key, however, is being able to leverage these tools to provide insights that drive change. While these concepts and technologies can be very useful to improve performance benchmarks for process manufacturing, communication and teamwork are needed to change the way the operations are run and managed. Certain myths that are considered sacrosanct based on operating paradigms must be overcome and changes to work processes made in order to successfully implement Digitalization. Introduction of new roles, like the Digital Asset Expert and concepts like IoT, leveraged Digital Twin sustenance-as-a-service, Collaborative Operations Engineering, are key business process additions that go hand in hand with an effective Digital Twin implementation.

The application of the Digital Twin concept at an Ethylene plant in North America has been quite successful. The Digital Twin approach has helped improve the Overall Asset Effectiveness by 8%, by improving Asset Availability by 6% and Feed Throughput and Overall Yield by about 1% each, over the previous year. This is a direct improvement in production by 8%. However, this was not easy or instantaneous. The Digital Twin is not a single model but a combination of tools that are themselves combined with statistical analysis and data analytics to be able to make the simulation into predictive models capable of providing prescriptive advice. Then, even with the best tools, communication, and teamwork remain the key to implementation and ultimate improvement.

The lessons learned from the implementation, the tools utilized, the team structure, and the associated changes to the work processes and thought processes that were required to make it successful will be described in the paper.

Abstract Title: Advanced Digital Services To Achieve Higher Plant Flexibility and Performance

Author: **Nicolas Menet, Axens**

In the oil and gas industry, refiners continue to seek incremental improvements to existing assets in order to remain competitive.

High-speed data networks, cloud-based systems, and advanced data compilation tools are leading the way of cost-effective techniques used in the industry to monitor and optimize its operating assets. Axens combines these solutions with real-time, advanced modeling in order to provide the greatest impact to process performance and plant availability.

Axens' digital suite of solutions (including simulators, APC, etc..) has been recently enlarged with the introduction of Connect'In™: a remote unit monitoring system displaying process data analyzed through high fidelity kinetic models to engineers, operators, and management on an online platform. That remote monitoring solution can embed accurate process simulators: the easiest way to conduct what-if studies and accurately predict unit performance.

This paper will present case studies, demonstrations, and economics highlighting the value added by integrating advanced real-time unit modeling into key performance indicator matrices, advanced process control, and accurate process simulators. Tailored MONITORING SOLUTION

This paper will especially present Axens' Connect'In™, a remote unit monitoring platform that utilizes immediate process data to deliver real-time, custom-made performance indicators using high fidelity models. This is accomplished by connecting a direct data transfer link, making the results easily and securely accessible through an online tool, and applying high fidelity kinetic models.

Automatic transfer and direct access of unit data allows Axens to provide faster and more proactive technical assistance for unit engineers to avoid sub-optimal operation and economic losses due to lost time. Tailor-made key performance indicators (KPIs) such as process normalizations are regularly updated and linked with alerts to notify the plant of any immediate need for unit optimization. Additionally, predictive kinetic models are utilized to evaluate future catalytic performance and estimate end of life cycles based on changes in unit feed quality or operation severity.

Connect'In™ unit monitoring also expands beyond catalytic support through the integration of a process heater monitoring tool supported by the models and expertise from Axens' subsidiary, Heurtey-Petrochem.

THE CASE STUDY

In that paper, author will present several cases studies where connection has been used to proactively optimize unit performance. Those cases will also focus on how such the solution provides a consistent and automated launchpad for collaboration and discussion on improving unit operation.

Abstract Title: Digital Operator Rounds Deployment at KNPC: Challenges and Opportunities

Author: **Abdulaziz Al-Duaij - Kuwait National Petroleum Company (KNPC), Anwaar Alnowh Kuwait National Petroleum Company (KNPC)**

"Digital Operator Rounds" is a solution that is being implemented as part of the Kuwait National Petroleum Company's digitization strategy. The solution aims to digitize the operational activities of field operators across KNPC's refineries by relying on a completely digital infrastructure for data collection. The solution uses handheld devices that the operators utilize to collect structured refinery data, which is synced to dedicated servers for data collection, verification, and analysis.

Operational activities, also known as "Operator Rounds", are one of the most valuable sources of data when it comes to making decisions that improve reliability and safety at the KNPC. By implementing the Digital Operator Rounds solution, the KNPC reduces the maintenance costs through early fault detection, which allows controllers and supervisors to perform efficient analysis, proactive decision making, and stay up to date when it comes to operational insight.

Guided work flows on the mobile handheld devices ensure that consistency and best practices are applied by every operator across the refineries. With the project's implementation, there were a total of 116 training sessions for all operation units, which covered a total of 1306 operators,

controllers and supervisors. The devices are being used around the clock throughout all the shifts, 24 hours a day, 7 days a week. This digitization of operator rounds significantly reduced the carbon footprint of the KNPC by eliminating up to a million paper templates per year that were consumed during day to day operational activities.

Some of the few major benefits that the solution offers include the standardization of data collection formats across all refinery units with the aid of MAXIMO's EAM system, the digitization and automation of field data collection performed by operators with the aid of the detailed and guided workflows that the hand held devices offer, and the centralization and mass collection of data in the SAP HANA database which allows for in-depth analysis that aids in real-time fault detection and the reduction of production down times.

Challenges are always faced when it comes to change, one of the major challenges included properly promoting and encouraging operators to utilize the new digitized solution over the pen and paper approach that they were used to. However, after initial doubts and feedback, currently, the vast majority of operators prefer their handheld devices to the old methods, mostly due to its improvements on efficiency with their work load.

So far, the solution has been successfully implemented across 29 refinery units in KNPC's Mina Abdulla Refinery and is fully functional with outstanding results. Further expansions are scheduled for other units and refineries, with plans in motion to begin implementing the solution at the Mina Ahmadi Refinery.

25th October | 08:30 – 10:00

Innovation & Technology

Abstract Title: Innovative Approach for Refinery Capacity Creep

Authors: **Prabhas Mandal - Saudi Aramco, Jeon Oh – Saudi Aramco, Sunmyoung Hong – Saudi Aramco, Daniel Vargas Fagundez – Saudi Aramco, Abdalaziz Albalawi – Saudi Aramco, Khalid Utaibi – Saudi Aramco, Mahmoud Alkahlout – Saudi Aramco**

Refinery capacity creep is comparatively easy to justify from an economic point of view considering investment cost per barrel of crude processing capacity. But the whole process conceptualization to project execution is very challenging due various unit limitations, equipment constraints, space constraints and tight execution window. The challenge increases manifold when the refinery is old and processing capacity has already been augmented. The conventional approach might lead to exhaustive equipment modification and extensive turndown work. An innovative approach is required to stretch the crude processing capacity beyond already achieved extra crude processing capacity. Recently, a prefeasibility study has been completed to increase 19% crude processing capacity of Riyadh Refinery, Saudi Aramco using some innovative ideas.

The objective of the study is to increase net cash margin of the refinery by increasing crude processing capacity to reduce $/barrel fixed cost. At the same time, revamp the scope of the secondary units is kept minimum to reduce project cost and execution downtime.

The study started with target setting using an LP model. Various cases were studied to check the possible crude capacities with minimum modification requirement in the secondary units. Though Hydrocracker is the key driver for refinery margin improvement, its revamp is capital intensive. Hence, crude capacity creep was targeted to produce extra VGO that could be handled with minimum investment in Hydrocracker.

Without doing any modification, only by changing the operation mode to “Once through Hydrocracking” and adding a smaller second stage, Hydrocracker capacity can be increased from existing 34 MBD to 42 MBD. Hydrocracker unit has been operated with 42 MBD of the hydraulic load with recycle. This modification will also allow the unit to absorb additional 7 MBD of DAO from the ongoing SSDA project to improve refinery margin further.

CDU and VDU equipment is already fully loaded. The limitation of Crude column overhead line and condensers can be overcome by converting existing Crude Stabilization Facility (CSF) into Preflash unit. Duty limitation of vacuum heater can be overcome by Overflash draw from CDU and processing it in a new vacuum flash tower.

LP run also indicated that distillate products cannot be handled without major modification of either Kerosene Hydrotreater or Diesel Hydrotreater. Installation of low cost KeroseneMerox can substitute costly revamp of KHT/DHT and ongrade Jet can be produced.

Rigorous simulation study was taken up to identify constraints of the units as well as to find the remedial actions required. Simulation model of primary units was fine tuned to suit the future crude blend and also to adjust the future Clean Fuel (EuroIV) products specifications.

The innovative approach to overcome different challenges has established the basis of engineering study for the capacity creep of Riyadh Refinery. The refinery margin improvement of 160 MM$/annum is expected from this crude capacity creep project execution.

Abstract Title: In-House Profit Improvement Program in ADNOC Refining

Author: **Ali Al-Mansoori, ADNOC Refining**

ADNOC Refining Operates three Refineries in UAE with a total Crude capacity of 927,000 Barrels per day with the Refinery Complexes in Abu Dhabi and Ruwais (East & West) along with Primary Product Supply Terminal in Abu Dhabi. Profit Improvement Program implemented in ADNOC Refining as part of Operational excellence activity to improve the Refinery profitability by creating a culture and systems for continuous and sustained profit from various opportunities exists or arises in Supply chain and production optimizations process.

In 2001 ADNOC Refining worked along with KBC for the development of Profit improvement Program (PIP) for the Abu Dhabi Refinery & Ruwais Refinery East to capture the opportunity exists during that time and tracking the same. Upon formation of Supply division in2012, new In-house Profit Improvement program and Tracker was developed by reassessing entire supply chain of Downstream operation for improvements as well as to capture the opportunities arising from changing market dynamics, upgraded Refinery configuration. As part of continuous improvement, ADNOC Refining formed cross-functional expert team at the operating sites to evaluate and implement new opportunity & periodic review of existing opportunities. The existing Opportunity parameters are evaluated and prioritized as low or high based on economic Benefit & criticality. All the existing Opportunity parameters are set with the target range and are being tracked through various reports for its performance and the resultant monetary benefits are reported on prevailing market prices of feed stock & product or cost saving achieved.

Implementation of new profit improvement opportunity follows the rigorous process of identification, screening, review by Site Opportunities Management Committee, then followed by Techno-Economic Analysis by Process engineering & Economics team. Upon Committee recommendations Management approval will be sought with the Management of Change for implementation with a tracking mechanism.

The establishment of in-house Profit improvement program resulted into implementation many new opportunities and also monitoring it for continuous improvement. In addition, the culture of profit

improvement expanded to further avenues of optimization such as dynamic optimization with the Advance process Controllers in Abu Dhabi and Ruwais Refinery East with its integration with the current planning and optimization process to improve the profit, Base and Delta vector mapping in Linear Programing Refinery model, Monitoring and measure the Product Quality improvement by eliminating Product quality giveaways. The initiatives of the profit improvement program are sustained by setting up a target for new initiatives, continuous monitoring of performance and profit reporting to Management. All employees and departments are motivated by management with the implementation of reward and recognition programs. The In-House Profit Improvement Opportunities implemented so far have resulted in a cumulative benefit of about AED 317 Million till 2015 to the Company.

Establishment of Cross function expert team at the operating site for the opportunity management provides a core responsibility for effective implementation of profit improvement opportunity starting from proposal screening to implementation and monitoring stage. Establishment of Systems and Procedures and business processing mapping to review the existing opportunity for improvement, new opportunity management from identification to implementation.

Abstract Title: Advanced Process Control Plant-Wide Optimization in Ras Tanura Refinery

Author: **Feras Alanazi, Saudi Aramco**

Ras Tanura Refinery is the oldest and largest of Saudi Aramco's refineries with a distillation capacity of 550,000 barrels per day (bpd) of crude oil and condensate. The refinery has a large install base of Multivariable controllers and significant benefits has been realized over the last two decades from advanced control (APC) applications.

In order to sustain the realized benefits from APC applications, Ras Tanura Refinery implemented a rigorous maintenance program and monitoring application to ensure the effective utilization and model quality index are optimal.

The refinery next step for optimization is to minimize a gap between plant-wide optimization and local optimization. Plant-wide optimization is conducted by planning & scheduling with LP yield models. Local optimization is carried out by Profit controller and Profit Optimizer with process dynamic models. Difference between two optimization structures exhibit a gap in optimization results. Plant-wide optimization captures essential material and energy balances for whole refinery models, hence It leaves out many actual process constraints for the economic optimization. In contrast, local optimization captures essential process operating constraints but limited scope which typically excludes process integration and blending economics optimization. Therefore, the refinery is planning to deploy an integrated solution which can minimize the gap between these two different optimizations.

Ras Tanura Refinery will share their study to show the potential economic points to be optimized with the integrated solution.

25th October | 08:30 – 10:00

Digitalization

Abstract Title: Enterprise Wide Electronic Shift Hand-Overs

Author: **Dr. Nicholas Hurley, J5 International & Leen Remmelzwaal, J5 International**

Events arising from badly performed Shift Handovers are widely recognized as the single most common cause of serious and even catastrophic upsets in the process industry. As a result, more and more industries are now planning to replace their outdated (but functional) paper or spreadsheet-based handovers with enterprise-wide electronic shift handovers.

To do this, implementers of modern shift handovers are faced with a series of key questions. These include: What qualitative and quantitative benefits can I expect if I go to an Electronic Handover? What implementation difficulties can I expect and what options do I have to solve these in a straight-forward way? How do I integrate the handover with other applications like Permit to Work and Work Orders? How do I automatically collect relevant information from my real-time, asset management, laboratory, safety and other systems? Finally, how do I make all this run additionally on my mobile network?

This presentation uses a modified Operational Balanced Scorecard approach to address these questions. The Operational Balanced Scorecard weights the important attributes of an electronic handover and ensures that none of the key requirements are unaddressed. (See the diagram below). The process additionally quantifies the benefits up front so that potential implementers can make decisions on moving to the electronic handover.

In conclusion, the paper addresses the critical questions facing an industry in moving to an electronic handover. It also introduces a methodology to (i) ensure all requirements are covered and (ii) accurately estimate the benefits likely to be achieved in the process.

Abstract Title: Advanced Work Packaging: A Game Changer in Oil and Gas Project Management

Author: **Abdelghani Sinno, Bentley Systems**

Projects are expected to keep on increasing in size and complexity. A considerable number of projects are not meeting their targets in terms of completion date and allocated budget. As per the Independent Project Analysis (IPA) four out of every five oil and gas megaprojects (projects with a value of more than 1 Billion dollars) were characterized as ‘failure’. There is a need to address many of the construction industry challenges such as poor coordination between engineering, procurement, and construction, poor field planning, a large amount of rework, poor productivity at the field. One of these best practices that address these challenges is Advanced Work Packaging (AWP). With the current emphasis on project profitability and execution predictability, more owners are specifying that AWP is implemented on their EPC construction and fabrication projects. In fact, with the advancement of software technologies related to construction industries, project management processes, resource skills, training, consulting services necessary to support these best practices: AWP will be a game changer for EPC project execution. AWP benefits include and is not limited to: Improved safety awareness and performance, reduced cost through improved labor productivity and reduced rework, improved overall project predictability for cost and schedule, improved up-front planning, better alignment among stakeholders from planning through construction, improved quality of progress tracking. In effect, AWP implementation will soon become the norm in EPC project execution.

Abstract Title: IT/OT Maturity Framework Deployment in KIPIC

Authors: **Ahmad A. Almulaifi - Kuwait Integrated Petroleum Industries Company (KIPIC), Hadla AlFedaghi - Kuwait Integrated Petroleum Industries Company (KIPIC), Qais AlDoub - Kuwait Integrated Petroleum Industries Company**

Information Technology (IT) and Operational Technology (OT) exist separately; divided by virtues, physical walls and organizational barriers; IT and OT are differences when it comes to purposes, architectures, venders and people. However, OT as in all other industries is increasingly relying on IT infrastructure and systems. This dependency is creating an overlap between services and functionality as well as increment in cost and risk. Therefore, with the privilege of being a greenfield, KIPIC relisted the important and benefits aligning IT and OT in early stages to maximize business efficiency. This paper/presentation will describe and evaluate KIPIC approach in initiating IT/OT alignment with the deployment and evaluation of "Gartner Framework for IT/OT Maturity Levels" with its five-step roadmap. Also, this paper/presentation will define the common benefits that KIPIC is using as a metric to measure the OT/IT alignments in different areas. The used methodologies in this paper/presentation includes analysis of the literature, expertise, practices, workshops, and a comprehensive interview inside the company.

IT/OT alignment is becoming a necessity as OT increases dependency on IT based Infrastructure and systems. As this alignment get delayed, the harder and complex any integration will be in the future. Furthermore, one of the many benefits of IT/OT alignment is reducing cost and risk of cyber security since IT is well-established in this field. Furthermore, IT has a wide experience in software lifecycle, software development, update/upgrade procedures, infrastructure operation and maintenance. For initiating and establishing the alignment, KIPIC is employing and evaluating "IT/OT Maturity Levels framework" which includes 5 steps; initial, deployment, define, manage and optimize. In the initial stage, OT systems are identified to increase the awareness of the systems landscape and degree of convergence. Then in deployment stage, justification and benefit metric are set. In the Third stage, the mythology of how IT and OT are managed are defined with the goal of reducing risk. In Managed stage, the question of what to integrate is achieved with the goal of data leverage. In the last stage, transformation will be implemented which include full integration between IT and OT resources and management. Furthermore, the alignment metric which KIPIC is using to set value and alignment benefits includes the following: Finance, Risk, Security, Agility and Data. This will establish a mature IT/OT alignment and will bridge the gap when it comes to Industrial technology such as AI, IoT, Industry 4. 0..etc which will pave the road for the refinery/ industry of the future.

In conclusion, by implementing IT/OT Maturity Framework and with its success in effecting all of benefit metric criteria; KIPIC, downstream and upstream companies will be able to achieve their goal of IT/OT alignment which is becoming a priority and a necessity as well as measure the success through tangible benefits. This enable KIPIC to reduce cost and risks while increase agility and data value.

25th October | 08:30 – 10:00

Improvements

Abstract Title: New Innovative Concrete Technology To Improve Terminal Asset Integrity and Safety

Author: **Darren Hughes, Concrete Canvas**

With an increasing awareness and greater focus placed on environmental protection and the impact that petrochemical assets have on their surroundings, operators are continually challenged with the use of traditional materials to ensure compliance and safe working when implementing large-scale construction projects.

Geosynthetic Cementitious Composite Mats (GCCM›s) was originally developed in 2005 and are a relatively new material technology in the world of geosynthetics. GCCM's consist of a flexible 3-dimensional fiber matrix filled with a high-early strength dry concrete mix with a PVC membrane laminated onto one side. In this way, they combine geotextile, geomembrane and concrete technology enabling geosynthetics to be used in completely new markets and applications.

Geosynthetic Cementitious Composite Barriers (GCCB›s) were developed as an extension of the GCCM technology and largely driven in response to the more demanding rules and regulations imposed on petrochemical terminal operators over recent years for their secondary and tertiary containment solutions.

The last decade has seen a real shift in the regulation of the Oil & Gas industry, since the major conflagration events, such as Buncefield, UK, and Longford, Aus. The vast majority of Countries are now either reviewing, or already implementing new legislation, aimed at not only new projects but those that have been operating for many years. For example, the PGS 29 regulations, which apply to cylindrical storage tanks operated in the Netherlands, now set out far more stringent regulations than previously adopted regarding containment structures, inspection, and ongoing maintenance. Hence, with Amsterdam and Rotterdam having a very high concentration of terminals and assets, this one piece of legislation alone has extremely dramatic and far-reaching effects for everyone involved in these critical operations.

For this paper, we will focus on one of the key applications commonly employed in terminal operations, secondary containment systems, specifically trapezoidal bund or berm walls. These features are one of the most common forms of environmental protection utilized in the industry and it is still surprising to some, that they should largely consist of earth profiles which are allowed to naturally vegetate.

Therefore, when we consider how these systems could be brought in line with current legislation, there are many aspects that need to be considered:

- Increased impermeability
- Erosion control
- Vegetation suppression
- Animal attack
- Reduced contractor burden
- Certifiable and testable installation

This paper is an overview of this innovative material technology, including details of key properties and how these can be fully utilized in an application. It will demonstrate through case history, how GCCB's have found their place in a crowded market and brought strong, tangible benefits to the various stakeholders tasked with managing petrochemical facilities on a day-to-day basis.

Abstract Title: Rotating Equipment Interchangeability Program

Author: **Mohammed Al-Subaie, Saudi Aramco**

As in most of the maintenance organizations worldwide, Riyadh Refinery Department «RRD» has developed its reliability programs that compete the time and cost by arising new approaches in order to prevent/reduce the equipment downtime at the minimum cost of repair, which is aligned with Saudi Aramco's Operational Excellence Focus Areas "Reliability & Profitability".

One of these programs that were purely driven by Time & Cost-effectiveness is the (Rotating Equipment's Components Interchangeability Program). This program had been initiated to unify some of the rotating equipment's' components in an engineering calculated manner, with an ultimate goal of using the minimum spare parts to serve the maximum number of equipment.

It worth to mention that the interchangeability program covers a lot of rotating equipment components. However, this paper had focused on two examples to be shared due to their high population & contribution to the equipment failures comparing to the other components.

In order to reach an effective implementation of the Interchangeability Program, RRD had been started with the main contributor to the pumps' failures, which is the Mechanical Seal (MS), and by considering the similarities between the refinery pumps, it was possible to group a number of pumps to utilize the same MS instead for one for each. These similarities wouldn't be easy to be identified without the development of a very comprehensive database that includes all the required technical & administrative information for each and every pump and its seal. This database was an essential tool for the interchangeability program.

The identified likenesses had helped the refinery to group more than 40 pumps to utilize a one-design seal instead of having a different seal for each pump as it was originally. This success had encouraged RRD to further expand this program by exploring means of creating some similarities between some potential equipment & their seals. These means include modification to the pump stuffing box, seal ports & piping, seal faces material, etc. This had led to a great reduction of seals inventory & improvement of the spares availability of the critical pumps.

Moreover, there were many byproducts obtained by introducing this program such as the elimination of "single" vendor domination, as well as enriching the department Rotating Equipment Engineers knowledge to a level of MS designers. Some of the quantified consequential benefits included a significant saving equivalent to 25% reduction in the seal›s inventory stocks.

RRD efforts hadn't stopped at that type of component, but also, the program was expanded to cover another important component of the rotating equipment, which is the couplings due to the importance of this type of component & the need to establish a comprehensive database for the couplings. Likewise, the couplings' interchangeability helped RRD to enjoy the benefits & advantages of cost reduction and gained experience.

In this paper, the author will present how the reliability programs and approaches such as the Interchangeability had helped the plant to reduce the required spare parts inventory, improve equipment uptime, and avoid the critical equipment outages; while sighting some real example from RRD.

Abstract Title: Ras Tanura Refinery Desalination Plant Journey Towards Operational Excellence

Author: **Hassan Abu Al-Saud, Saudi Aramco**

Ras Tanura Refinery (RTR) Air and Water team has exercised a great challenge in identifying and eliminating a number of hindering factors those have impacted RTR distillate water production and its supply the RTR users. The team was empowered to overcome the situation and identified several recommendations and innovative ideas that were implemented with the collaboration of all involved disciplines through the use of: Submergible pump in intake cleaning, seawater disinfection system application, Antiscalant chemical type change, 3DT technology dosing automation, detailed inspections with several mechanical fixes, procedural changes and especial chemical cleaning to remove hard scale; resulted in desalination plants efficiency recovery from 65% to 95%.

25th October | 13:00 – 14:30

Innovation & Technology

Abstract Title: First Industry Artificial Intelligence Application in Crude Refinery

Author: **Bilal Abdallah, Maana**

Tight refining margins and high competition are key drivers for refiners to consider cheaper crudes. However, it is important to evaluate the risks of processing such crudes in designated refineries in order not to waste dollars through deterioration of refinery asset integrity while trying to save pennies in crude purchases. To evaluate such risks, refinery experts' study potential crude properties and evaluate their impact on refinery assets considering refinery asset details, process factors and processing history; a very sophisticated task that requires high expertise, intellect, and need to keep abreast of latest research in the material science.

To address this problem, Maana developed a Crude Flex application for Shell using models that leverage AI and machine learning algorithms to extract concepts from both structured databases and unstructured data such as PDFs, web portals, RTDB's and emails.

The Shell CrudeFlex application powered by the knowledge models provides a recommendation that augment human-decision-making. Now, crude engineers and traders can better understand the corrosion risks associated with each type of crude to ensure the right crude is purchased for processing in each refinery. This application has been put into production and is expected to manage associated risks, with the objective to save Shell $300M per year.

Abstract Title: Digital Operator Advisory System - A New Era of Operator Collaboration

Author: **Dr. Darius Ngo, Yokogawa**

Digitalization is bringing in a new world of business models based on delivering outcomes, rather than products. Yokogawa's Approach through Synaptic Business Automation (SBA) underlies a process of co-innovation and collaboration leveraging domain knowledge and digital automation technologies to create sustainable value. The approach has broadened the integration, interpretation which act on production-related information in real-time to optimize plant operation and development. The aim to improve quality, increase profitability, reducing energy and eliminate non-productive time with the help of automation, design, and deployment of Operator Advisory System (OAS) which is a combination of electronic workflow through mobile devices, modular procedure automation and integrated asset management are now a reality.

The OAS aims at providing a collaborative framework to support operators in the panel & the field (using mobile devices such as tablets on a 3D visualization) with daily operations & interactions within the organization. The framework will be consistent with the specific workflows & practices adopted by Operations and Maintenance teams. The solution helps the operators to carry out their daily tasks with faster Insight with higher accuracy & efficiency. The real-time monitoring and supervision capabilities of the solution will provide the team with advanced analytic information along with predictions to help them take the appropriate course of actions to maintain the desired production and reduces unnecessary plant downtime.

In this presentation, Yokogawa will share our experience in creating an environment for the emergence of an intelligent Digital oilfield through a collaborative environment utilizing OAS on an integrated operation. These innovative technologies can also be extended onto a Cloud-based platform to help Multi-enterprise companies remotely and automatically monitor their well and fields (in the 3D platform) and take preventative measures to avoid downtime. This implemented solution has helped translating the benefits into value creation within the organization.

Abstract Title: Salient Technologies /Design Features adopted in KNPC's (Kuwait National Petroleum Company) Clean Fuels Project

Authors: **Daniel Jeyasankar - Kuwait National Petroleum Company (KNPC) & Wasemeya Alshammari - Kuwait National Petroleum Company (KNPC)**

Due to highly competitive market environment and need for the refiner to stay ahead with excellence in the refining business, it is apparent that need for each refiner to embark on implementation of new projects as well as expansion with substantial investment is unavoidable. It is of utmost vital importance that application of salient technologies, design features in these projects that cater for the product quality to meet the existing and near future market demand, tighter environmental regulations, improved operational efficiency and product maximization is the need of the day.

Kuwait National Petroleum Company, KNPC embarked on Clean Fuels Project CFP in its Mina Abdulla (MAB) Refinery to remain competitive and move forward as a leading refinery with commitment to meet the demands of today's uncertain refining market that is characterized by remarkable shift in various products demands in terms of both quality and quantity.

Though different configurations serving different markets is available, KNPC's Clean Fuels project employs the most cost effective and economic process configuration with salient technologies that is adaptive for its geographic location and transforms the available Kuwait Export Crude feedstock into high quality fuels and other refined products. Clean Fuels Project with advanced technologies, design features caters to meet the tighter environmental and product quality regulations. Clean Fuels project is capable of meeting product quality demand characterized by lower-sulfur concentrations even in long residue stream to the tune of 0.5 wt.%.

This abstract highlights the salient technologies, design features that is applied in MAB Refinery's Clean Fuels Project such as application of HTER (Heat Exchange Reformer) technology for large capacity Hydrogen production with relatively smaller footprint as compared to stand-alone conventional steam reformer and optimal heat recovery with minimal steam production, state of art reactor internals for all the Reactors of Hydro processing units for effective catalyst utilization that allows the use of advantageous catalyst system with improved cycle length and liquid yields, membrane technology for hydrogen recovery from high pressure purge gas, vertical heat exchangers in overhead system of Crude Distillation Units for corrosion abatement with enhanced reliability, design features for swing cut operation to cater for the product demands optimized for price driven economics, Liquid Ring Compressors for off gas recovery in Vacuum system with potential of reduced maintenance and improved reliability. With the application of design

features such as Low NOx burners for combustion, low leak seals for equipment in sour service, demountable flare stack, KNPC through Clean Fuels Project is committed to achieve cleaner environment and meet tighter environmental regulations. KNPC is committed to be a safe and environmentally compliant refiner with its Corporate Social Responsibility in tandem with superior business performance to cater for superior customer satisfaction by applying these technologies in its ambitious Clean Fuels Project

25th October | 13:00 – 14:30

Digitalization

Abstract Title: Facing Challenges and Changes in Industrial Cybersecurity

Author: **Mohammed Nabeel, Yokogawa**

In recent years, we have seen a growing awareness of most of the industrial companies implementing cybersecurity programs to protect their automation systems and facilities. These initiatives are followed through recognized standards and guidelines like IEC 62443, NERC CIP, etc. as per ARC research shown. Although these documents provide comprehensive guidance and reduced the risks of cyber-attacks, a recent new form of malware target (i.e. “Meltdown”, “Spectre” and “Triton”) continue to raise concerns if the cybersecurity measures have been of sufficient equipped to secure the infrastructure organizations.

Challenges continue to grow for industrial cybersecurity community whereby the convergence of IT/OT has created new challenges establishing effective defenses from IT to OT level. ICS Supplier like Yokogawa has to broaden deployment of automation products and securing the infrastructure to minimize these threats.

This presentation will include a discussion of these new challenges and gaps that need to be filled. Yokogawa will also present the kinds of recommended changes that are required to strengthen the overall cybersecurity measures.

Abstract Title: Reaping the Rewards of Digital Transformation - The $6.5 Million Savings Journey

Author: **Iain Mackay, Petrotechnics**

Over 73% of industry leaders recognize the power of digitalization to accelerate and deliver sustainable operational excellence*. A reduction in operating costs, broader operational efficiencies, and fundamental business transformation are what’s expected. But for many, the ability to achieve these benefits remains elusive.

Organizations have vast amounts of data, hidden away in silos. Take risk management. The reality is that people at the frontline intervene dynamically to operate, maintain, inspect and fix equipment. This is an inherently hazardous place to work. But information on the multiple components of risk is managed differently by different parts of the organization. As a result, a holistic and up-to-date view of risk is not automatically available to decision-makers. Instead, they are forced to resort to manual searches for relevant data, relying on experience and instinct to judge when situations become unsafe.

With 'digitalization', organizations can ensure that risk management data is aggregated and transformed into a user-friendly way that informs decisions and improves prioritization. Frontline operations have immediate access to easy-to-read, data-rich information, with context to make better, risk-dependent decisions.

Executives can take an enterprise-wide view to compare asset performance, with insight into how risk is managed across the organization. Management and planners have access to tools that show the risk implications of scheduling decisions, deviations, and planned activities, and what-if scenarios for enhanced future planning.

Leadership can see accurate levels of risk and productivity and trends for plan-attainment.

This presentation will look at how one leading Middle East operator with a production capacity of over 250,000 BOE per day and a crew of 2500, implemented a disruptive technology to improve risk management. The result? Annual frontline savings of $6,5MM, a 75% reduction in crew wait time, a 50% reduction in supervisor wait time and a 47% reduction in annual plant downtime.

Abstract Title: Kuwait Integrated Petroleum Industries Company (KIPIC) Readiness to Industry 4.0

Authors: **Ahmad A. Almulaifi - Kuwait Integrated Petroleum Industries Company (KIPIC), Hadla AlFedaghi - Kuwait Integrated Petroleum Industries Company (KIPIC), Qais AlDoub - Kuwait Integrated Petroleum Industries Company (KIPIC)**

Industry 4.0 is also referred to as "the fourth industrial revolution" reinforced by the rapid growth and development of the Internet of Things (IoT). Industry 4.0 also represents the real-time digital integration of suppliers, product, equipment, and customers which brings many benefits including improved efficiency, lower costs, higher revenues, and increased innovation. Therefore, In this paper/presentation, KIPIC is deploying and evaluating different readiness, framework and benefit metrics models to build the foundation and roadmap for a solid and successful implementation of Industry 4.0 in all of its integrated petroleum industries including al-zour refinery, petrochemical factory and LNG (liquefied natural gas). In the presentation/paper, a mixed of methodologies were used including analysis of the literature, expertise, practices, workshops, and a comprehensive interview inside the company.

The Industry 4.0 has moved from talk to action with the use of digital communication in industrial/factory systems, products, and services. It is associated with the notion of Smart Factory, Industry 4.0 is a revolution that enables industrial production to be fully automated and interconnected everything that is IT-based and digitalized. As KIPIC explore the ways in which data can be used to create value through digitalization; Industry 4.0 combined with the Internet of Things (IoT) is paving the road for full utilization of data and technology such as analytics, robotics, artificial intelligence, cognitive technologies, and augmented reality. KIPIC adopted and deployed Industry 4.0 readiness and framework model is based on nine dimensions including Products, Customers, Operations and Technology to assess the basic enablers. Additionally, the dimensions include Strategy, Leadership, Governance, Culture, and People representing organizational aspects of the framework and readiness model. Furthermore, the focus on operations and growth in Industry 4.0 can serve as a guide for value merit. This includes improved productivity and reduced risk for business operation metric. It also includes incremental revenue and new revenue when it comes to business growth metric.

In conclusion, having a solid framework and model for deployment of Industry 4.0 in KIPIC, downstream and upstream companies; is critical and will bring many benefits including improved efficiency, lower costs, higher revenues, and increased innovation.

25th October | 13:00 – 14:30

Improvements

Abstract Title: Increased Heavy Naphtha Draw from Condensate Distillation Unit Through Rigorous Simulation Debottlenecking

Authors: **Dr. Mohammad Shamsuzzoha - ADNOC Refining, Dr. Mohammad Abdur Rakib – ADNOC Refining, Mohamed Al-Musharfy – ADNOC Refining, Dr. Mabruk Issa Suleiman - ADNOC Refining**

SteadyState process simulations provide powerful insights into the plant behavior which can be used to enhance designs, safety, and operations of oil refinery units. The process simulation model can be utilized in several ways from the design stage to operation in oil refinery i.e., efficient and profitable designs, achieve consistent product quality, analyze plant operations, monitor & optimize operations and Realtime optimization etc.

In order to explore sources of increased demand of heavy naphtha for increasing the throughput of heavy naphtha reformer or for an additional heavy naphtha reformer, a rigorous simulation model was developed in process simulation software for an existing condensate distillation column. The model was tuned using test run data. Assays information for various sources of the condensate feed mix were studied and implemented in the feed definitions to see the impact of different feed mix ratios. Since monitoring the benzene precursors for the downstream section is an important requirement, special attention was given to include detailed naphtha component analysis while defining the assays for the different condensates. A PengRobinson (PR) Equation of State was utilized while developing the rigorous traytotray model. The model captures detailed heat exchanger networks with heat recovery from the column pump around. Hence the model was capable of evaluating different scenarios and studying the equipment limitations, especially the heat exchangers. An optimum scenario was thereby proposed to maximize heavy naphtha yield with details of benzene precursors for the downstream heavy naphtha reformer.

Keywords: Crude distillation unit, integrated refineries, heat exchanger network, process simulation

Abstract Title: Retrofitting Existing Reactors - A Novel Approach to Modernization

Author: **Rajan Jawale, Chevron Lummus Global**

Retrofitting existing fixed bed reactors that are not performing as expected with CLG's latest and proven ISOMIX-e® internals along with catalyst refill by ART can bring high value to the customers. The reactors, their internals, and the catalyst are core to the performance of any hydro processing or dewaxing unit. CLG has a long history of the development of the reactor internals and are looking for opportunities to provide reactor retrofitting solutions to clients.

This paper will discuss the various pain points clients face in the performance of the reactor and how CLG can help in solving these problems. The paper will discuss before and after performances of some retrofit projects. It will also discuss other tangible benefits that these internals bring to clients such as faster installation and turnaround times and a possible increase in catalyst volumes. The paper will discuss case studies of how the retrofitting of the reactor have helped the clients.

The paper will discuss the features of the ISOMIX-e® internals that help in the solving the underperformance. Finally, it will discuss the process CLG follows in the investigation and providing the retrofitting solutions.

Abstract Title: Fluid Catalytic Cracking Reactor Simulation Model at SAMREF

Author: **Abdullah Alraddadi, Saudi Aramco ExxonMobil Refinery (SAMREF), Sivaprasad PP - Saudi Aramco ExxonMobil Refinery (SAMREF)**

Using a rigorous kinetic model for the FCC reactor is one of the most important tools to effectively monitor and optimize the unit operation. Having this model will help the unit to follow the proposed optimization strategies and enhance the overall unit profitability. A calibrated and fine-tuned model for SAMREF FCCU specifically can be used for the real-time optimization.

FCC Reactor Model has been used in SAMREF. This article points out SAMREF FCC Model configuration and its methodology, in addition to the Model advantages and realizable benefits. The Model contains on Optimization and Simulation modes which can help in running different cases objectives through an interface sheet.

There are several benefits of using the powerful Model to be highlighted, the article summaries them and indicates the Model contribution. A reliable and very well configured Model can evaluate the economic tradeoffs of alternative FCCU operations and will answer accurately on ‘’What if ‘’ scenarios in the case-study works.

The article takes the reader through the below advantages with an example and explanation of each item:

Evaluation of New Feeds/Products/Cut points.

Catalyst Selection and Evaluation.

Enhanced Planning Models.

Optimization & Training.

Feed Characterization.

Selection of Operating Targets.

The reader should realize the importance of having this tool in a conversion unit and what is the added value of the rigorous FCC Reactor Model which has been used in SAMREF.

Digital iPoster Program Abstracts

Abstract Title: Desuperheater Piping Modification Project in Steam Generation Unit (SGU)

Author: **Fahad AlRuhayem, Sadara Chemical Company**

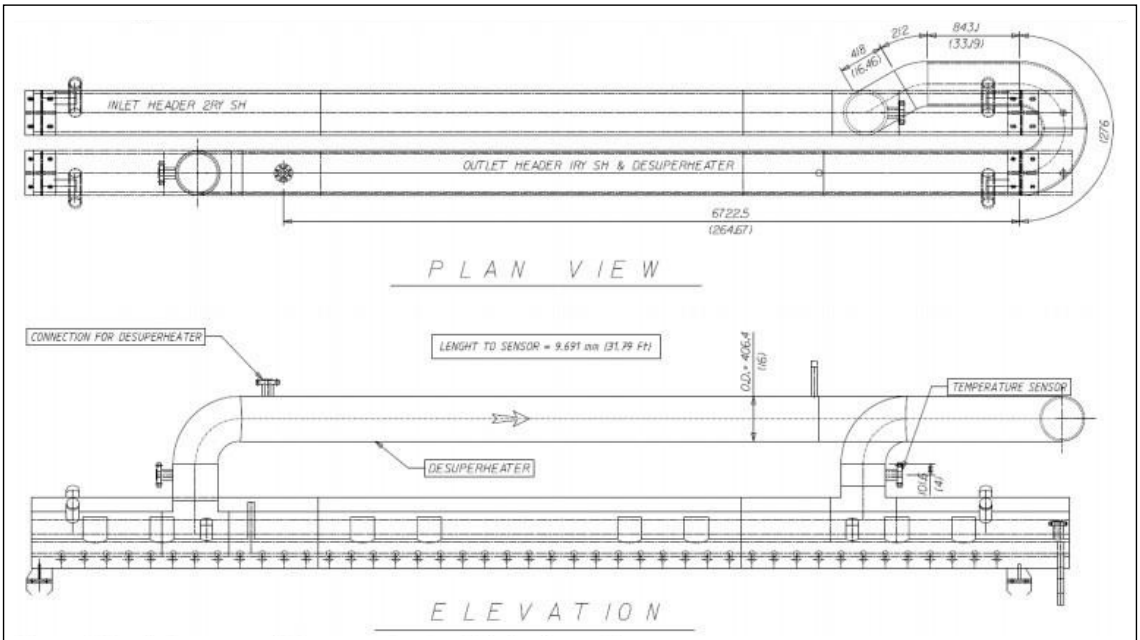


Figure No. 1 Increased Desuperheater Piping Length

Steam temperature is one of the most challenging control loops in a boiler because it is highly nonlinear and has a long dead time and time lag. Adding to the challenge, steam temperature is affected by boiler load, the rate of change of boiler load, air flow rate, the combination of burners in service, and the amount of soot on the boiler tubes. Steam temperature is normally controlled by spraying water into the steam between the first and secondstage superheater to cool it down. Water injection is done in a device called an attemperator or desuperheater. The spray water comes from either an intermediate stage of the boiler feed water pump (for reheater spray) or from the pump discharge (for superheater spray). In the Utilities, Power & Infrastructure (UPI) envelop, in the Steam Generation Unit (SGU) an unexpected obstacle have aroused. During boiler startup for steam blowing and boiler normal operation, it was reported that temperature at the desuperheater outlet is at saturation state at all boiler loads below 50% of the Maximum Continuous Rate (MCR) when spray water is required. However, as per the thermal balance around the desuperheater, this leaving temperature must be higher than the readings shown in the control room. After several analysis and calculations, it was determined to change the configuration of the desuperheater in order to increase the distance traveled by the steam and the length to the temperature sensor in order to achieve total evaporation from the inlet steam. There were a couple of different approaches considered to solve this dilemma; the first approach was to relocate the temperature elements in order to achieve the required evaporation temperature of the steam. This approach was not considered due to the space limitation of the desuperheater. The second approach was to change the spray nozzles to a larger size in order to increase the heat transfer rate and eventually achieving the preferred results. The approach was not considered as well due to a clear

noncompliance with Sadara standards. The best approach was to modify the attemperator design by increasing the length of the desuperheater pipe in order to provide more traveling distance for the steam to ensure complete evaporation for the introduced steam. Due to space limitation in the pent house, the modification used a Ushape spool to be connected to the desuperheater (Please see Figure 1). In order to implement this modification, the desuperheater must be cut in 3 different locations and 4 Field Welds (FW) need to be executed. This modification can be easily accommodated in the current area available in addition to generating an extra distance for the steam to travel to achieve the required function of the desuperheater.

Abstract Title: Enabling solutions to the upcoming challenges in hydroprocessing refinery applications

Author: **Ir. Xander de Jong - Kuwait Petroleum International, Dr. Florian Huber – THE, Dr. Daniel van Herk - HTE**

The 2015 United Nations Climate Change Conference (COP21 in Paris) confirmed the targets set by the European Commission of 80-95 % GHG emission reductions by 2050. In order to reach these goals all energy-related activities have to lower their carbon emissions. For the refining industry, this means that both the direct GHG emissions from the refinery operations have to be lowered and the demands on fuel specifications continue to increase.

One of the keys to achieving the climate goals in the refining industries is the selection of the right catalysts for each of the catalytic refining processes. This can lead to significant energy savings in the refinery and the ability to meet the new product specifications without extensive modifications to the equipment or high capital investment for a new conversion unit.

In addition to the tightening of environmental regulations as mentioned above, trends such as increasing global demands for fuels and the optimization of refining processes, have led to an increasing demand for commercial catalyst testing capacity. High throughput catalyst testing is a time- and cost-efficient approach that is key to meeting this demand.

Kuwait Petroleum Research & Technology (KPR&T) has experience in catalyst testing since 1986. Main equipment were two conventional pilot plants to support the refinery operations. As testing different catalysts with conventional pilot plants takes much time, it was decided to invest in a state of the art catalyst testing pilot plant. After a thorough selection process, a high throughput unit from hte, the “High Throughput Experimentation company” was selected meeting the extensive requirements.

In recent years, pilot plant testing developed towards testing on a smaller scale with more accuracy and better reproducibility. Especially high throughput testing with parallel reactors that are simultaneously operating under the same conditions has matured. Advantages of this technology are that different catalysts can be tested together and compared more accurately on a shorter timeframe. Especially for competitor catalyst testing closing the mass balance and high accuracy & precision are prerequisites to differentiate highly optimized catalyst systems from different vendors. With the development of the technology and standard operating procedures, full-size commercial catalysts can be tested at scales of 1 to 100 ml. These tests can be done on real refinery feedstocks ranging from naphtha, diesel, vacuum gas oil, deasphalted oil, atmospheric residue or wax. As Kuwait Petroleum Corporation (KPC) has the largest Atmospheric Residue Desulphurisation (ARDS) capacity, an important criterion was that the system is able to test catalysts for this process.

In this presentation, we will give an overview of KPR&T’s catalyst research activities and how he›s technology matched those requirements. Furthermore, we will review the benefit of high throughput parallel testing of commercial hydroprocessing catalysts1 and the state of the art of the technology. We will present data on the qualification of he›s technology for testing hydroprocessing catalysts on KPC’s residue feedstocks.

Abstract Title: Higher Margin with Integrated & Cost-effective Refinery Scheme

Author: **Sanjeev Mullick, KBR**

Converting residues are top priorities for refineries, globally, in the upcoming IMO 2020 Marine Bunker fuel regulation environment. Generally, refineries use either hydrogen addition or carbon rejection technologies for converting residues into high-value products. Long residues or vacuum tower bottoms (VR or VTB) with limited amounts of metals and Conradson carbon can be hydrotreated; however, hydrotreater products require further treatment for making final products. The residue hydrotreaters require high pressure and frequent changes of catalyst, making them both capital intensive and high in operating costs. Short catalyst cycles also reduce on-stream factor.

Short residues are usually converted using thermal processes such as thermal cracking and delayed coking. Nonetheless, all products need to be further processed to achieve transportation fuel quality products, adding to the cost of the resid upgrading schemes.

ROSE is the market leading Solvent deasphalting (SDA) technology that can be combined with FCC and/or hydrocracking (mild-to-high pressure as well as ebullated bed hydrocracking) and has been commercially proven and relied upon to meet the need for higher yields of transportation fuels while improving the quality to meet new gasoline and diesel specifications at comparable operating costs and complexity of operations. Combining high-lift ROSE with high conversion hydrocracking and an integrated solidification system would mean a significant reduction in fuel oil exposure and result in higher overall margin than other resid upgrading options described above.

We will present schemes using combinations of solvent deasphalting, hydrocracking and solidification processes. In our presentation, we will discuss economic and operating benefits of other bottom-of-the-barrel schemes and commercial examples (i.e. debottleneck VDU and/or synergize with cokers), where applicable.

Abstract Title: Honeywell UOP's Advanced Methanol to Olefins (MTO) Technology

Author: **Geoffrey Fichtl, Honeywell UOP**

As the global demand for light olefins increases at a steady rate of around 4% annually with the significant demand growth in developing markets, the need for alternative technologies has emerged. Honeywell UOP's Advanced MTO process converts methanol from non-crude oil sources such as coal, natural gas, biomass and petcoke into ethylene and propylene. In addition to offering the lowest operating cost, quick and efficient start-up and operational reliability, the process also offers flexibility in the ratio of propylene and ethylene produced, so that producers can adjust plant operations to meet market demands more effectively. Advanced MTO is already commercially proven, with three units currently in operation, including the largest MTO unit in the world, and several more due to start up in the next two years.

Abstract Title: Information Technology's Role in Oil and Gas Industry

Author: **Turki Alsuraihi - Saudi Aramco Base Oil Company - Luberef**

IT has a major role to play in terms of oil and gas industry. Hence Luberef management decided to facilitate all the recourses to have an integrated system that can be compatible with the oil and gas industry. LUBEREF has embarked on an initiative to enhance its existing SAP Solutions and application landscape to enable improved support for its business operations in Jeddah & Yanbu.

The key objectives of the SAP enhancements initiative are :

- Enhance business capability by enabling most of the business processes across Jeddah and Yanbu refinery through the SAP

- Enhance integration across all business processes within Yanbu and Jeddah office, as required
- Enable “what-if” analysis and decision making support & Reduce time for report preparation
- Reduce inventory costs through better and near real-time visibility of inventory levels as well as demand forecasting capabilities
- Increase the ROI on the SAP investment by optimizing the existing SAP solution.

IT completed the migration to the latest SAP HANA platform to improve the processing capacity and get a reliable database. Nevertheless, IT started implementing in this year new modules such as MII to link all non-SAP system in the refinery to SAP, Success Factor to improve HR activities, and Ariba to be aligned with Aramco e- Marketplace which will be the national e-Marketplace.

Abstract Title: K-S AAT – A Break-through Solid Acid Alkylation Technology

Author: **Rahul Pillai, KBR**

Globally, the demand for cleaner-burning gasoline blend components is increasing while demand for gasoline is declining. This increase in demand for cleaner-burning gasoline is driven primarily by environmental mandates and high-performance engines. Alkylate, isomerate, ethanol, and ethers represent the cleaner-burning gasoline blend components. Among these, alkylate is the ideal clean fuel component because it has a high octane rating, exhibits low vapor pressure, low sulfur levels, no aromatics or olefins. Alkylate is currently produced using either sulfuric or hydrofluoric acid as the catalyst. Both acids are dangerous and can lead to corrosion-induced accidents and impede firefighting efforts. Solid acids have for many years promised safer and cleaner alkylation. The poor stability of most solid acids, however, have resulted in expensive processes with complex reactors and large catalyst inventories, making them uncompetitive with liquid acid technologies.

After years of development, a new solid-acid catalyst technology ExSact has reached the point of outperforming these liquid acids. The engineered solid-acid catalyst has been designed to give over 24-hr cycle-times, robust resistance to typical poisons, the ability to handle a variety of feedstocks, a simple adiabatic fixed-bed reactor design and regeneration using hydrogen. The ExSact catalyst forms the core of a safe and efficient K-SAAT process that generates high-octane alkylate without the dangers and costs associated with liquid acid technology. K-SAAT reactors can be used to replace/debottleneck existing liquid acid alkylation reactors by reusing the existing recovery system (DIB/Debutanizer).

The stable catalyst performance greatly simplifies the overall process design, which reduces the capital cost of the alkylation plant, while lowering energy consumption. KBR has licensed K-SAAT units to Haike Ruilin Petrochemical Co. Ltd. and Luoyang Aiyou Chemical Co. Ltd., both in China. The Haike unit is slated to start up in Q1 2018.

Abstract Title: The methodology of Control Valves Design Consideration to Enhance Safety, Reliability

Author: **Nileshkumar Patel, Sadara Chemical Company**

This paper emphasis on how to reduce control valves problems through adequate process design engineering consideration. When designing and installing a piping system for liquid and two phase service applications design engineering consideration plays a major role in whether the valve will operate smoothly or experience vibration, cavitation and not meeting process flow requirements. These severe operating conditions could create a safety hazard to plant personnel in addition to asset damage and increase maintenance cost. If control valves are not designed properly, then its directly going to impact on organization profitably and safety KPIs.

This paper addresses different control valves scenario cases and lessons learned during start up and commissioning of different plants. It gives a design engineer around the world the different approach/check list & importance consideration for alignment with all engineering functions with system specific requirements. It's a very important for the design engineers to understand why control valves vibrate, cavitate, create high noise and to recognize potential causes for improvement of a system performance. The information of this paper is detailed for current knowledge regarding control valve which is continually growing and improve performance of control valves.

Abstract Title: Optimizing the Multivariable Control System of RTR's Visbreaking Plant

Author: **Kumail Alqatari, Saudi Aramco**

Human resources are important in running processing plants across the oil and gas industry, however, automatic control systems, if well utilized, could have even a bigger impact. Ras Tanura Refinery (RTR) is continuously improving its own multivariable control (MVC) systems through workshops including a multi-disciplinary team. As an example, the RTR visbreaking plant was able to reduce the diesel cutters blended into its product by revamping the MVC system. The redesigned system gives the optimum product qualities in order to minimize the middle distillate cutters. The optimization led to a 3% reduction in the blended diesel cutters without having any capital investments. Similar improvements can be utilized to increase the reliability, efficiency, and added value across the industry.

Abstract Title: A proactive approach to alleviate fluid flow problems in Downstream plants

Author: **Faisal Baksh, Sadara Chemical Company**

The objective of this abstract is to enable engineers to predict hydraulic problem areas when operating at conditions other than design and during startup. The examples included will demonstrate how minor undetected deficiencies in the design phase could limit plant operation and how the correct modeling approach helps in diagnosing and treating these limitations.

An often-overlooked parameter in Process plants is the optimum operating pressure within the process and utility pipes and pipelines. Typical over margin provided during initial design phase passes through unrevised or unoptimized. It turns out that significant over design is not always better, not just in terms of the energy lost in operating away from optima, but also in terms of the lifecycle costs as equipment undergo higher stresses and premature failures when they operate below-rated capacity.

The paper will describe key concepts that affect pressure drop and fluid flow in liquid and gas service and demonstrate through case studies, the significant impact on normal plant operation caused by improper design and over margin. Following the case studies will be covered:

pipe and valve failures due to higher recycle flows at a lower plant load

two-phase flow in pipe segments designed for single phase

insufficient flow due to equipment elevation changes during design

the complexity of bypass stream hydraulics around key equipment in gas systems

It will be shown how these hydraulic problems remain undetected even when process models were developed for the plant. Process simulators cannot perform rigorous hydraulic modeling because they do not perform momentum balance in addition to typical heat and material balances (HMB) in steady-state mode. Similarly, hydraulic modeling tools, while very effective in modeling cooling

water and flare gas networks, are handicapped in modeling typical chemical processes with phase change, temperature change, and chemical reactions.

The solution presented here is to adopt an integrated approach, where an initial Heat & Material Balance for a given scenario is established through process simulation models and synchronized with a hydraulic model. In some cases, hydraulic methods within a process simulator can be used by identifying the controlling hydraulic resistance of the network and balancing the flowrates to satisfy this constraint.

Abstract Title: Shifting Inspection Strategy from Time Based to Risk-Based

Author: **Abdulhamid Al-Akel, Luberef**

Luberef is Saudi Aramco Joint Venture lube oil refinery with two refinery operations in Jeddah & Yanbu. The core business of Luberef is to produce series of Group I & Group II finished lube base oil from the reduced crude oil feed supplied by Saudi Aramco Yanbu Refinery.

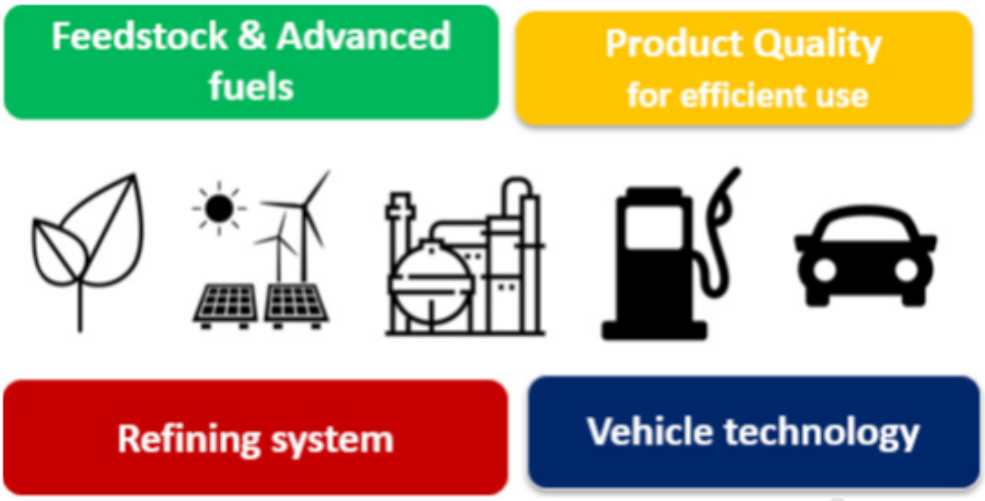
As part of Luberef effort to optimize inspection strategies for static equipment/piping and to be aligned with static equipment reliability best practice, Risk-Based Inspection program has been applied to the two refineries in Jeddah & Yanbu. The objective is to move from the current Inspection strategy of Time Based Inspection to Risk-Based Inspection taking advantage of Health Safety and Environment (EHS) & Business risk evaluation the RBI offers. Unlike time base, RBI addresses specific damage mechanisms based on established process corrosion loops (PCL) and equipment inspection history.

The advantage of team semi-qualitative RBI study conducted is, it allowed team participation & awareness of specific potential damage, probability & consequence of failure for each equipment/ PCL, in addition to risk ranking. Also, the inspection plan for each equipment/PCL is established based on an active or potential damage mechanism avoiding unnecessary general inspection plans thus reducing cost & equipment outage.

The paper will discuss the outcome of applying RBI for both plants and gained benefits including risk identification, risk ranking, and gained saving in optimizing inspection strategies. Also, other indirect advantages gained by team members assist integrity and turnaround strategy.

Abstract Title: Vision 2050 - a pathway for the evolution of the refining industry and liquid fuels

Author: **Ir. Liesbeth Jansen - Kuwait Petroleum Research & Technology, Ir. Xander de Jong - Kuwait Petroleum Research & Technology**



The European Commission has set climate goals targeting 80-95 % GHG emission reductions by 2050. After the COP 21 Paris agreement on climate change, it is possible that the target becomes even more ambitious. There is a strong focus on reducing C02 emissions from transport fuels. The role of electrification of light transport is among the solutions that the EU is considering in order achieving “net-zero” carbon emissions in light transport cars and light vans by 2050. However, the “net-zero” definition should be looked at in a Well-to-Wheel (WTW) or Life Cycle approach. To give a substantial contribution, the EU refining industry is evolving and adapting to the energy transition. The goal is to provide fuels and other products necessary to the economy while substantially reducing GHG emissions. The EU Refiners Industry1 “Vision 2050” represents an industrial opportunity for Europe to develop low-carbon technologies as part of the global climate solution and includes opportunities like integration with other industries (intake of biomass, petrochemical production) and local communities (waste, heat or conversion captured CO2).

In the EU Refiners Industry “Vision 2050”, low-emission fossil fuel in an optimized refinery combined with biofuels and synthetic fuels in the most efficient internal combustion engine and hybrid vehicles could offer an alternative to lower greenhouse gas emissions in the passenger car segment. Liquid fuels are the most efficient products for other modes of transport including heavy-duty transport, aviation, and marine. As the petrochemical industry relies on refinery products as well, there will be a need for these products for many decades.

The EU Refiners Association studies various pathways to produce a low-emissions fuel to reduce the greenhouse gas (GHG) intensity (WTW) in EU transport. In refining options are e.g. carbon-capture & storage and carbon-capture & usage. Other so-called low-carbon pathways explored for future refining are e.g. the use of green hydrogen and the use of renewable electricity. On product quality, the impact of options like higher octane in gasoline or changing the carbon/ hydrogen ratio is explored. The use of advanced biofuels will play a significant role in the reduction of greenhouse gas emissions. The low-carbon pathway study looks at the whole supply chain for options to reduce the WTW GHG intensity. Low-carbon, liquid fuels are complementary to gaseous fuels and electric vehicles. Future service stations use the existing infrastructure to provide a variety of “fuel” options.

The Vision 2050 shows that within the right policy framework and the right investment in R&D technologies, the refining industry can play a key role in the development of breakthrough technologies. Furthermore, the development of a diversity of “fuels” will give the economy flexibility, resilience and the possibility for the market to select the optimal solution for every sector and use. As a member of the EU Refiners Association, Kuwait Petroleum presents an overview of the Vision 2050.

Abstract Title: Maximising customer benefit by focusing project delivery on full beneficial operation

Author: **Dr. Damon J Hill – Wood, Michael Whitling - Wood**

Successful commissioning, start up and operations are key areas of any project – small or large. These specialist areas when coordinated correctly have a positive impact on project safety, schedule delivery and costs.To this end, commitment to a right first time culture has to embrace FEED, EPC Contractors, CSU organisations, training and development bodies, PMC / PMT organisation, Licensors and Vendors, Subcontractors and third party operators.

In this presentation, Wood will outline a proven practical model that fully integrates all the above stakeholders.

For many years Wood has provided Operational Readiness programs, which on numerous occasions has extended to providing ongoing operations management. Our delivery methodology has been continually refined to embed best practices to ensure right first time start-up is achieved. Our methodology outlines a collaborative approach to delivering:

Integrated completions, commissioning, start-up and handover A Right First Time Start-Up program Operations input to the design, development of operations documentation and maintenance Management systems

To support the program Wood utilises lessons learned and best practices gained from operational Asset Integrity Solutions, asset optimisation programs, including organisational and management, energy, mechanical integrity and reliability improvement studies.

Operational readiness planning is regarded as a critical factor in the success of any project. Key to success is working together as an integrated team with the Operator in order to ensure they fully embrace the process and can demonstrate ownership to their workforce ahead starting up and progressing rapidly to beneficial operations.

Our Operational Readiness expertise is based upon our long and worldwide asset management experience. We understand how to set up and deliver operations for our customers. Wood offers specialist skills from across diverse affiliates to seamlessly deliver successful right first time commissioning, start up and operations across upstream, midstream and downstream, both onshore and offshore.

Abstract Title: Turning IoT Data into actionable insights Combining business objectives, engineering accumulated knowledge with streaming analytics, Oil & Gas organizations can optimize their internal operations.

Author: **Satyajit Dwivedi – SAS, Alaa Youssef - SAS**

Growth and optimization are key objectives on the top of the Agendas of today's organizations in every sector across the world. However, the nature of oil & Gas industry and the dynamics around it increase the pressing demand to introduce new approaches and techniques to achieve the targeted optimization goals and maintain sustainable growth.

The revolution in analytics and artificial intelligence domain introduced to the world new technologies and methodologies to help organizations leverage the huge data assets generated across the organizations from the operational systems or generated from the sensors monitoring the assets and equipment in Real-time which is known as IOT in today's terminologies. Oil and Gas organizations are looking to leverage theses technologies to monitor the performance of their assets and entire operations against key performance indicators defined based on the industry standards and organizations objectives.

The monitoring by itself is no longer sufficient to identify the optimization areas and the measures of the possible optimization. Today's technology is helping decision makers and engineers to merge between historical data, Real-time date, operational systems data, along with accumulated engineering experience and hypotheses from field, process and operations engineers to better understand their assets performance and make the right optimization decisions accordingly, We call this approach the balance and alignment between judgmental and analytical approaches to achieve operational excellence of the assets.

It's a bi-directional learning process between the machines and engineers as the parameters around operations are huge which means decisions cant to be addressed in rule-based approach and it requires intelligent systems to learn from every incident and every decision related to the asset as well as for engineers to adjust the operational hypotheses based on the facts and findings of the accurate day to day collected and analyzed data

This transformation requires strong plans in place and especially change management plans for adopting the culture of analytics across the organizations to gain the maximum benefits of these technologies and automate the monitoring and optimization processes to the extent of decision making in several cases.

Organizations have to Adopt BIG Data, IOT, Analytics, and Artificial Inelegance technologies without ignoring the accumulated collective experience of the human capital of the organization. The idea is not just to adopt these technologies and assume we will see the results directly, the idea is how can we make these technologies work within our assets considering the different dimensions such as People, Processes, data, applications, technology, and infrastructure. These dimensions need to be always in harmony to make sure the framework for optimization is working in optimal way to bring values to the organization.

Abstract Title: Pressure Energy Recovery Practical Case Study in Yanbu Refinery

Author: **Raad Mulla, Saudi Aramco**

Yanbu Refinery (YR) has five different locations in the process where the pressure is being dropped dramatically using angular valves. These locations are allocated and involved in four different processes, each encompassing one step of the production process. The processes include Diesel Hydrotreating, Amine regeneration, and Naphtha Hydrotreating. In order to utilize this pressure drop to produce energy, this case study is assessing the power and energy loss as well as discussing the applicability of using new pressure energy recovery technologies to utilize this wasted energy. In addition, the energy loss monetary value for YR not utilizing this available source of energy was conducted. At current energy rates, the total loss is $772,825 per year and the estimated annual saving assuming 80% efficiency of energy recovery is $618,260. The energy price used to calculate this value was obtained from P&CSD at a value of $53/MWh. The Aramco energy rate value has been used in this report despite the fact that YR was charged by Marafiq (Electrical Company in Yanbu) at a lesser value, around $48/MWh for the year of 2016. This is because Marafiq increases its rate on a year-to-year basis. Hence, Marafiq energy rate in 2017 is expected to increase to $50-60/MWh.

Out of the five potential sites, only two can be redeemed economically viable given the current electricity costs with the pay-back period between 3-10 years. The two sites are location #2 between the high-pressure cold separator (V05-D-005) and the low-pressure cold separator (V05-D-006); location #4 between the DHT separation and Stripper Section. The initiative requires a capital investment of $2-3 MM, and this includes all equipment cost, site, and utility upgrade to handle the additional capacity, pre-operation, and start-up costs, and electrical analyzers attached. One aspect to highlight in the capital cost is that the reverse-pump cost is around $1.1 MM per unit. In terms of environmental benefits, the utilization of energy recovery technologies at these two sites would reduce YR's indirect fuel oil burning by 4541 barrels annually, which would reduce YR's carbon footprint by 7200 tons of CO2-equivalent/year. The total energy saved as a result of implementing energy recovery technology on those two sites is 8,519.8 MWh per year, which would decrease the YR Energy Intensity Index (EII) by 0.54.

The concept of energy recovery can be applied to any process streams at high pressure or temperature, especially for those containing combustible materials such as hydrocarbons. Energy can be recovered through differential temperature between the inlet and outlet stream of a specific equipment, through heat exchangers, or differential pressures as well, through pumps and turbines.

In conclusion, high-pressure drops in Yanbu refinery processes take place in five main locations, two locations in Area II, three locations in Area III. The pressure drops occur in the five locations across angular valves. These angular valves can be replaced by reverse running pumps or specially designed turbines to optimize the energy utilization of Yanbu refinery

Abstract Title: SAMREF Molecular Management – LLCO to MHFO and HGO to Vacuum

Authors: **Sivaprasad P - Saudi Aramco ExxonMobil Refinery, Abdullah Raddadi - Saudi Aramco ExxonMobil Refiner, Mesfer AlGethami - Saudi Aramco ExxonMobil Refinery**

Heavy end of gasoline is very low in octane and having this molecular family in Gasoline Pool brings down the octane number of the pool by more than a number. This portion of gasoline is not suitable as a Diesel Hydrodesulfurization (CHD) unit feed also; since it can create fouling issues in the preheat train due to high Bromine number. Also taking out this stream from the Light Cycle Oil will allow the good quality Light Light Cycle Oil (LLCO) tail end to be dropped to Heavy Light Cycle Oil (HLCO) as CHD feed, thus increasing the saleable Automotive Diesel Oil (ADO) from refinery. Also, the reduction in gasoline is compensated with the higher octane number of the remaining volume; thus getting a benefit from improved octane barrels. The resultant LLCO which is basically the heavy gasoline with low octane number is an ideal cutter stock for Marine Heavy Fuel Oil (MHFO); with lower viscosity, density and Sulfur it can reduce the other valuable cutter stocks like ADO and Kerosene; thus potentially increasing the saleable distillates from refinery and enhancing the Gasoline Octane number. This has resulted in significant improvement of the refinery profitability, further details will be covered in the article.

Similarly, for molecules improvements initiative, FCC was experiencing 25% light HGO in the feed from the Crude tower, a test run performed to improve FCC feed quality via slip streaming of Heavy Gas Oil from Crude Tower to Vacuum Tower. The aim to improve the distillate yield and reduce the light ends for FCC feed. The trial proved successful increment of 0.2% Light Vacuum Gas Oil in FCC feed, providing two fold benefits of having more diesel production and more cracking margin in FCC. Initial results reflected marginal improvement of ~ 1.0 M$/yr by an increase the FCC Reactor Top Temperature (RTT) by almost 1 deg C.

24th & 25th October

Abstract Title: Alternative H2 Source for Reformer Unit Start up

Authors: **Tariq Aljedaibi - Saudi Aramco ExxonMobil Refinery, Mukeshkumar Patel - Saudi Aramco ExxonMobil Refinery**

Reformer unit produces H2 to supply users in the refinery, but requires H2 for Start up to initiate platforming reactions. H2 supply source is normally stored in 70 H2 cylinders with 150 bar for Reformer unit start up. HAZOP studies has identified risks associated with using these H2 cylinders due requirement of specialised maintenance for the rupture disk in each cylinder. Seeking alternative H2 supply was driven by the HAZOP requirements. In 2013, Samref installed Hydrogen Recovery (HRU) unit which can be utilised as a startup for Reformer unit. HRU supplies H2 with 99.0% purity which is outside of the Compressors design limit for molecular weight. In order to use the HRU H2, Samref developed procedure to mix H2 with N2 gas to increase the molecular weight up to Compressor operation range. As a result, an alternative H2 Source was introduced which can be utilised to eliminate the risks associated with using and maintaining high pressure H2 Cylinders.

Abstract Title: Global fuel development and the impact on the Middle East refining

Author: **Ir. Liesbeth Jansen, Kuwait Petroleum Research & Technology**

The expectation is that the world energy demand will grow in the next decade due to a growing world population and growing economies, particularly in developing countries. Crude oil is traditionally the main source of energy for transport, where the Middle East production plays an

important role. As the effects of global warming are becoming clearer and after the ratification of the Paris agreement (COP21) every country is developing his own strategy to meet the agreed targets. In addition, developments in the upstream sector like unconventional oil and gas production in North America and the growing deployment of renewable energy in many parts of the world can have a great impact on the global energy demand system.

This presentation highlights the insights on the global fuel demands and the developments in the various parts of the world for the next decades. Transportation fuels fall into two categories namely fuels that are used globally like marine fuel and aviation fuel, which have global specification requirements, and fuels used locally such as gasoline and diesel for which regional specifications apply.

A large focus area is currently on the Marine fuels. The IMO regulated global cap on sulfur by 2020 will largely regulate the Marine fuel quality and specification requirements. With new fuels coming on the market there is a specific emphasis on stability and compatibility performance.

In order to meet the agreed targets in the Paris agreement (COP21), the GHG emissions have to stabilize around 2020 and a reduction after that. In order to meet these GHG reductions, all sectors will have to reduce CO2 emissions including the transportation sector. This reduction will lead to alternative energy sources including biofuels in transport. The advancements of the different options are hard to predict but are mainly driven by global and local greenhouse gas reduction targets.

In addition, there is strong pressure to reduce the vehicle tail pipe emissions. Stringent legislation on the emissions of nitrogen oxide, hydrocarbon, carbon oxide and particulate matter is in place in many parts of the world. This has resulted in higher demands on the fuel quality requirements to enable new technologies. In more and more parts of the world, the awareness of the population grows of the negative effect these emissions have on their health. The equipment manufacturers want to standardize their technology around the world, which means that the fuel requirements will level to the high standards globally.

The key automotive fuel parameters that still show large differences between regions are sulfur, gasoline octane, gasoline lead content and diesel cetane number. There is a strong fuel quality development including the transition to low sulfur fuels in many regions of the world. The stringent European specifications for automotive fuels are now being used to meet the requirements for Euro 5/6 vehicle technologies. What does this mean for the Middle East refineries? What are the minimum specification requirements for the future technologies? These are the questions addressed in the paper.

Abstract Title: Higher Margin with Integrated Refinery/Petrochemical Scheme

Author: **Rahul Pillai, KBR**

Lower crude oil prices and decreasing refinery profit margins has opened an avenue for value-added opportunities such as integration of Refinery with a Petrochemical facility. In addition to higher operating margin through feed and product integration between the two facilities, refinery – petrochemical integration brings in other benefits such as energy savings, lower operating cost, and lower transportation costs.

Rates of propylene and ethylene from units in the refinery and petrochemical plant are key considerations in refinery – petrochemical plant integration. Selection of process unit, catalyst, feedstock, and operating conditions can significantly alter light olefin and aromatic rates and the propylene to ethylene ratio. Additionally, the selection of process unit should be flexible enough to address the challenges associated with large swings in olefins-fuels margins.

KBR's MAXOFINTM technology is designed to maximize propylene and ethylene from traditional FCC feedstock and low valued naphtha streams. We will present schemes using combinations of KBR's MAXOFINTM Technology and SCORETM technology (steam cracker) to integrate refinery with the petrochemical complex. We will also present a case study discussing the yields associated with this scheme. The presentation will also cover various options for revamping an existing FCC unit into KBR's MAXOFINTM unit.

Abstract Title: How to Minimize Risk and Optimize Profit when Planning an Integrated Refining and Petrochemical Complex

Authors: **Dr. Sachi Maiti - SNC-Lavalin, Lark Chapin - SNC-Lavalin, Scott Shorey - SNC-Lavalin**

Environmentally driven, clean fuels specifications put tremendous pressure on the business of refining worldwide. The International Maritime Organization (IMO) directive effective January 2020 is the latest specification issued and it significantly reduces the maximum sulphur content of global bunker fuel from its current value of 3.5% to 0.5%. In addition, enthusiasm for electric vehicles continues to grow, which will influence the future supply- demand pattern of petroleum products. To survive profitably in the market, an increasing number of refiners are planning to integrate refining with petrochemicals production as a means to diversify their businesses.

Building and operating a grassroots facility is a complex undertaking, but the economics associated with modifying an existing plant or revamping a few units are also complex. Many factors critically impact this investment, such as plant location, available feedstocks, the complexity of configuration, end- product mix, crude oil and raw material pricing, environmental issues (local, national, global), licensed processing technologies and market competition. So how does a company considering such an investment plan properly balance the project risks with the potential rewards?

This presentation discusses the investment planning road map for an integrated refining and petrochemicals complex and optimizes the process using linear programming (LP) modeling considering various techno-economic parameters and constraints.

Abstract Title: Innovative solutions for Resid upgrade and improved refinery margins

Author: **Ian Elgey, KBR**

Among the various bottoms upgrading technologies, Veba Combi Cracking (VCCTM) provides the ultimate flexibility with high residue conversion. With the implementation of the impending MARPOL bunker fuel oil restrictions, crude oil availability and prices, as well as fuel oil markets will be greatly impacted. These fluctuations will allow refiners with flexible bottoms upgraders to maximize profits by taking advantage of opportunity crudes and high sulfur fuel oils on the market. The VCC technology relies upon thermal cracking in a hydrogen environment for residue conversion, easily achieving 95% conversion without regard for the feed introduced to the unit.

What makes the VCCTM even more advantageous is the different options available for the second stage fixed bed reactor. This reactor can be tailored to exploit the existing assets within the refinery. Options range from no second stage, hydro processing to produce on-spec diesel, to full conversion of VGO to diesel and lighter, and even maximizing naphtha for petrochemicals production via Olefins or BTX value chain. VCC technology has been recently commercialized for two Coal and Coal tar based units in China and operating since 2015. The third unit at TAIF refinery, located in Nizhnekamsk Russia, is commissioned in 2017 and currently in the second phase of startup, illustrates the flexibility of the unit design to fit refiners' needs. The TAIF unit not only converts the vacuum residue, but it hydrotreats SR VGO, and adjusts VGO conversion in the second stage in order to fill the existing FCC Unit. This configuration allows for the production of Euro-V quality diesel from the VCC Unit, and also increases the gasoline yield from their FCC.

With the oil market fluctuations destined to arise in the coming years, refiners should look at ensuring they have feed flexibility and conversion options in their bottoms processing in order to maximize profits.

Abstract Title: Maximising Integration Benefits Between a Hydrogen Plant and the Refinery to Improve Margins

Author: **Matthew Akhurst - Air Products, Philip Morris - Air Products**

Air Products has a worldwide leadership position in outsourced hydrogen production and recovery with a strong focus on the refining and chemical industries. Having maintained a global leading market share for over 20 years and currently supplying over 3,000 MMSCFD of H2, the company has accumulated over 1,600 operating years of experience.

This paper describes the different degrees of integration possible between an Air Products hydrogen plant and a refinery customer, from simple integration with the steam system up to a complex feed and fuel integration utilizing a range of refinery off-gasses and liquid sources.

The paper will also describe options for integration of the electrical power generation requirements into the hydrogen plant and refinery to further optimize the overall efficiency.

Case studies will be included in the paper to illustrate the work process needed to develop the most optimal solution for the specific conditions and needs of the refinery.

Abstract Title: Molecules movement and quality optimization in Lube oil industry

Author: **Hani Aldawoodi - Saudi Aramco Base Oil Company – Luberef**

Introduction

Molecular management targets the right molecules to be at the right place, at the right time. It consists of molecular characterization of refining streams, molecular modeling of refining processes, process optimization, and overall refinery optimization integrating material processing system.

In a lube oil industry with 2 far apart refineries (250 KM) like Luberef, tracking the path of each individual molecule in a patch operation mode with 10 downstream units and more than 100 Simi finished and finished material tanks and more than 5 blended products and optimize the synergies between the two sites would be a burden without having an innovative tool that manage molecules movement and optimize products quality. This should allow us to get the most value out of any molecular species.

Objectives

Finding a suitable supply chain tool for lube oil industry and due to more diversified products and by-products post-Luberef plant expansion which requires more accurate and speedy tool than Excel was the challenge till the Implementation of Aspentech Base Oil Production Schedule Optimization Solution. The business objective that is being achieved through implementation of Base Oil Schedule Optimization solution is generating optimized Base Oil Schedule and assure the on spec product availability in the right time and place with a very significant time and man hours saving.

Methods/approach

When creating a basic crude and downstream units operating schedule, this model shall be capable of considering the following factors in an advanced data Integration with ERP, PI system as applicable and subject during optimization:

Optimization based on Fixed Selected Activities Optimization based on Assigned Unit Shutdown Optimization based on Changed Tank Assignment

Optimization based on Changed Crude Arrivals Optimization based on Priority Demand Order Min and Max feed rates per feed and unit

The actual timing of all demands or any subset of demands Basic synchronization between stages of production

Parallel Block Logic between Units Material operation sequence for unit

Costs of inventory and operating costs

Min and Max tank sizes for each stream modeled Feed changeover cost on each unit

Inventory of all Simi finished and finished materials simulated over entire scheduling horizon Inventory problems report for every raw material/intermediate/finished product

Visualization of minimum and maximum inventory used to indicate the magnitude of inventory problems Quickly evaluate late orders

Keep scheduled inventories between tank limits Quickly evaluate spot opportunities

Reduce run-outs

Increase on-time delivery

Quickly evaluate impacts of changes to the crude schedule Results/practice implications

Both the prototype and the preliminary model showed a significant improvement in the following areas:

Man-hours saving reaches up to two-thirds comparing with the past Excel sheet usage. Blended products availability.

Modeling Time and accuracy. Tanks relocation efficiency. Integration / Molecular Management.

Communications between Planning and Marketing.

Conclusions

In a lube oil industry where a patch operation mode present, such multi jobs program will ease and accelerate the process and work flow between Planning, Manufacturing, and Marketing and will minimize the potential human errors as well.

Abstract Title: Optimizing Training Transfer to Improve Organizational Performance and Individual Wellbeing Through an Evidence-Based Personal Resilience Learning System

Author: **Roddy Herbert, Koru International Ltd**

The Gallup World Happiness Report (2017) reflected an increased reliance on using happiness and subjective wellbeing as primary indicators of the quality of human development. Whilst inherently linked, happiness and personal resilience not only serves as a foundation to employee health and wellbeing, considerable research also associates the wellbeing of employees with work-related outcomes - driving high performance and overall organizational effectiveness.

The people profit chain link with wellness is also relevant in the people safety chain. Individual factors including fatigue and disengaged staff can contribute to human errors. The role of human error in accidents within the oil and gas industry has been well documented.

Developing personal resilience to employee happiness, wellbeing, and organizational performance

requires individual behavioral change and cultural transformation. Mission critical as it is, historically such change programmes have not been successful in training transfer of resilience skills back on the job.

The problem - even organizations that recognize the importance of developing resilience and happiness in their workforce generally approach such initiatives as a 'box tick' exercise.

Training programs typically offer instructional and informational content and conclude with a level 1 evaluation to gather delegates impression of the training. That does not provide for gauging the effectiveness of the knowledge transfer back in the workplace until sometime later – often beyond the ability to implement further interventions or take corrective action to get or stay on plan.

What is needed is a learning system that measures, monitors and manages the uptake of personal resilience techniques and necessary support back on-the-job for all employees. A system that optimizes training transfer.

Case Study – How a UK Water Utility Company used a series of guiding principles, quality metrics and advanced analytics to optimize performance outcomes from employee resilience training. Leveraging a predictive algorithm at the point of training transfer provided insight on where to invest targeted resources for maximum effect. This was how it was able to reverse plummeting Employee Engagement scores and increasing stress-related absences as frontline staff struggled with the change in a newly deregulated industry.

The learning system incorporated feedback loops, data science, and the Koru 'EPIC' ä model which is aligned to the pioneering field of behavioral economics and the work of Richard Thaler, Nobel Prize Winner in Economics (2017).

The organization›s Learning and Development department were guided by predictive analytics to identify and address root causes of skill and knowledge transfer issues. A successful outcome was achieved by acting on insights drawn from quality metrics, implementing training and non-training interventions, removing obstacles and strengthening support mechanisms.

Resilience training was turned into an evidence-based people development strategy that drove individual employee behavioral change, cultural transformation and so contributed measurable value to the business.

To conclude - making an investment in employee wellbeing is a critical component in human performance. A correctly implemented resilience learning system can transform overwhelmed individuals, and a workforce not fit for purpose back into a healthy, happy, productive and safety-conscious employees.

Abstract Title: Digitalizing Existing Brownfield Assets

Author: **Anne-Marie Walters, Bentley**

Today's operators of downstream oil and gas assets are constantly looking for ways to improve asset performance and achieve operational excellence. With the explosion of sensing technologies that can be added to existing plants to monitor and measure everything from the smallest vibrations to temperature variations and make this information widely available over the internet (the Industrial Internet of Things – IoT) there is no shortage of ideas or options. But how do you sort through the mass of available information and sort out what to act on and what to track? How do you know what data you don't have but need, and when to spend money on expensive sensors?

This is where leveraging engineering information (ET) can really help to converge the masses of operational information (OT) and enterprise information (IT) to help make better-informed decisions about your plant and improve its performance.

This paper will examine the range of engineering technologies available from providing accurate asset management information so you know exactly assets are there, engineering models describing what the asset is designed for and capable of doing, and performance information covering how and when the asset might fail. An emerging new technology to capture “as operating” data from simple digital photography (reality modeling) will be discussed and a new proof of concept will be demonstrated that combines reality models with engineering and operational information – running on Siemens’ MindSphere platform - to show how it quickly and inexpensively one can apply this technology to improve operations and maintenance for brownfield sites.

Abstract Title: Study of FCC Reactor Using a Seven Lump Kinetic Model

Authors: **Dr. Qi Xu - Saudi Aramco, Ali Jawad - Saudi Aramco, Musaed Ghrami - Saudi Aramco, Dr. Abdennour Bourane - Saudi Aramco**

One of the powerhouses converting technologies in modern refinery is the Fluid Catalytic Cracking (FCC) process. It converts heavier feedstocks into more valuable lighter products such as gasoline or olefins. The main goal of this study is to develop a seven lump kinetic model for the reactor section of a FCC unit to enhance the understanding of the reaction dynamics along the reactor.

Because of the complexity of the real FCC reaction network, it is challenging to model the real reactor with all the molecule components that participate the reactions taking place in the FCC reactor. Lumped kinetic model has been popular in the study of FCC reactor with success due to its accuracy and its relative simplicity. Therefore, a seven lump kinetic model is developed in this study with heavy lump (H-LMP), light lump (L-LMP), gasoline lump (G-LMP), light gas lump (C-LMP), propylene, propane, and coke. One feature of the kinetic model is the inclusion of the conversion of propylene to propane in the reaction network. This enables the direct study of the propylene production. In addition, a plug flow reactor model is employed for the reactor model.

Figure 1 shows the normalized lump profiles along the reactor for a hypothetical feed to FCC unit. The feed consists of 10 percent H-LMP, 40 percent L-LMP and 50 percent G-LMP. It is shown in Figure 1 that the concentration of H-LMP, L-LMP, and G-LMP all decrease along the reactor while the concentration C-LMP, propane, and propylene all increase. G-LMP is both produced from H-LMP and L-LMP and consumed to produce lighter lumps along the reactor. The overall balance of the two mechanisms is a net consumption of the G-LMP, indicating that this case study with the specified set of parameters is better suited for propylene production rather than gasoline production. In addition, the reactor dynamics and behaviors are studied under different reactor conditions, including reactor temperature, feed variabilities, and catalyst to oil ratio. Product distribution at the exit of the reactor is also compared.

In conclusion, a newly developed seven lump kinetic model was successfully employed to study a FCC reactor unit with a plug flow reactor model. The lump profiles along the reactor were examined and explained using different reaction mechanisms. The final product distribution at the reactor exit was explained with a different catalyst to oil ratio, and under different temperatures. This study will potentially help to improve the understanding of propylene production in a FCC unit and benefit future reactor scale up.

Abstract Title: Modular Delivery for Project Execution in Existing Plants

Author: **Mike Trivunovic, Honeywell UOP**

Today’s rapidly changing energy industry presents many opportunities and challenges for developing oil & gas projects. In recent years, refiners have had a need to upgrade existing assets to meet new regulations, as well as continued growth in fuel demand. As a result, owners are faced

with the implementation of smaller brownfield projects in an efficient and timely manner while minimizing disruption to existing operations. Innovative technology, delivered in modular form, provides owners with an alternative end- to- end technology delivery solution that reduces project cycle time and cost. With more than 1,600 fully engineered and fabricated modular process units delivered to customers around the world, Honeywell UOP has successfully managed a broad range of projects enabling owners to meet these challenges. This presentation will provide brief case studies of recent successful applications of modular delivery of technology to customers. Project considerations that guide refiners toward modular execution techniques will be discussed.

Abstract Title: Optimising construction through innovation – evolving modularisation and prefabrication solutions

Author: **Dr. Damon J Hill, Wood**

In today's challenging markets, major capital investments in oil and gas need to be extremely robust and meet stringent investment risk criteria. Developing the right execution strategy is critical for the successful implementation of any project, large or small.

Part of developing the right execution strategy for mega-projects is to develop EPC solutions that increase the predictability of cost and schedule outcomes. Success in these areas provides greater certainty to the markets, improves investor confidence and demonstrates best practice management of risk.

LNG Plants with their high capital outlay and long-term offtake agreements are no different; in fact they are extreme examples of the need for an optimized project execution strategy and provide a perfect case study to demonstrate innovative thinking in delivering highly complex projects.

Wood has taken our modularization expertise, including two of the world's largest LNG mega-plants, and developed and enhanced our modularization strategies with a particular focus on improved execution predictability and risk reduction.

However, although this presentation showcases some high profile projects, we also apply this expertise across a wide range of investments, from relatively small refinery upgrades or early oil production facilities, to mutli-billion dollar mega-projects; a range of examples will be described.

In this presentation we will discuss our thinking behind modularization, how we continue to develop it and how recent projects have taken our modular concept to yet another level of providing solutions for our clients. How to maximise in-country / local content is also addressed.

Abstract Title: Yokogawa Wireless Solution contributes to competitive downstream through innovative technology

Author: **Koji Watanabe, Yokogawa**

The use of wireless technology in industrial automation systems offer a number of potential benefits, from the obvious cost reduction brought about by the elimination of wiring to the availability of better plant information, improved productivity and better asset management. However, its practical implementation faces a number of challenges: not least the present lack of a universally agreed standard. This article looks at some of these challenges and presents the approach being taken by Yokogawa.

Wireless sensor networks are currently attracting the most attention. Apart from the benefits of eliminating signal and power wiring, wireless sensor networks will open up measurement applications in sites that are hard to access, or where the wiring cost cannot be justified. They will also prove invaluable for the modernization of existing facilities, for temporary installations, or for locations where a power source is not available. Wireless sensor networks also offer

enhanced plant asset management through the freeing up of cable resources for higherpriority measurements in existing installations, the replacement of many traditional pressure gauges and temperature indicators, and the ability to make measurements that could not previously be justified. There is also a reduction in 'blind spots' through the ability to make measurements on rotating or moving equipment and in remote locations. A further important point is that, once established, wireless sensor networks are scalable: additional sensors can be added at low cost, and temporary measurements can be easily incorporated for process diagnostics and optimisation.

Yokogawa is currently in the process of developing and evaluating a number of products for wireless sensor networks, with the emphasis on redundant mesh network configurations, long battery life for field operation and a high degree of security. It is expected that wireless sensor networks will gradually be adopted by the process industry. Although ISA100.11a is designed to accommodate control applications, initially the majority of applications will be for monitoring due to battery life limitations. In existing installations the benefits are obvious. Measurements for process monitoring and condition monitoring can be added where the existing infrastructure cannot accommodate them. State of the art greenfield sites are expected to be equipped with intelligent instruments that are mostly connected through wired instrumentation systems such as Foundation Fieldbus while having several wireless networks for process and condition monitoring present.

This presentation will explain basic information of wireless benefit, Yokogawa unique key feature and variety of application examples.

Abstract Title: Cooling Water Improvement in Refinery/Petrochemical Plants

Authors: **Nishad Abdul - Saudi Aramco Mobil Refinery Co Ltd, (SAMREF), Ali Ansari - Saudi Aramco Mobil Refinery Co Ltd, (SAMREF), Hani Atiyah - Saudi Aramco Mobil Refinery Co Ltd, (SAMREF)**

Samref refinery have achieved substantial efficiency improvement through a systematic approach of improvement in cooling water system. We have addressed systematic approach for finding out leaking exchangers to cooling water which has been a chronic issues in Samref similar to other refineries and petrochemical plants.

Samref cooling water system has a capacity of 30,000 m3/hr with a heat duty of 600MW serving 21 PHEs, the approach temperature before the implementation of improvements was around 9-8degC whereas, after partial execution improvement plans (upgrading of PHE is partially completed), the approach is 5-6degC and expected after full implementation is 3degC.

The following were the major steps taken during the improvement program

Developed a systematic approach to identify leaking sources to cooling water Developed strategies for periodic chemical cleaning of Plate Heat Exchangers Upgrade the Plate Heat Exchanger to more efficient type Strategies to maintain water quality parameters such as turbidity, iron content etc. Cleaning of cooling water system to remove debris and to make system hydraulically robust.

Therefore this topic mainly talks about the major opportunities that every process industry can look in to gain substantial improvements in their cooling system. Most of the cases, this will bring very high margin gain to the industry along with a high reliability to the exchangers, pumps, compressors which uses the cooling water.

Abstract Title: How Big Data Can Drive Operational Excellence

Author: **Katherine Jones, Honeywell UOP**

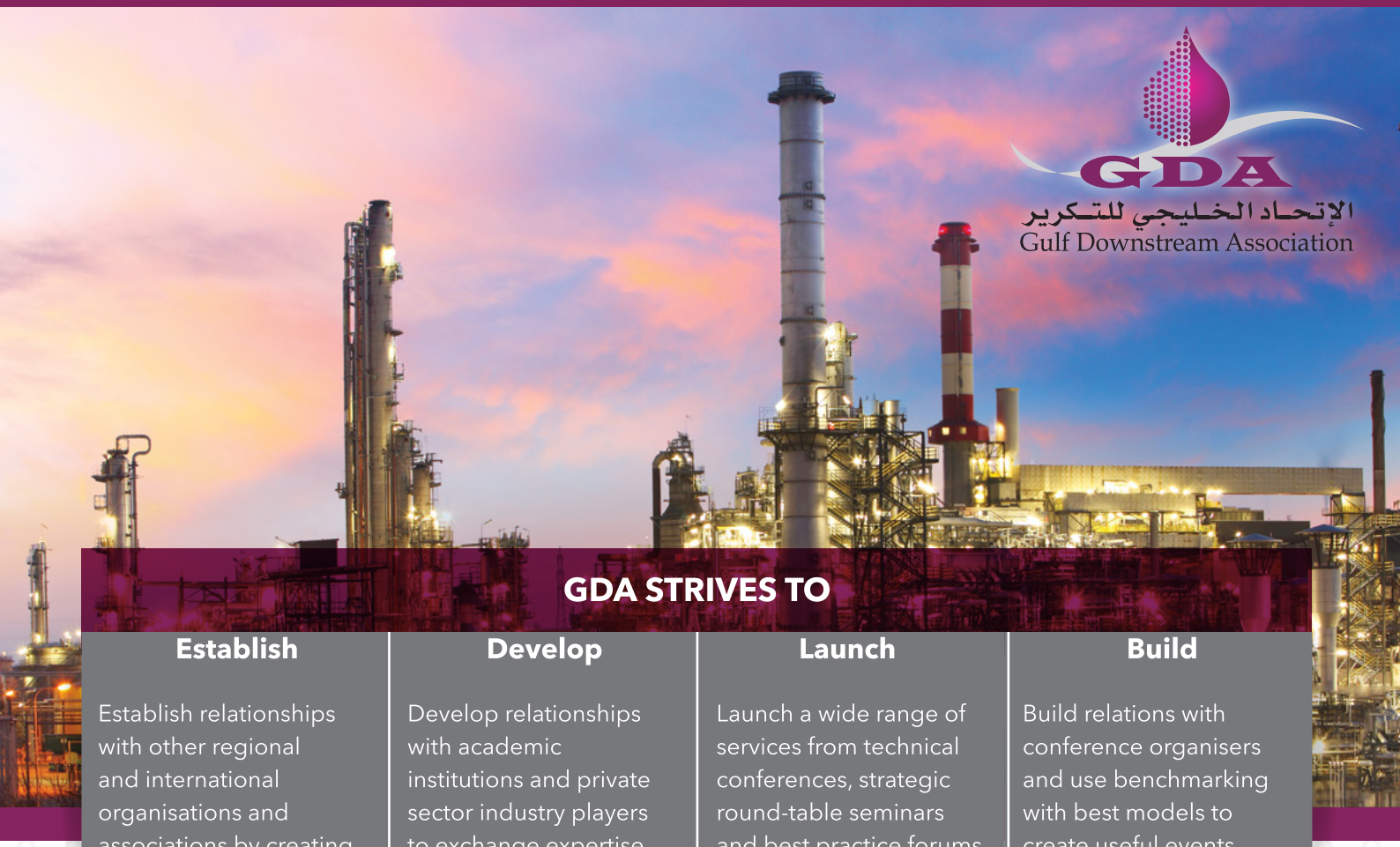
In an increasingly competitive environment, asset utilization has become a critical area of focus. Operators of Refining and Petrochemical processes are

challenged to find the best-operating conditions to meet targets and maximize profits even as conditions outside of your control change. The complexity

of this problem is greatly enhanced when considering asset utilization across a complex, such as an Aromatics or Naphtha Complex, due to process and energy integration, not to mention human capital challenges.

Many Refining and Petrochemical producers are looking to technology and software to address this challenge in a sustainable way. Honeywell UOP is in a unique position with Connected Process Insights, which is a family of cloud-based services that delivers on-going UOP insights and recommendations directly to the right person from the unit engineer to owner at the refinery or petrochemical plant. One solution is a Process Optimization Advisor, which continuously analyzes an entire complex and identifies the optimal operation based on current economic information and leveraging detailed tuned process models, fed by current plant data. Recommendations are then communicated to users by both the economic impact and the appropriate operational changes to reach the optimal.

In this presentation, UOP will discuss how the Process Optimization Advisor works including how an early user has used the Process Optimization Advisor to debottleneck operations in order to push throughput and therefore maximize profitability.



GDA
الإتحاد الخليجي للتكرير
Gulf Downstream Association

GDA STRIVES TO

Establish

Establish relationships with other regional and international organisations and associations by creating alliances.

Develop

Develop relationships with academic institutions and private sector industry players to exchange expertise, promote research and align sector needs.

Launch

Launch a wide range of services from technical conferences, strategic round-table seminars and best practice forums.

Build

Build relations with conference organisers and use benchmarking with best models to create useful events.

The Gulf Downstream Association (GDA) is established by its founding companies from Saudi Aramco, Kuwait Petroleum International (KPI), Bahrain Petroleum Company (BAPCO), Kuwait National Petroleum Company (KNPC) and Abu Dhabi National Oil Company (ADNOC). The GDA is a non-profit organisation which aims to bring leading Downstream players together to further develop the industry and draw mutual benefits from sharing knowledge and best practices.

GDA's vision is to become an internationally recognised association that serves as a catalyst for the strong and sustainable growth of the Downstream industry.

GDA's mission is to provide a platform for sharing knowledge, experience and best practices. This will be achieved by becoming a premier association in the region that connects the Downstream companies, service providers, governmental organisations, and academic institutions.

OUR CORE VALUES

Collaborate and network to promote knowledge sharing
Provide high quality services with best values
Promote innovation and continuous development
Foster excellence in all activities
Support and champion sustainability as a priority
Strive to be a respected institution driving the industry

OUR FOUNDING COMPANIES

أرامكو السعودية
saudi aramco

Q8

بابكو
Bapco

البترول الوطنية
KNPC

أدنوك
ADNOC

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