EPC Operations Committee Meeting Minutes

Time: 2:00 – 3:00 pm
Date: 11-9-21
Location: virtual
Attendance:

Patty Summers (Zeochem)
Jenny Heinlein (Dow)
David Dutschmann (ExxonMobil)
Richard Rolke (Dow)
John Dillon (Dow)
Ali Abbaspour (UOP)
Dan Euhus (ShinTech)
Tho Tran (Ineos)
Vik Balasubramanian (Linde)

Agenda:

- Anti-Trust statement – Patty
- Update on 2022 Conference (April 10 – 14, San Antonio, TX)
- Update on abstracts – review of abstracts

Anti-Trust Statement:
"No activity of the Committee shall involve the exchange, collection or dissemination of information among competitors for the purpose of bringing about or attempting to bring about any understanding or agreement, written or oral, formal or informal, express or implied, among competitors with regard to costs, prices or pricing methods, terms or conditions of sale, distribution, production quotas or other limitations, on either the timing, or volume of production, or sales, or allocation of territories or customers."

Meeting Minutes

Main Committee:
No update. Other than the **call for papers has been extended until Nov 30**. Some committees have reported that companies are reluctant to spend time working on a paper for the conference given there is the possibility it will again be virtual. It's a lot of work with less "reward" for the speaker if it is recorded and not delivered in person to an audience.

Papers Discussion:

Summary: Nine abstracts were reviewed/discussed. – 6 papers as Yes/Maybe

1. Hold spot – YES
2. YES
3. LIKELY YES
4. MAYBE BUT HOLD FOR NOW
5. PASS TO DIGITAL SESSION
6. PASS TO DIGITAL SESSION
7. HOLD. KEEP IN RESERVE UNTIL WE SEE WHERE WE END UP
8. YES

9. PASS

Paper 1. ExxonMobil: use of simulators for training and preparing for start-up – David says this is still on track. The abstract is written and has now been submitted to legal for approval. We should be able to count on this one. Sponsor: David Dutschman – HOLD SPOT

Paper 2. Revamp of YNCC No. 2 Ethylene Plant, large plant expansion/revamp – abstract is a good one and should be uploaded to our subcommittee's Operations Session. Sponsor: Miguel Moldonado Miguel to follow up. KEEP

Muhammad Imran, Lead Process Engineer, Technip Energies Process Technology, Chang-Seok Park, Process Manager, Yeochun NCC Co. Ltd., etc

Abstract: Yeochun NCC Co., Ltd (YNCC) Ethylene Plant No. 2 is located near Yeochun, Korea. The plant No. 2 ethylene technology was licensed by Technip Energies Process Technology (formerly Stone and Webster) in 1992. The original capacity of this plant was 350 KTA of polymer grade ethylene with the equipment designed for capacity of 450 KTA (based on 8,000 operating hours per year). YNCC#2 revamped plant on various occasions to 543 KTA. In 2009 Technip Energies Process Technology performed a feasibility study to identify the bottlenecks and required scope of modifications. The objective was to increase the operating capacity of the plant from 543 KTA to 859 KTA. In 2018, YNCC decided to implement 859 KTA expansion and contracted Technip Energies Process Technology to provide Basic Engineering Package (BEP) and Ethylene Technology Licensing for the planned capacity, as well as efficiency increase for YNCC No. 2 Ethylene Plant. This important plant revamp had many challenges due to the large capacity increase of ~160% from the current capacity.

This paper will discuss the various revamp techniques and construction challenges in this large capacity increase. Few examples are:

- Addition of two 192U furnaces and a gas turbine on a tight plot space.
- All three major compressors (Cracked Gas, Ethylene Refrigeration and Propylene Refrigeration) had a foot print replacement on the same foundation.
- High capacity trays were used in many towers.
- Parallel towers were added for few services where required capacity increase was beyond capacity limit of the high capacity trays.
- Efforts were done to minimize the parallel equipment addition due to the limited availability of the plot space. Many equipment were therefore replaced on the same foundation instead of adding a parallel equipment.

YNCC along with its construction partners Daelim and Hanwha successfully completed the construction in December 2020 and plant was started up and achieved the targeted ethylene production in January 2021.

Paper 3. id# 639184: Promising Chemical Treatment Approach for 1,3-Butadiene Fouling – entered into the website – looks good. Happy it has a producing partner. Sponsor: Jenny KEEP, LIKELY YES

Henrique Silva1, Tatiana Barbosa2, Fabio Rios3, Williane Carneiro3 and Zaelma Matos4, (1)Customer Application Engineering, Suez Water Technologies & Solutions, Cotia, SP, Brazil, (2)SUEZ Water

Technologies & Solutions, Camacari, Brazil, (3)Braskem S. A., Camacari, Brazil, (4)Braskem S.A., Camaçari, Brazil

At Braskem's Camaçari site, in a Nippon Zeon design plant, 1,3-butadiene is produced by extractive distillation with dimethylformamide (DMF) used as solvent. Since longer campaigns have been desired, the treatment of the extraction section has become more challenging, especially due to its historical issues with widespread polymerization at the bottoms of extractive towers.

This paper recaps the general mechanisms involving fouling on butadiene extraction and how SUEZ and Braskem are working together to control severe fouling on the system with a promising inhibition chemical program currently used. Then some positive preliminaries results will be shown.

This process is featured by high temperature at the bottoms of the extractive distillation towers. Hence, this environment is severe enough to easily foul rubber and sheet forms of polybutadiene on economizers, reboilers and on tower's chimney trays. OH-TEMPO chemical additive is commonly used in this system with the function of inhibit this phenomenon, but for large runs purposes this approach may be not enough. To improve inhibition efficiency, a new synergic blend of OH-TEMPO with a specific antioxidant has been used covering critical areas of the process and responding better than the previous chemical used.

Paper 4. id# 639298: Benchmarking Study of Caustic Tower Operation and New Analytical Method for Red Oil Polymer Looks like no producing partner. Some interest but may not want 2 Suez papers. Sponsor: Patty & Dan: MAYBE BUT HOLD FOR NOW

Joop Dees, Customer Application Engineering, SUEZ Water Technologies & Solutions, 's Heer Arendskerke, Zeeland, Netherlands and Steven Imbert, SUEZ Water Technologies & Solutions, Herentals, Belgium

Process streams in ethylene units contains acid gases, like carbon dioxide and hydrogen sulfide, as a result of cracking and coking/decoking reactions in the furnaces. The acid gases are typically removed in the caustic tower, which is integrated into the charge gas compressor. Other components, like aldehydes and ketones, are present as contaminants in the cracked gases and can polymerize under basic conditions to form aldol condensation polymer. The polymer can deposit on the internals of the caustic column and in the downstream spent caustic process like tankage, caustic stripper and/or wet air oxidizer. The fouling can have a huge impact on the overall plant performance.

The fouling has a significant effect on the efficiency and reliability of the caustic column operation and is heavily affected by operational process parameters. A global benchmarking study identified the most important parameters such as temperature profiles, caustic strengths, and aldehyde content. The process conditions were then simulated in the laboratory to better quantify their impact on polymer formation.

A new analytical method was also developed for quantifying the red oil polymer during the laboratory work and the results favorably compared with the traditional manpower-intensive analytical method (polymer extraction with solvent). The new method has now been deployed to the field, where it reduces the analysis time from several hours to minutes and has shown to be very accurate.

Paper 5. T4 639562: Aligning Ethylene Plant Production Planning with Online Optimization Seems a better fit for the Digital Session. Richard to pass it to them. PASS

Ethylene producers are continuously faced with the challenge of reducing margin leakage that occurs between various levels of production execution — from production planning to real-time operations. This challenge arises from misalignment in models, assumptions or actual constraints that may occur over time across the layers of planning and operations. The units across the entire ethylene production process may not be running at their collective optimal to meet ambitious plans, even though individual process units may be pushed to their specific constraints by their respective APC applications. As the planning layer is optimized it is key to align the business process down below all the way to operations. Gaps may arise from slow or inaccurate information flow which leads to margin leakage. Also information about changing asset conditions from the operational layer needs to flow back up to planning. Lack of such information flow on a timely basis hinders the decision agility needed to close the gap between these layers.

AspenTech's General Dynamic Optimization Technology, Aspen GDOT™ addresses this long-standing issue by using an innovative modeling and optimization approach that combines fundamental planning models with dynamic APC models. This results in the ability to have consistent models, economics and objectives between offline planning and online optimization that ensures best site-wide economic results consistently and on a minute-by-minute basis. Plants can also boost production agility and responsiveness by giving planners a more accurate view of current process conditions and constraints via feedback on updated model parameters from GDOT. GDOT directly inherits APC models & can immediately adjust to any changes in the APC layer.

While real-time optimization applications for ethylene have existed for a long time, sustaining benefits from these applications has been a challenge and required significant process simulation experience. Aspen GDOT™ is designed to be run and maintained by APC engineers, making it significantly easier to adopt and sustain. Join us in this session for an overview of the technology and how it can benefit your ethylene production sites.

Tushar Singh
Email: tushar.singh@aspentech.com -- Will not be published
AspenTech
Sr. Product Manager, Dynamic Optimization
Houston TX
USA

Paper 6. T4 639593: Digital Twin for Efficiently Addressing Plant Operational Challenges Better fit in the digital session. Richard to pass it along. PASS

The Chemical and Refinery Processing Industry has made very good use of 'High Fidelity' simulators – 'Digital Twins', utilizing the rapidly improving computational capability to develop first-principles based models of various process operations. One of the best examples of such simulators are the Operating Training Simulators, which have proved to be a valuable resource for training of operations personnel, but most importantly also to trouble-shoot deviations.

There are many operations in an Ethylene plant that 'Digital Twins' can serve as a valuable enabling tool to ensure, safe, reliable and cost-effective performance and deliver expected business performance.

Use-cases involving 'Hot End' of the Cracking Process, as well as the Separation Train will be presented.

First Presenting Author
Presenting Author

Review
Raghu Narayan
Email: rnarayan@ingenero.com -- Will not be published
Alternate Email: rnarayan@ingenero.com -- Will not be published

Ingenero Inc.
Houston TX
USA

Paper 7. T4 639372: Increasing Butadiene Unit Run-Length and Reliability with Advanced Antifoulant Technology Nice abstract, however, potentially too much on butadiene given the Suez/Braskem paper. Sponsor: Patty/Dan HOLD. KEEP IN RESERVE UNTIL WE SEE WHERE WE END UP

In recent years, ethylene producers have made significant progress to reduce costs and increase productivity by increasing the time between plant turnarounds. This is increasing the need for improved run-length and reliability of the butadiene section of the olefins complex. Fouling control in the extraction section of the butadiene process is one of the most important challenges limiting run-length and reliability.

This paper discusses the fouling mechanisms in the extraction section and the challenges faced by butadiene producers to control fouling. Best practices and case studies are presented that show how improved fouling control can increase run length and reduce maintenance & energy costs. One case history focuses on improving control of stripper column pressure drop. The second case history discusses how pump strainer cleaning frequency can be improved with better fouling control and how this improvement is correlated with performance of the recovery heat exchanger and stripper reboiler. In both cases, improvements in monitoring and control of fouling provided the olefins complex with better predictability of planned outages.

First Presenting Author
Presenting Author
Review
Joice Boll
Email: joice@dorfketal.com -- Will not be published
DORF KETAL
Global Technical Support
Technical Support Manager
Rua da Pedreira 559
Nova Santa Rita RS 92480-000
Brazil

Paper 8. T4 639321: CO2 Reduction for Steam Cracking Furnaces By Full Hydrogen Firing – This paper was offered to us by the Fundamentals Technology session and we agreed we liked it. Patty will let Jack Bueler know that we are interested in it being transferred to our session. Sponsor: Ali. Ali to let author know we have accepted it as soon as we see the transfer. YES

Abstract: When firing fuel gas as generated within the cracker, the steam cracking furnaces emit about 90 to 95 percent of the plant's total CO_2 emissions. One option to reduce CO_2 emissions from the

cracking furnaces is to increase the hydrogen content in the fuel gas. By switching to firing 98 vol.% hydrogen fuel gas, CO_2 emissions from the furnace stack can be reduced by about 95 percent for liquid crackers (typically 10 vol.% H_2 in fuel gas) to 85 percent for ethane crackers (typically 85 vol.% H_2 in fuel gas).

Due to the difference in fuel gas characteristics when moving to firing high hydrogen content fuel gas the flue gas mass flowrate decreases, the firebox efficiency increases, the heat load into the furnace convection section decreases and the adiabatic flame temperature increases. When revamping existing furnaces, next to the adequacy of the firing system, there will be consequences on the furnace run length and superheated high pressure steam production and the revamp strategy needs to be adopted accordingly.

This paper discusses the design considerations when firing high hydrogen content fuel gas. The effect on the cracking furnace performance such as run length and SHP steam production, will be further explored and the adequacy and considerations on the convection section will be discussed. In addition, the impact on the burner design will be touched upon. Technip Energies is developing and testing burners suitable for hydrogen firing. The results from both the large capacity LSV® bottom burner and side wall TSWB® burner firing full hydrogen are presented.

First Presenting Author
Presenting Author
Review
Jelle-Gerard Wijnja
Email: jelle-gerard.wijnja@technipenergies.com -- Will not be published

Membership Number: 009905781722
Technip Energies
Technology Manager Ethylene Furnaces
Afrikaweg 30
Zoetermeer No State 2700 AB
Netherlands

<u>Paper 9. T4 639097: Effect of Analytical Precision on Cracking Yield Modeling: A Monte Carlo Approach</u>

We agreed that this paper is not a good fit for our session and would perhaps fit better in the feedstock session. As this was offered to us by the Fundamentals Technology session, Patty will advise them we appreciate the offer, but are not interested in this one. PASS

Abstract: Ethylene and propylene are predominantly produced by means of steam cracking. In steam cracking, a hydrocarbon feedstock is mixed in a well-defined ratio with dilution steam and heated to temperatures typically between 800 °C and 860 °C. Due to the thermal energy, the feedstock reacts and forms mainly the products ethylene and propylene but depending on the feedstock, also other molecules can be formed. While some regions (e.g. Saudi Arabia) use predominantly gaseous feedstocks like ethane and propane, liquid refinery streams like naphtha are the main feedstocks in Europe. Unlike ethane and propane, the composition of naphtha varies over a wide range of hydrocarbon molecules, which has an important impact on the products and hence on the profitability of the feedstock. Consequently, price and yields expected from a determined feedstock constitute the most important parameters in deciding whether a feedstock should be purchased.

To determine the product slate of naphthas, typically it is sufficient to supply basic parameters such as, but not limited to, the boiling point curve, density and the amounts of normal paraffins, iso-paraffins,

naphthenes and aromatics. These can be used in steam cracker models to predict the cracking yields at different operating conditions

There are different sources of error. The first one is introduced from the modeling itself. Due to a variety of reasons, there will always be an error between the modeled cracking yields and the true cracking yields achieved in the plant. Directionally the yields should match reality sufficiently well to be able to evaluate the profitability of the feedstock. The second source of error is introduced with the precision and accuracy of the analytical results, which are used as an input to the models. This analytical error can be either a bias or a random error. Biased results would always lead to over or under predicting of cracking yields. Consequently, the respective models can be tuned to minimize the effect of the (unknown) bias in the results. The random analytical error is usually a normally distributed deviation of the measured result from the measured mean value. This type of error cannot be removed by model tuning. Still it is important to know the impact of it on the results, to be able to determine if the difference in economic value of two different feedstock is statistically significant. Therefore, this study focuses on the impact of this random error on cracking yields.

Random error can come from a variety of sources such as sampling, the analysis itself or the lab where the analysis is performed. For most lab analyses standard methods are applied, for which the theoretical precision (expressed as reproducibility) is typically known. In this work, an investigation is performed on how yield modeling is impacted by the precision of the analytical methods themselves and by the overall precision of the results using a Monte Carlo approach.

To avoid running the computational-intensive, steam-cracking models a simple statistical model was built. This model is based on the basic input parameters to calculate the yields of naphthas . To avoid the effect of correlation between these basic input parameters, principle components were used in the linear regression model rather than the basic input parameters themselves.

With the statistical model, each basic input factor was varied according to the determined precision of the standard method. The corresponding yields have been calculated for several thousand combinations within less than a second. The results clearly show the importance of knowing the error that is introduced due to the analytical precision when comparing different naphthas among each other.

Next Meeting: Tuesday, November 30, 2022 2:30pm – 3:30pm VIRTUAL