ETHYLENE PRODUCERS' TECHNICAL SUBCOMMITTEE MEETING

Date: Thursday, Sept 24, 2015,
Time: 4:30 to 5:30 PM CDT

DRAFT

Location: Doubletree by Hilton Hotel Houston, TX

Members: Jack Buehler, Chell Chellappan, Alain Chepda, Greg Dunnells, Thomas Emmert, Sanjeev Kapur, Robert Krinock, Aivars Krumins, Ravi Lal, Darren Le Geyt, Krishna Merchant , Alberto Morales, Mike Tallman, Greg Yeo, Tim Zygula, Bala Devakottai, Anthony Hakim

Present: Jack Buehler, Alain Chepda, Chell Chellappan, Thomas Emmert, Sanjeev Kapur, Robert Krinock, Aivars Krumins, Ravi Lal, Darren Le Geyt, Mike Tallman, Tim Zygula, Greg Yeo, Bala Devakottai, Anthony Hakim

Absent: Greg Dunnells, Krishna Merchant, Alberto Morales (tried to call in)

Other: Rick Prickett has left the sub committee
Distr: Above + ethyleneproducerscommittee@gmail.com

AGENDA

I. Reading of the Anti-Trust Statement

No activity of the Committee shall involve the exchange, collection or dissemination among competitors of information, or be used 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.

II. Five Minutes on Safety

III. Approval of Previous Meeting Minutes –Aug 13, 2015

IV. Session Planning Status –

a. Report from Main EPC: (5 min)

b. New Subcommittee Member Guidelines: Greg Yeo (10 min)

c. Technology Fundamentals: Jack Buehler / Bob Krinock (10 min)

d. Feedstock Flexibility: Akllain Chepda / Thomas Emmert (10 min)

e. Mega Projects: Sanjeev Kapur (5 min)

f. Other Joint/Co-Sessions (5 min):
1. MACT ?:
2. Separations ?: Greg Yeo

V. New business (5 min)

VI. Calendar for 2015 – 2016 - Upcoming Meeting Date Reminders:

* 29 October
* 10 December

* 4 February (if needed)
* Call for papers closes 2 November (may be extended) and Sessions should be final early December.
* 2016 AIChE Spring Meeting / EPC Conference dates are 10-14 April 2016. Hilton Americas & George R. Brown Convention Center, Houston, TX

VII. Review Action Item List

VIII. Adjourn

Sept 24 Mtg.

I. Reading of the Anti-Trust Statement

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II. Five Minutes on Safety:

Discussed driver awareness with school being in session now. Kids run out everywhere. Accident in which car was "T-boned" at a intersection, and a recent tragic accident in which the driver was considered as being over-medicated.

III. Approval of Previous Mtg Minutes

The Aug 13, 2015 meeting minutes were accepted & approved.

IV. 2016 EPC Conference Planning

- **Membership –** Anthony Hakim from Ineos, and Bala Devakottai from CP Chem both attended for the 1st time. Bala is replacing Rick Prickett who recently retired from EPC committee activities.

Greg discussed the new member guideline document. The most relevant section being the following…

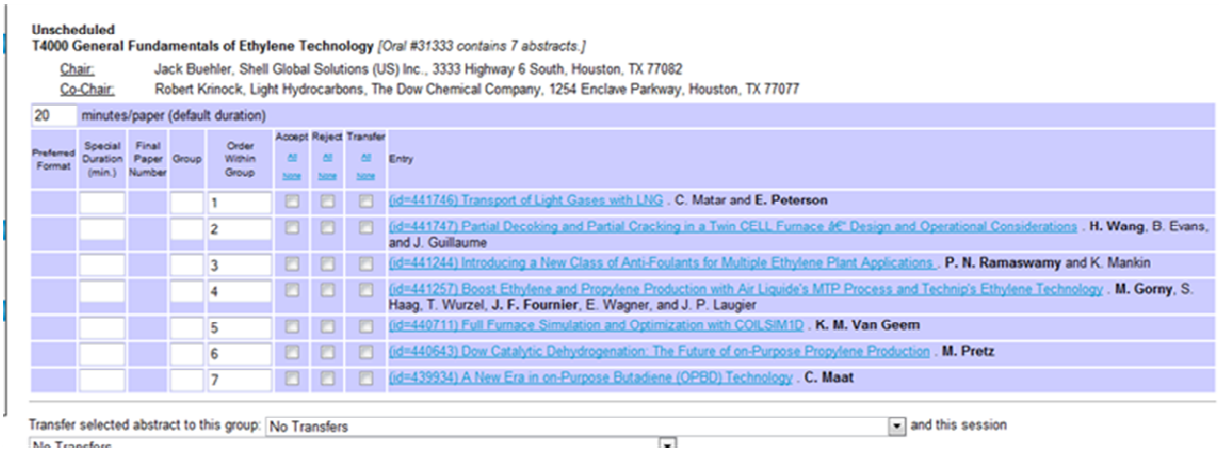
Subcommittee Governance:

1. Subcommittees may create written Operating Rules. Subcommittee Operating Rules must be reviewed by the EPC Nominating Committee and approved by the EPC prior to implementation.
2. Operating Rules may include limitations on Subcommittee membership. In the absence of written Operating Rules, Subcommittee membership shall be governed by a process similar to that described in the EPC Bylaws for Committee membership:
    a. Candidates in the employ of Ethylene Producers and licensors of ethylene producing technology shall be nominated by the EPC member employed by that company.
    b. Candidates in the employ of other companies, including consultants, shall be nominated by a Subcommittee member. These candidates shall be accepted for membership by vote of a simple majority at a regularly scheduled Subcommittee meeting.
    c. Subcommittee member composition shall be consistent with the intent of the bylaws governing the EPC, with not less than 50% of members employed by Ethylene Producers.

It was discussed to determine our current balance of members and to plan on voting on possible new members at the next mtg,

- **Fundamentals Session Paper ideas** - Jack B./Bob K

  Jack reviewed our spreadsheet with 5 likely papers. We now have 7 papers with abstracts. A copy of all abstracts (as of Oct 15, 2015) in the Fundamentals of Technology Session is attached at the end of the minutes.



Unscheduled
T4000 General Fundamentals of Ethylene Technology *[Oral #31333 contains 7 abstracts.]*

Chair: Jack Buehler, Shell Global Solutions (US) Inc., 3333 Highway 6 South, Houston, TX 77082
Co-Chair: Robert Krinock, Light Hydrocarbons, The Dow Chemical Company, 1254 Enclave Parkway, Houston, TX 77077

20 minutes/paper (default duration)

Preferred Format	Special Duration (min.)	Final Paper Number	Group	Order Within Group	Accept All / none	Reject All / none	Transfer All / none	Entry
				1				(id=441746) Transport of Light Gases with LNG . C. Matar and **E. Peterson**
				2				(id=441747) Partial Decoking and Partial Cracking in a Twin CELL Furnace â€" Design and Operational Considerations . **H. Wang**, B. Evans, and J. Guillaume
				3				(id=441244) Introducing a New Class of Anti-Foulants for Multiple Ethylene Plant Applications . **P. N. Ramaswamy** and K. Mankin
				4				(id=441257) Boost Ethylene and Propylene Production with Air Liquide's MTP Process and Technip's Ethylene Technology . **M. Gorny**, S. Haag, T. Wurzel, **J. F. Fournier**, E. Wagner, and J. P. Laugier
				5				(id=440711) Full Furnace Simulation and Optimization with COILSIM1D . **K. M. Van Geem**
				6				(id=440643) Dow Catalytic Dehydrogenation: The Future of on-Purpose Propylene Production . **M. Pretz**
				7				(id=439934) A New Era in on-Purpose Butadiene (OPBD) Technology . **C. Maat**

Transfer selected abstract to this group: No Transfers and this session

- **Possible Joint sessions with other subcommittees**

  Feedstock Flexibility – Alain Chepda & Thomas Emmert.

  Have 4 papers in hand (Solomon, Nova/KBR, C2 Splitter, CB&I), & possible commitments for 3 more (BASF, Linde, Technip). Some discussion on giving direction to the different papers so that a wide range of topics is covered.

  Mega Projects – Sanjeev Kapur

  The session will likely be Monday afternoon after the EPC keynote address (by CP Chem?). Three companies (Linde, Fluor, Technip) have shown an interest in presenting, still waiting on responses from KBR & Bechtel. If Solomon presents would they be too generic? (Thomas to work with Sanjeev?)

  MACT Session– Greg Y.

  Environmental will have something related to MACT, Greg will help them.

  Other Sessions/Ideas
  Greg still investigating

VII. TSC – New members topic

VIII. Calendar for 2015 – 2016 - Upcoming Meeting Date Reminders:

Planned future mtg dates are as follows:

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X. Review Action Item List

a. Jack has identified most follow-ups in his spreadsheet, additional items
b. Bala to follow up on Nicholas Graham at CP Chem on any topic

XI. Adjourn

Next Mtg Oct 29, 2015

Minutes prepared by RJ Krinock (Technology Subcommittee Chair) – Oct 15, 2015

General Fundamentals of Ethylene Technology

Abstract id# 441746
Transport of Light Gases with LNG

Charles Matar and **Edward Peterson**, Agility Gas Technologies, Park Ridge, NJ
Abstract Text:
Transport of Light Gases with LNG

Abstract

The Liquefied Natural Gas (LNG) industry is well established and growing. Recently depressed Natural Gas prices have encouraged several companies to build or plan LNG export terminals. The USA and other regions around the world have low cost ethylene and ethane available as well as LNG they export or are getting ready to export. Agility Gas has patents pending to co-transport LNG and high value gases including ethane and ethylene. These normally gaseous high value hydrocarbons can be easily transported as a liquid blend with LNG or as separate pure components that are kept cold by LNG. Blends can be separated into pure components at the receiving terminal. Pure components require no separation. Using well-established LNG transport technology, co-transport of light gases as liquids opens

new markets to these valuable light gases. Use of existing infrastructure and transport vessels with slight modifications allow faster implementation with minimal capital expenditure yielding higher returns.

Abstract id# 441747
Partial Decoking and Partial Cracking in a Twin CELL Furnace â€“ Design and Operational Considerations

Harry Wang[1], Bruce Evans[1] and Joel Guillaume[2], (1)Process Engineering, Technip USA, Inc., Claremont, CA, (2)Technip Stone & Webster Process Technology, Houston, TX
Abstract Text:
PARTIAL DECOKING AND PARTIAL CRACKING IN A TWIN CELL FURNACE – DESIGN AND OPERATIONAL CONSIDERATIONS Harry Wang

Senior Process Supervisor

Technip Stone & Webster Process Technology, Claremont, CA

Joel Guillaume

Ethylene Technology Manager

Technip Stone & Webster Process Technology, Houston, TX

Bruce Evans

Director of Pyrolysis Technology

Technip Stone & Webster Process Technology, Claremont, CA

Abstract: Cracking furnaces are the heart of the ethylene plant. Ethylene producers purchase various feed stocks ranging from “Gas” feeds to “Liquid” feeds and up to “Heavy Liquid” feeds. Economically, it is important to minimize the number of furnaces in the design of a modern ethylene plant, to have multiple feedstock flexibility and also to have partial decoking and partial cracking features in the twin cell furnace design.

Co-cracking or blended cracking is often used to handle two or more feed stocks in a single furnace. Segregated or “hybrid” cracking (two or more feeds cracked separately in a single cell or in a twin cell furnace) becomes important in modern furnace design for achieving feedstock flexibility while maintaining furnace availability, when it is desired to crack each feed at a specific conversion or severity. In addition, due to the large capacity of modern twin cell furnace, it is also essential to consider to decoking in one cell and normal cracking in another cell in the same twin cell furnace to increase furnace availability.

In 2011, Technip presented a paper in AIChE Spring Meeting (EPC Conference, Paper Number 96E) titled “Co-cracking vs Hybrid (Segregated) Cracking in Individual Furnace – Design and Operational Considerations”. This abstract is a continuation (Part 2) of the paper presented in 2011.

Simulation of decoking and cracking in a twin cell furnace is another major step advance the simulation of hybrid cracking or co-cracking in an individual furnace. A significant challenge in the design of decoking and cracking in the twin cell cracking furnaces is how to properly simulate the complete furnace performance due to several times difference in the furnace fired duty from each cell, large difference in flue gas mass flow from each cell as well as large difference in bridge wall temperature from each cell. In addition to the radiant coils, simulation of furnace firing, flue gas mixing and process convection banks present a significant challenge. Convergence of the simulation of the complete system presents a big challenge for such a complicated system. How to control the crossover temperature in the decoking cell

during this operation is a real challenge. Material selection of convection process bank in decoking cell is also to be carefully evaluated. For decoking and cracking in the same twin cell furnace, a new cracking furnace model has been developed by Technip called SPLIT-MIXING to simulate decoking and cracking using an integrated EFPS (firebox and radiant section) model and PROVISION (heat exchanger) software. In addition, Technip has recently developed a new generation furnace simulation software: SPYRO® Suite 7, and this tool is able to rigorously simulate decoking and cracking in the same twin cell furnace in a single converged SPYRO® Suite 7 file.

Computer Fluid Dynamics is also discussed in this paper for decoking and cracking in a twin cell furnace.

Abstract id# 441244
Introducing a New Class of Anti-Foulants for Multiple Ethylene Plant Applications

P.N. Ramaswamy, Dorf Ketal, Houston, TX and Kyle Mankin, Dorf Ketal Chemicals LLC, Houston, TX
Abstract Text:
The process of steam cracking various feedstocks for the production of ethylene invariably produces a large number of minor undesirable byproducts. While these byproducts are not large in volume, they are substantial in number and in the amount of operational problems they can cause over a long period of time. Particularly harmful are components like styrene, indene, butadiene, and others that are subject to self-initiated free radical polymerization. Left untreated, they can cause significant buildup of polymer in primary-fractionators, compressor systems, and in downstream distillation. Conventional control agents continue to have excessive polymerization problems due to temperature limitations and the aggressive nature of the reactive monomers in question.

An entirely new class of anti-foulants addresses the most serious issues routinely seen in ethylene plants. The new chemistry uses a unique approach to interrupt the free radical polymerization process in the earliest steps, thus slowing the rate of polymer buildup. In addition, this new class of anti-foulants remain effective at elevated process temperatures. This paper will discuss all the areas within an ethylene plant where such kinds fouling are an issue and present best practices for control. Several commercial plant case studies will be shared to demonstrate these findings.

Abstract id# 441257
Boost Ethylene and Propylene Production with Air Liquide's MTP Process and Technip's Ethylene Technology

Martin Gorny, Air Liquide Global E&C Solutions, Frankfurt, Germany, Stéphane Haag, Air Liquide Research and Development, Frankfurt, Germany, Thomas Wurzel, AIR LIQUIDE GLOBAL E&C SOLUTIONS, Frankfurt, Germany, **Jean-Francois Fournier**, Technip Stone & Webster Process Technology, Claremont, CA, Eric Wagner, Technip Stone & Webster Process Technology, Inc., Claremont, CA and Jean-Paul Laugier, Technip, Paris, France
Abstract Text:
In recent years, the steam cracker industry has moved to lighter feedstocks. In particular, a significant number of steam crackers in the US have been revamped to switch to ethane feedstock, thereby reducing the propylene production. As a result, olefin producers must find new ways to restore the balance between the ethylene and propylene products. Conversion of methanol to propylene via Lurgi MTP™ from Air Liquide is one of the proven technologies available for on-purpose propylene production. Up to now, Air Liquide MTP™ plants have been designed and installed as stand-alone units. Air Liquide and Technip are currently proposing a new design approach, which combines an MTP plant and a steam cracker unit. Compared to a stand-alone MTP plant and a stand-alone ethane cracker, the integration of the two units boosts the overall ethylene and propylene production by 5 to 10%, depending of the site configuration. The proposed integration is flexible and can be applied to both existing steam crackers as well as grass-root plants.

Abstract id# 440711
Full Furnace Simulation and Optimization with COILSIM1D

Kevin M. Van Geem, Laboratory for Chemical Technology, Ghent University, Ghent, Belgium
Abstract Text:
COILSIM1D is the result of more than 40 years of expertise of the Laboratory for Chemical Technology (LCT) in independent research and modeling of thermal cracking reactions. The kinetic model incorporated in COILSIM1D is the broadest and most accurate reaction network for steam cracking of hydrocarbons. The kinetic model has been recently updated and validated based on more than 1000 different pilot plant data points. Among others, the effect of typical oxygenated impurities can be accounted for.

COILSIM1D also comes with a fast feedstock reconstruction method that allows reconstructing the composition of naphtha's, kerosenes, gasoils and vacuum gasoils based on their commercial indices. The combination of the feedstock reconstruction method with COILSIM1D allows to obtain accurate simulation results and provides a valuable tool to take optimal advantage of feedstock flexibility.

COILSIM1D incorporates a TLE simulation module that enables users to carry out simulations using different boundary conditions:

- Specific mass flow of water
- Specific steam quality
- Full thermosyphon simulation

A specific model for the deposition of condensation coke is implemented for the TLE next to the specific coke deposition models for gaseous and liquid feeds in the reactor section. This provides users with a very accurate tool for the estimation of run length based on their intrinsic fouling tendency.

In its latest release, several essential additions to COILSIM1D have been implemented. It now simulates both the radiant and convection sections of a cracking furnace, allowing users to estimate process parameters of interest:

- Flue gas temperature
- Utility steam production

COILSIM1D supports different tube bundle arrangements in the convection section and allows users to customize the fuel gas composition.

These new additions can further boost the profitability of steam crackers by maximizing yields and optimizing the process, using highly accurate furnace simulations for a broad range of feedstocks, reactor geometries and operating conditions. Results of an extensive evaluation of one of the largest olefin producers using real plant data will be shared to illustrate the performance of COILSIM1D.

Abstract id# 440643

Dow Catalytic Dehydrogenation: The Future of on-Purpose Propylene Production

Matt Pretz, Hydrocarbons R&D, Dow Chemical, Freeport, TX
Abstract Text:
Shale gas has produced an imbalance in the propylene supply/demand balance. This sudden commercial need drove the implementation of several projects with previously commercialized technology in the propane dehydrogenation market. These technologies were adapted from existing processes that were in the licensor's capabilities. Unfortunately, the existing technologies are not tailored to efficiently manage the inherent challenges in the area of catalyst activity, heat input, reaction equilibrium and gas residence time that hydrocarbon cracking processes possess. Therefore, the Dow Chemical Company has developed a Catalytic Dehydrogenation Process that is designed from the standpoint of a producer to efficiently solve the problems inherent in catalytic dehydrogenation processes.

The new technology is a circulating fluid bed technology that is modeled off the existing Fluid Catalytic Cracking process (FCC). The Dow process utilizes a proprietary catalyst with a proprietary reactor and regenerator design to achieve 45% propane conversion at approximately 93 mol% selectivity to propylene. The simplicity of the system versus other commercial offerings enables a capital savings greater than 20%. In addition, the higher conversion at moderate pressure reduces the energy requirement per pound of propylene.

This new technology can be fully integrated to existing ethylene crackers in parallel with new or existing furnaces. In this way, a producer can increase production in an existing light hydrocarbon facility with back end C3 splitter capacity or build a new facility with exactly the amount of ethylene and propylene product that is desired based on ethane and propane feeds. Dow is currently planning a project to implement this technology in an existing cracker at commercial scale and would license the technology upon request.

Abstract id# 439934

A New Era in on-Purpose Butadiene (OPBD) Technology

Cliff Maat, Process Engineering, TPC Group, Houston, TX

Abstract Text:
Butadiene is produced almost entirely as a byproduct of ethylene plants. As ethylene plants switch from naphtha feedstock to cheaper ethane, the amount of butadiene byproduct decreases. A supply shortage is anticipated. On-Purpose Butadiene will be needed to meet the demand. One way to make On-Purpose Butadiene is Oxidative Dehydrogenation of butenes, TPC Group's proprietary OXO-D technology. TPC and UOP have worked together to make further enhancements to the TPC technology. The improvements, including advances in process safety, increased yields and improved energy efficiency, are reviewed and the new technology compared with alternate routes for On-Purpose Butadiene.