FINAL Minutes of September 10, 2020 Ethylene Producers' Environmental Sub-Committee Meeting
(September 10, 2020, Rev. 0)

Following are the minutes of the September 10, 2020 Ethylene Producers' Environmental Sub-Committee Meeting, held via teleconference with Walter Postula, Shell Global Solutions (US) Inc., as host.

Present: Rick Beleutz, LyondellBasell
David Elam, TRC Solutions
Ahmad Hamad, Siemens
Jacob Hilbrich, ChevronPhillips
Dan Lutz, Ineos
Andrés Muñoz Gandarillas, Neste
Jennifer Port, ExxonMobil Chemicals
Walter Postula, Shell Global Solutions (US) Inc.
Gerardo Ruiz-Mercado, US EPA (AIChE Environmental Division)
Jason Trembly, Ohio University (AIChE Environmental Division)
Mark Ulrich, Linde Engineering North America
Gary Wojnowski, BASF

Absent: Benjamin Burns, SASOL North America
Ted Heron, The Catalyst Group
Brad Hopper, BASF
Brandon Lithgoe, NOVA Chemicals
Patti Long, Eastman
Arijit Pakrasi, Edge Engineering and Science
Mark Schmidt, Dow
Jeffrey Seay, University of Kentucky (AIChE Environmental Division)
Debalina Sengupta, Texas A&M (AIChE Environmental Division)
Dick Siegel, R&B Consulting Services (AIChE Environmental Division)
Edward Soliz Jr., SASOL North America
Russell Wozniak, Dow

The teleconference began at 9:06am with Walter Postula reading the Ethylene Producers' Committee (EPC) 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 an understanding or agreement, written or oral, formal or informal, express or implied, among competitors, with regard to costs, prices, 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.

The meeting agenda was published in advance and is included below:

1) Reading of Anti-Trust Statement [9:02 AM]
2) Review of 2020 Environmental Session / Conference [9:03 AM]
3) Chair/Co-Chair for 2021 session [9:13 AM]

4) Discussion of Potential Topics (list below) for 2021 Environmental Session [9:15 AM]
    a. Waste plastic liquids as steam cracker feed (Andrés Muñoz, Neste, planning paper)
    b. Electrification of crackers
    c. Use of fixed sensors for LDAR compliance (per Gary, mpact2wo is interested in presenting)
    d. Rejected papers from 2020 session
        i. "Flare Instrumentation – Minimum Expectations," Derek Stuck, Spectrum Environmental
        ii. "The Proposed Ethylene Production NESHAP and Potential Complications with Reclaimed Water Use," Bill Celenza and Sarah Shank, KBR
        iii. "Proposed Ethylene MACT Flare Requirements," Herman Holm, Spectrum Environmental
        iv. "A Novel Approach of Converting Industrial Wastewater into Energy," Chad Felch, Siemens (Ahmad Hamed sponsor?)
5) Other potential topics? [9:35 AM]
6) Date for Potential Face to Face [9:45 AM]
7) Review of Action Items [9:50 AM]
8) Important Date Reminders
    - September 11, 2020 – Call for abstracts opens
    - November 20, 2020 – Call for abstracts closes
    - December 13, 2020 – Papers accepted or rejected
    - January 15, 2021 – Draft schedule available
    - January 18, 2021 – Program goes live
    - March ??, 2021 – Paper submission closes
    - April 18-22, 2021 – Spring Meeting – Dallas, TX
9) Adjourn [10:00 AM]

Review of 2020 Environmental Session / Conference: Several on the call stated their expectations were surpassed. The chat function for Q&A was nice but staying for a paper's Q&A lead to missing the initial slides of following presentation. A "rewind" function for the live presentations would have been useful. There was not a method to send a chat message to a "random" attendee. One had to search existing chat rooms for attendee of interest in order to chat. The ability for Session Chairs to see attendees would be a good feature.

Chair/Co-Chair for 2021 Session: Jacob Hilbrich is the Session Chair and Andrés Muñoz is the Session Co-Chair. As usual, others on the subcommittee who have filled one/both of these roles previously will be available to help Jake and Andrés with questions they may have.

Discussion of Potential Topics for Environmental Session: The topic list generated during the June subcommittee telecon (see below) was reviewed. The waste plastic liquid as cracker feed topic could be more of a fit for a Technology or Feedstock session (though is not precluded from Environmental Session). As an "environmental" topic, circularity or sustainability (as related to waste plastic) is probably a better approach.
Electrification topic could be tackled from a CO2 reduction perspective. What are long term plans for CO2 reduction? What are the regulatory impacts in EU vs US?
Gary sent the subcommittee more information from mpact2two.
Of the rejected 2020 papers, 4a and 4b seem to have good potential. 4c has been well covered the past couple years. More information is needed on 4d to verify applicability for the ethylene industry.
Post telecon note: 4a-4d abstracts are included at end of minutes.

Specific to the EPC Environmental Session, the list below was generated:
1) Waste plastic liquids as steam cracker feed (topic from Andrés Muñoz, Neste, planning paper). With all the interest in the industry, there could potentially be an entire session on this topic.
2) Electrification of crackers (from Brandon). Walter mentioned the recent announcement from Dow & Shell on their joint effort on this topic. (https://www.shell.com/business-

customers/chemicals/media-releases/2020-media-releases/dow-and-shell-team-up-to-develop-electric-cracking-technology.html).

3) Use of fixed sensors for LDAR compliance (topic from Gary). Gary sent e-mail to subcommittee of recent video and press release from mpact2wo. They are interested in presenting at the 2021 environmental session.
4) Rejected papers from 2020 session
    a. "Flare Instrumentation – Minimum Expectations," Derek Stuck, Spectrum Environmental
    b. "The Proposed Ethylene Production NESHAP and Potential Complications with Reclaimed Water Use," Bill Celenza and Sarah Shank, KBR
    c. "Proposed Ethylene MACT Flare Requirements," Herman Holm, Spectrum Environmental
    d. "A Novel Approach of Converting Industrial Wastewater into Energy," Chad Felch, Siemens (I think Ahmad Hamed was a sponsor for this paper)

Date for Potential Face to Face: Tabled this topic again as openness to travel and face-to-face meetings is still unclear. Rick volunteered to host if face-to-face meeting goes forward.

Review of Action Items: **Mark Ulrich** to follow-up with Linde colleagues in Europe around topic of electrification. **Jake Hilbrich** will follow up with 4a and 4b (and potentially 4d) authors on interest to have abstract considered for 2021 conference. **Brandon Lithgoe** to assist Jake with e-mail addresses of rejected 2020 papers.

Important Date Reminders: The dates for the 2021 Spring Meeting were confirmed following the telecon and are listed in the "agenda" section.

Adjourn: The meeting/teleconference was closed at 9:56 am.

Rejected 2020 Abstracts

(4a) Flare Instrumentation – Minimum Expectations

Derek Stuck – Project Manager, Spectrum Environmental Solutions LLC

As the U.S. EPA begins expanding the flare requirements first found in the Refinery Sector Rule to other industries, newly affected facilities need to begin planning the installation of new monitoring on covered flares. This potentially includes pilot monitoring, visible emissions monitoring, vent gas flow monitoring, assist gas flow monitoring, and net heating value and/or composition monitoring; all of which will be required to meet the new requirements. This presentation will summarize the monitoring required by the new flare requirements and describe some of the technologies which may be used to comply with the regulations' requirements.

(4b) The Proposed Ethylene Production NESHAP and Potential Complications with Reclaimed Water Use

William Celenza – Senior Technical Advisor-Environmental, KBR Inc.
Sarah Shank – Engineer, SES Inc.

Volatile Organic Compound (VOC) emissions from industrial cooling tower systems can occur due to corrosion or cracking of a heat exchanger's internal tubing material, allowing some process fluids to mix with or become entrained in the circulating cooling water. VOCs in the process fluids may subsequently be released from the cooling water into the atmosphere when the water is exposed to air. The Ethylene Production National Emission Standard for Hazardous Air Pollutants (NESHAP) includes heat exchange or cooling tower systems as emission sources at ethylene production facilities. Under this standard, an Ethylene Production Maximum Achievable Control Technology (EMACT) identifies work practices that specify monitoring and Leak, Detection and Repair (LDAR) to control potential heat exchange system VOC air emissions. In September 2019, the EPA proposed EMACT amendments for heat exchange systems that would further reduce potential air emissions. A leak action level is to be defined using the Modified El Paso Method for Determination of VOC Emissions from Water Sources. The resultant action level is equivalent to less than 1 ppmw of strippable VOC in the return cooling water. Since the monitoring point for this proposed EMACT is only after the heat exchanger(s) in the system, organics in makeup water, such as from a reclaimed/recycled water source, are not factored in as a background concentration and would be counted toward compliance. This paper presents an analysis of the impact this proposed EMACT may have on options to use reclaimed water sources for cooling water makeup at ethylene production facilities subject to this standard.

(4c) Proposed Ethylene MACT Flare Requirements

Herman Holm – Director, Spectrum Environmental Solutions LLC

New regulations requiring improved monitoring and control of flares at petroleum refineries are starting to be passed along to other manufacturing sectors. In October 2019, the U.S. EPA proposed amendments to the Generic Maximum Achievable Control Technology Standards for Ethylene Production (EMACT). Among those amendments are new monitoring and operational requirements related to flares at ethylene production facilities. This presentation will summarize the new flare

requirements and will draw heavily on the lessons learned from implementing the similar flare requirements in the refining sector.

(4d) A Novel Approach of Converting Industrial Wastewater into Energy

Chad Felch – Technology & Innovation Manager, Siemens Energy Inc. Water Solutions
Bryan Kumfer – Lead Research Engineer, Siemens Energy Inc. Water Solutions

Many industries use complex production processes that result in high-strength, hard-to-treat wastewaters. Examples include oil and gas refining, petrochemicals, and pharmaceuticals. Their wastewaters may vary in composition, but they typically have at least one of these problematic characteristics: high levels of biorefractory compounds; toxic compounds; halogenated organics; and aromatic or aliphatic hydrocarbons.
In addition, their chemical oxygen demand (COD) levels can range widely, up to 300,000 mg/l. On top of that, some process waters/wastewaters have high salt levels, especially chlorides, requiring expensive materials of construction, making cost-effective treatment especially challenging.
Existing treatment solutions for these high-salt wastewater streams are typically incineration or gasification. The former combusts the wastewater completely in the presence of excess oxygen at 1,100°C (2,012°F), producing carbon dioxide, water, and salts. The latter burns the wastewater using stoichiometric oxygen to produce carbon monoxide and lesser amounts of hydrogen. In turn, these gases can be processed into more useful fuel gases. Unfortunately, both processes are expensive, especially their energy costs. Also, high-temperature processes can be expensive to maintain, requiring backup units that consume capital, operating expenses, labor, and space.
Given these challenges, this presentation will focus on hydrothermal gasification to handle wastewaters that cannot be economically treated with other oxidation technologies. It uses a heterogeneous catalyst to spur reactions similar to those that typically occur in steam reforming and gasification. These reactions occur in an aqueous phase, so temperatures are much lower than what gas-phase gasification processes require. This paper will provide data on treatment for organics and chlorides; propylene oxide/styrene monomer (PO/SM) wastewaters; produced waters containing kinetic hydrate inhibitors (KHI); and propylene glycol wastewaters.
The benefits of catalytic gasification will be explained. They include fuel-gas production, providing data of gas composition for different types of compounds treated; high COD destruction rates, helping reduce downstream treatment costs; capital and energy savings, due to a lower-temperature process; and saving space, relative to other oxidation treatment approaches.