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Reduced Carbon Intensity Ethylene Production

PEP Report 29M

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Abstract

Ethylene is the largest-volume basic petrochemical, produced primarily by steam cracking of hydrocarbons (naphtha, gas oil, ethane, and LPG) and is utilized to produce a spectrum of chemical intermediates. Ethylene consumption has been increasingly driven by its demand in emerging countries and the consumption has increased at an average rate of ~4% per year over the past decade.

Ethylene production is one of the three largest CO_2 emitters in the chemical industry; the other two are that of propylene and ammonia. Conventional cracking generates roughly 1–1.8 metric tons (Mt) of CO_2 for every metric ton of ethylene produced. Globally, that amounts to more than 260 million tons of CO_2 emissions per year.

This report provides an overview of the developments in ethylene production technology with a focus on reduced carbon intensity. Numerous technological advancements have been presented which significantly reduce CO_2 emission from ethylene plants. Detailed technical and economic evaluations are presented for the following three technologies with reduced carbon intensity for ethylene production:

• EcoCatalytic chemical looping technology

• Coolbrook's roto dynamic reactor (RDR) technology

• Electric furnace technology

The analysis and techno-economic design results for the above three technologies are based on the production of 1 MMtpa polymer-grade ethylene. Electric furnace and Coolbrook's roto dynamic reactor have been evaluated with wide range naphtha (WRN) as feed while the design of the EcoCatalytic technology will be based on ethane feed. The capital and production cost results herein are presented for the fourth quarter of 2020 on a US Gulf Coast basis.

The analysis is based on information by the technology provider presented in the open literature (such as patents or technical articles) or in-house generated data (e.g., HYSYS simulation, equipment cost estimation). While this assessment may not reflect the actual plant data fully, we do believe that it is sufficiently representative of the process and process economics within the range of accuracy necessary for economic evaluations of a process design.

Contents

Tables

Figures

Appendix C Figures

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