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Process Economics Program Review 2017-12

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Abstract

With the signing of the Paris Climate Agreement in December 2015, pressure is mounting for all 197 countries that signed the agreement to reduce global greenhouse gasses (GHGs) emissions. In particular, the 135 countries that submitted NDCs (nationally determined contributions) need to develop a credible plan and adopt a workable mechanism, such as a carbon trading system (CTS), to meet their reduction targets by 2030. The chemical industry, being one of the most energy-intensive industries, will certainly be a major target for emission reduction.

This review investigates how to account for carbon emission cost in the chemical production economics and assesses its impact on the competing processes and regions, including:

- Ammonia production from coal and natural gas in China and from natural gas in the USGC
- Urea production from ammonia in the USGC and China
- Integrated ammonia-urea production from natural gas in the USGC and from coal in China
- Ethylene production by wide-range naphtha steam cracking in the USGC, Germany, and China; ethane steam cracking in the USGC; and coal-to-olefins (CTO) in China
- Chlor-alkali production by membrane cell technology in the USGC, Germany, and China
- Bio-isoprene production from glucose in the USGC

A template is provided for each process/region in a Microsoft Excel interactive file that uses a reference process in the PEP database, so that the impact of adding carbon emission cost to the variable cost, cash cost, and net production, etc., can be seen with a few mouse clicks. Our clients can enter their own raw material and utility prices and unit consumption, and specify their own carbon emission intensity, carbon emission benchmark (allowance), and carbon emission cost to develop customized production economics, should the clients numbers deviate from those in the PEP database.

Ammonia is selected since there is a proposed methodology on how to set an emission benchmark (allowance) in China. Urea is chosen to represent a process that consumes CO_2 as a major raw material. Integrated ammonia-urea processes are examined to see if including carbon emission cost in the production economics will alter an ammonia or urea producer's decision to integrate or operate as a stand-alone plant. Ethylene is selected since it is the highest commodity chemical, and it can be produced from ethane, naphtha, and coal, each emitting a very different amount of CO_2. Chlor-alkali is chosen to represent a process with high electricity consumption. Bio-isoprene is selected to represent a biomass-based process.

We also provide a summary of the status of global greenhouse gas (GHG) emissions in major regions, with particular emphasis on the chemical industry; a review of current emission trading systems in major regions and recent carbon emission prices; and an example of how to set carbon emission benchmarks (allowances).

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Contents

Tables

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