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Technology and Costs

TECH 2021S2: Carbon Monoxide

Carbon Monoxide is one in a series of reports published as part of NexantECA's 2021 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Carbon monoxide (CO) is used in a variety of ways, including as a feedstock/raw material for chemicals production, including acetic acid, phosgene, and many others. There are no significant natural sources of carbon monoxide. The major source of industrially produced carbon monoxide is from synthesis gas (syngas), a mixture of carbon monoxide and hydrogen. There is renewed interest in dry reforming of methane, a process that utilizes carbon dioxide in the reforming reaction in place of some or all of the steam.

A wide variety of feedstocks are used for syngas production, from natural gas to naphtha, gas oil, coal, and waste/biomass. Each can be used in various reforming or gasification processes. Syngas is produced with a wide range of hydrogen to carbon monoxide ratios. For carbon monoxide production, lower ratios would be preferred unless there is a need for additional hydrogen. Cryogenic separation is typically used to produce high-purity carbon monoxide from syngas.

This TECH report provides an updated overview of technological, economic, and market aspects for carbon monoxide. The following issues are addressed in this report:

- What are the main routes for syngas and carbon monoxide production? Are technologies available to license?
- What are the options for dry reforming of methane with carbon dioxide? What are the obstacles to widespread commercial implementation?
- How do the process economics compare across processes and different geographic regions?
- What is the current market environment for carbon monoxide? What applications will drive growth?

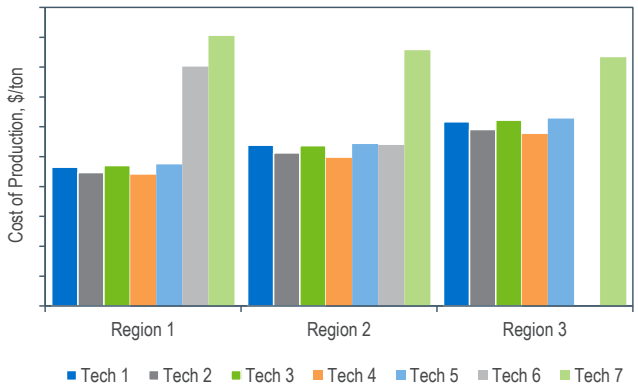
Commercial Technologies

Technology for syngas production and carbon monoxide separation/purification is readily available from multiple licensors and technology providers. The choice of process and feedstock depends on many factors including desired hydrogen to carbon monoxide ratio, feedstock availability and cost, product purity, and byproduct credits.

Process Economics

Detailed cost of production estimates for seven different production routes to syngas are presented for USGC, China, and Western Europe locations. Estimates are developed for steam reforming, partial oxidation, autothermal reforming, combined reforming, and dry reforming (all based on natural gas), as well as gasification of coal and municipal solid waste (MSW). Each syngas has a hydrogen to carbon monoxide ratio in the range of 3:1 to 1:1, depending on the process. Detailed cost of production estimates are also presented for the cryogenic separation of carbon monoxide and purification of hydrogen based on syngas from each of the seven syngas processes.

Cost of Production Comparison for Carbon Monoxide



Commercial Overview

Carbon monoxide is used to produce many chemicals. Depending on the chemical, carbon monoxide can be utilized directly from syngas or after separation from the hydrogen in syngas. The major chemicals produced from pure carbon monoxide are acetic acid and phosgene and its major derivatives of TDI, MDI, and polycarbonate. The implied carbon monoxide capacity required to produce these chemicals was approximately 14 million tons per year in 2020. Demand growth will be driven by acetic acid and the Asia Pacific region. An overview of current and forecast derivative capacity and implied carbon monoxide capacity is provided on a global and regional (North America, Western Europe, and Asia Pacific) basis in this TECH report.

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The TECH program (formerly known as PERP) is globally recognized as the industry standard source of process evaluations of existing, new and emerging of interest to the energy and chemical industries.

TECH's comprehensive studies include detailed technology analyses, process economics, as well as commercial overviews and industry trends. Reports typically cover:

- Trends in chemical technology
- Strategic/business overviews
- Process Technology:
- Chemistry
- Process flow diagrams and descriptions of established/conventional, new and emerging processes
- Process economics – comparative costs of production estimates for different technologies across various geographic regions
- Overview of product applications and markets for new as well as established products
- Regional supply and demand balances for product, including capacity tables of plants in each region
- Regulatory and environmental issues where relevant

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- PDF reports including detailed technology analyses, process economics, as well as commercial overviews and industry trends
- Cost of production tables in spreadsheet format
- Consultation time with the project team

An annual subscription to TECH includes twenty reports published in a given program year. Reports can also be purchased on an individual basis, including reports from previous program years.

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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