Abstract

This review presents a technoeconomic of a methanol production process based on coke-oven gas (COG) as a starting material. On the PEP evaluation timeline, this review follows a recently published PEP report (43F), which presented the technoeconomic evaluation of four major methanol manufacturing technologies that are based on natural gas used to make synthesis gas—an intermediate product produced in the methanol manufacturing process.

COG is a by-product of the coking process used in steel manufacturing. Besides COG, other major byproducts of the steel making process are blast furnace gas (BFG) and oxygen furnace gas (OFG). COG has the highest calorific value and a high hydrogen content. For these reasons, it has great industrial value as a fuel. However, it is also gaining more recognition as a raw material for the production of commercially-important chemical products among which methanol is notable. BFG, on the other hand, is primarily a nitrogen-rich and carbon dioxide-rich product though its CO content is generally 4 to 5 times higher than the CO content of COG. COG’s higher heating value (HHV) is about 8–10 times higher than that of BFG. BFG is traditionally combusted for low-grade heat applications.

As the world’s largest producer of steel, China is the most experienced country in dealing with the off-gases produced in steel plants. Estimated from a recent database of IHS Markit, approximately 17% of the Chinese methanol capacity is based on COG. That shows the potential importance of COG as a source for methanol and potentially for hydrogen and methane as well. A major portion of COG is currently used as fuel, mainly in ballast furnaces in steel plants.

Since a significant proportion of the methanol global capacity is based on COG, IHS Markit decided to carry out an economic study of the COG-methanol route. This review is being done from that perspective. The cost economics have been broken down to three levels of methanol production capacities—500 MTPD, 1000 MTPD, and 2,000 MTPD. The plants are assumed to be built in the US Gulf Coast.
Contents

1 Economic conclusion 3
2 Commercial overview 3
3 Technology overview 5
   Preview of modelled process 5
   Scope of process economics 6
   Process description 6
      Syngas production – Section 100 7
      Methanol production – Section 200 9
4 Process discussion 11
   Feedstock/product 11
   Unreacted syngas recycling 11
   Methanol converters sizing estimate 11
   Methanol product purification 11
   Steam consumption 12
   Plant startup boiler 12
   Materials of construction 12
   Miscellaneous plant sections 12
5 Cost estimates 21
   Fixed-capital costs 21
   Production costs 21

Tables

Table 1.1: Methanol production from coke-oven gas 8
Table 1.2A: Methanol production from coke-oven gas 13
Table 1.2A: Methanol production from coke-oven gas 14
Table 1.2A: Methanol production from coke-oven gas 15
Table 1.2B: Methanol production from coke-oven gas 16
Table 1.2B: Methanol production from coke-oven gas 17
Table 1.3: Methanol production from coke-oven gas 18
Table 1.3: Methanol production from coke-oven gas (concluded) 19
Table 1.4: Methanol production from coke-oven gas 20
Table 1.5: Methanol production from coke-oven gas 23
Table 1.6: Methanol production from coke-oven gas 24
Table 1.7: Methanol production from coke-oven gas 25
Table 1.7: Methanol production from coke-oven gas (concluded) 26

Figures

Figure 1-A: Global methanol production by region 3
Figure 1-B: Global methanol capacity by region 4
Figure 1-C: Global methanol nameplate capacity changes by region 5
Figure 1.1: Methanol from coke-oven gas (1 of 2) 28
Figure 1.1: Methanol from coke-oven gas (2 of 2) 29