5A3. CO_2 Conversion Technology

Technology overview

1. Urea production

At present, urea is produced from ammonia and carbon dioxide, which is generated from inexpensive natural gas (off-gas) during the manufacture of ammonia. When urea is synthesized with natural gas as a raw material, however, the available CO_2 may be insufficient in view of the balance between ammonia and off-gas CO_2. In such cases, CO_2 is recovered from the exhaust gas of the steam reformer, which produces hydrogen and CO from natural gas, to supply it for urea synthesis to adjust the ammonia-CO_2 balance, thereby enabling urea to be produced in large quantities. A plant Mitsubishi Heavy Industries, Ltd. delivered to Malaysia PETRONAS Fertilizer Sdn. Bhd. (Photo 1) matches this purpose.

Photo 1 Urea plant

2. Methanol production

Methanol is now also manufactured mainly with natural gas as the feedstock. If H2 and CO are synthesized by steam-reforming the natural gas, then the H_2:CO ratio is 3:1. On the other hand, for methanol synthesis, the best H_2:CO ratio is 2:1, and the output of methanol can be maximized through the recovery of CO_2 from steam reformer flue gas, allowing the addition of a meaningful amount of CO_2 into the process. At present, active planning for CO_2 addition is underway to improve the production capacity of Saudi Arabian methanol plants.

Figure 1 shows a system where, in the process to produce methanol with natural gas as the feedstock, CO_2 is recovered from steam reformer flue gas to optimize the H_2:CO ratio for methanol synthesis, thereby enhancing methanol production.

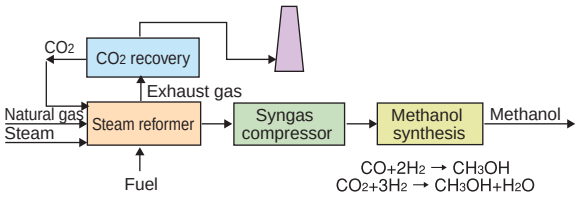

Fig. 1 CO_2 recovery from flue gas for enhanced methanol production

3. DME (dimethyl ether) production

DME is currently synthesized from methanol. The process is similar to that used for the above-mentioned methanol production.

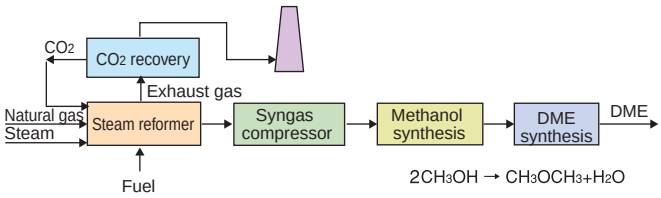

Fig. 2 CO_2 recovery from flue gas-integrated DME production system

4. GTL production

GTL, or Gas-to-Liquid, generally refers to a process to synthesize kerosene and light oil by the Fischer-Tropsch Process (FT Process). For this GTL synthesis, as in the case of methanol, it is necessary to adjust the H_2:CO ratio to 2:1 and recover the same volume of CO_2 from the steam reformer flue gas for use in the process, also as in methanol production, to enable the H_2:CO ratio to be adjusted.

The system recovers and recycles CO_2, which does not contribute to the reaction from the FT synthesis process, to the stage prior to steam reforming.

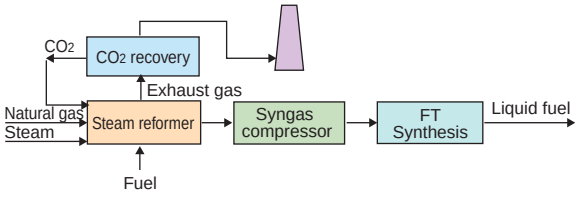

Fig. 3 CO_2 recovery from flue gas-integrated liquid fuel production system

Reference

Masaki Iijima et al., "CO_2 Recovery/Effective Utilization/Fixation and Commercialization," MHI Technical Journal, 39 (5), 286, 2002.