Warm Syngas Clean-up Processes Applied in Synthetic Natural Gas (SNG) Production with Coal and Biomass Blending.

Chen, Po-Ch.
2016

Warm syngas clean-up processes applied in Synthetic Natural Gas (SNG) production with coal and biomass blending

Po-Chuang Chen, Hsiu-Mei Chiu, Yau-Pin Chyou,[1] Karel Svoboda
Institute of Nuclear Energy Research, Chemistry Division, No. 1000, Wenhua Rd., Jiaan Village, Longtan District, Taoyuan City 32546, Taiwan (R.O.C.).; tel. +886 34711400 x. 5050, e-mail: ypchyou@iner.gov.tw; [1]Institute of chemical process fundamentals of the ASCR, v.v.i., Rozvojová 135, 165 02 Praha 6, Czech Republic.

In Taiwan, the Greenhouse Gas Reduction Act has been issued since 2015, which sets the target to reduce greenhouse gas (GHG) emissions to 50% of the 2005 level by 2050. Natural gas is one of the options to reduce the GHG emissions due to lower CO_2 emission in electricity generation. The value discharged from NGCC (natural gas combined-cycle) is near half of that from coal-fired power plant. The price of natural gas in Taiwan is substantially higher than that of coal, which results in the situation that near 50% of electricity is generated from coal and the capacity factor of NGCC units is relatively low. If cheaper gas fuel could be provided to domestic NGCC units, their capacity factor could be increased; then, the CO_2 emission in power sector could be decreased to help meet the GHG reducing target. Synthetic natural gas (SNG) from solid fuel via gasification is possible to provide a relatively lower price than that of natural gas to NGCC units in Taiwan. The price of SNG from coal has been studied in 2012, and the results showed that the mean price of SNG is US$12.27/MMBtu, while the liquefied natural gas (LNG) is US$14.32/MMBtu [Chang et al., 2012]. It shows the possibility to decrease the CO_2 emission with relatively lower cost of electricity in Taiwan.

The SNG production processes have been built with the commercial chemical process simulator, Pro/II® V8.1.1, to analyse the efficiency improvement with warm gas clean-up processes. The four major blocks, consisted of air separation unit (ASU), gasification island, gas clean-up unit, and methanation processes, were built in a previous study [Chen et al., 2015]. Two different parts in the study, i.e., warm syngas clean-up processes and another kind of biomass that is possibly used in Taiwan, are discussed and compared with the previous study. The warm gas clean-up process is implemented to keep the temperature of syngas in the range of 400°C to increase the available energy which is compared with typical one with lower temperature. A series of sorbents are selected for the processes: e.g., Na_2CO_3-based sorbent to remove HCl and ZnO-based sorbent to deminish sulphur contained in syngas, while MgO-based sorbentfor removal of CO_2 to enhanced the methanation processes. The results show that the efficiency could be increased as warm gas clean-up processes are adopted in the system. Biomass could further reduce the CO_2 emission, due to the advantage of carbon neutral feature. The effect of biomass blended with coal shows the similar trend with previous study, i.e., the system performance is slightly decreased with the blend percentage of biomass.

Reference:

[1] H. W. Chang, C. H. Chen and L. F. Lin, 2012, Techno-economic Analysis on the Use of Substitute Natural Gas (SNG) with Carbon Capture and Storage (CCS), 2012 Taiwan Symposium on Carbon Dioxide Capture, Storage and Utilization, Nov. 25-27, Taiwan.
[2] P. C. Chen, H. M. Chiu, Y. P. Chyou, 2015, Synthetic Natural Gas (SNG) Production via Gasification Process with Blend of Coal and Wood Chip as Feedstock, Chemical Engineering Transactions, Vol. 45, pp. 601-606.