Effect of Oxygen to Fuel Ratio on the Conversion of Synthetic Natural Gas (SNG) via Gasification from Coal and Wood Chip Blending

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Abstract

Since mid-2016, the “energy transition policy” has been launched in Taiwan to establish low-carbon, sustainable, stable, high-quality and economically efficient energy systems, during the next decade. The target of electricity from renewable energy is set as 20%, and the portfolio of natural gas (NG) in electricity generation increases significantly as well. In Taiwan, the price of natural gas is substantially higher than that of coal; moreover, the limited receiving and storage capacity of liquefied natural gas (LNG) poses concern for energy security on the island at present, while commissioning of additional LNG terminals can relieve the situation in the future. Nevertheless, the economy and safety issues of electricity generation need to be addressed. Alternatively, production of synthetic natural gas (SNG) from solid fuel via gasification is possible to provide competitive or lower fuel cost, but with better supply independence.

The SNG production processes have been built with the commercial chemical process simulator, Pro\textsuperscript{II}\textsuperscript{®} V8.1.1. The focus of this work is to analyse the impact of oxygen to fuel ratio on the gasification performance and the efficiency of fuel converted to SNG. The oxygen to fuel ratio is evaluated in the range of 0.78 to 1.0, for the cases of coal blending with wood chip (5% and 10%), owing to the consideration that biomass could further reduce CO\textsubscript{2} emission via the advantage of carbon neutral. The results show that gasification temperature increases and the major trend of cold gas efficiency (CGE) decreases, as the oxygen to fuel ratio increases in both cases; similarly, the SNG conversion efficiency decreases as well. For the range of reasonably high gasification temperature in the case of 5% wood chip blending, CGE drops from \textasciitilde78.5\% to \textasciitilde69.5\% and the SNG conversion efficiency falls from \textasciitilde61\% to \textasciitilde59\%, respectively. Similar tendency is observed in the case of 10% wood chip blending, with the values about 1 to 2 percentage point lower. In general, the performance of SNG production varies slightly within the range of parameters studied in this work.