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Abstract

Indirect syngas-to-olefins technologies (syngas→methanol→olefins) allow selective production of light olefins (ethylene and propylene) at relatively lower costs than from conventional petroleum-based sources. They also provide an alternate route for olefins production from a nonpetroleum-based source. For that reason, those technologies have attained great importance and commercial popularity China, and potentially elsewhere, especially where coal is inexpensive. China, reportedly, has been building up its indirect syngas-to-light olefins capacity rapidly. Indirect processes, however, still face some major challenges, including high carbon dioxide emissions and high water demand. Direct syngas-to-olefins technologies (coal→syngas→olefins) are comparatively more efficient conceptually but have suffered from issues of catalyst lifetime and inadequate products selectivity. Still, as our evaluation in this report demonstrates, direct syngas-to-olefins processes are potentially somewhat more economically efficient, and also more environmentally efficient in terms of carbon utilization, than indirect processes when the two routes are compared on the basis of an integrated process with coal gasification.

This report examines two direct syngas-to-olefins technologies and presents technoeconomic assessments along with an overall picture of their carbon emissions. Both processes are designed to use coal-derived syngas. Economics are presented for the corresponding coal-integrated cases as well. The two technologies operate using different kinds of catalysts and different process conditions, and they produce somewhat different product slates. The following three technologies are presented and compared in economic terms.

- The OX-ZEO direct process for olefins production from syngas (developed by the Dalian Institute of Chemical Physics in China)
- The SARI direct process for light olefins production from syngas (developed by the Shanghai Advanced Research Institute)
- A direct olefins production technology (process economics only)

When compared within a coal-to-olefins production cycle, the direct technologies can substantially reduce the cost of production of olefins, by being somewhat more selective on a carbon utilization basis and by having a smaller overall process footprint. However, the long-term industrial and operational viability of each process remains to be seen. We believe that sustained capability of the catalysts on a long-term basis will be key to the success of these technologies.

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