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Sustainable DME synthesis-design with CO2 utilization

Minimizing CO2 emission, while achieving economic feasibility in CO2 utilization for producing valuable chemicals is a challenging problem, as reported in recent studies.Due to its high Cetane number, clean-burning, and non-toxic, DME is a promising fuel alternative, and therefore, potentially valuable chemical that can be produced via thermochemical CO2 conversion reactions. The aim of this study is to identify the most promising processing route for sustainable production of DME in terms of CO2 emission, economic indicators and sustainable indicators. The three processing routes are generated: (A) dry reforming step, methanol synthesis step, and methanoldehydration step; (B) CO2 hydrogenation step followed by methanol dehydration step;and (C) dry reforming step followed by direct DME synthesis step. Starting with a base-case design, the process flow sheets for the three routes are studied in detail to identifythe process bottlenecks or hot-spots. Alternatives addressing the hot-spots are generated to identify the processing route with the best potential. The results indicate that processing route-B gives the highest CO2 consumption; nevertheless, this route is not feasible in terms of economic factors due to the negative rate of return. The final selection, however, depends on a trade-off between CO2 consumption and economic sustainability indicators. In principle, for all three alternatives are more sustainable options.

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