Abstract

In this research, the C, H and O bond equivalent diagram was used to design processes for DME synthesis using natural gas as a feed. This research proposes alternative ways of producing DME using natural gas (a cleaner gas) compared to the traditional routes.

The different feed combinations were assessed for the production of syngas. The crucial step is the H_2:CO ratio in each feed which determines the DME synthesis process route and yield.

The syngas process was developed under equilibrium and non-equilibrium conditions (assuming 100% methane conversion). The region of operation on the ternary bond diagram was limited by mass and energy balance and carbon deposition boundaries. The feed composition was as follows,

(1) Feed 1: methane, steam and oxygen

(2) Feed 2: methane, oxygen and carbon dioxide

(3) Feed 3: methane, oxygen, carbon dioxide and water.

Feed (2) had the highest DME yield. The most optimal reaction route produced DME via the JFE reaction route (H_2:CO =1). The yield of DME was 0.67 moles of DME per mole methane processed under non-equilibrium conditions. The proposed route does not emit CO_2, excess CO_2 is recycled back to the reforming reactor. Under equilibrium, the yield of DME was 0.25 mole DME per mole methane processed. The results indicate that a combination of partial oxidation and dry reforming produces a syngas composition which results in a high DME yield compared to (1) and (3).