Development of Methanol Synthesis Process Using Chemical Looping Partial Oxidation of Byproduct Gas from Steel Plant

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COG (Coke Oven Gas), a byproduct gas from steel plant, is mainly composed of H_2 (55-60 vol.%) and CH_4 (23-27 vol.%). However, most of it is burnt or emitted into the environment, leading to pollution and waste of resources.

This work proposes a thermodynamically efficient process for converting COG to methanol. In this process, exothermic Chemical Looping Partial Oxidation (CLPO) process was designed with iron-based metal oxide which is readily available in steel plant. Metal oxide selectively carries O_2 from air and stabilizes explosive partial oxidation reaction system.

This work consists of two sections; 1) syngas production and 2) methanol synthesis. In the first section, CLPO reaction was simulated using RGibbs model in Aspen Plus to calculate thermodynamic equilibrium. In the second section, methanol reactor model was built in MATLAB and implemented to Aspen Plus to consider fluid dynamics which is not considered in Aspen Plus reactor model. Exergy and energy efficiency and operating cost were calculated to evaluate the proposed process.