The Experiment and Simulation Analysis of the Effect of CO₂ and Steam Addition on Syngas Composition of Natural Gas Non-Catalyst Partial Oxidation

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Abstract : Non-catalyst partial oxidation technology has been widely used to produce syngas by reforming of hydrocarbon, including gas (natural gas, shale gas, refinery gas, coalbed gas, coke oven gas, pyrolysis gas, etc.) and liquid (residual oil, asphalt, deoiled asphalt, biomass oil, etc.). For natural gas non-catalyst partial oxidation, the $H_2/CO(v/v)$ of syngas is about 1.8, which is agreed well with the request of FT synthesis. But for other process, such as carbonylation and glycol, the $H_2/CO(v/v)$ should be close to 1 and 2 respectively. So the syngas composition of non-catalyst partial oxidation should be adjusted to satisfy the request of different chemical synthesis. That means a multi-reforming method by CO_2 and H_2O addition. The natural gas non-catalytic partial oxidation hot model was established. The effects of $O_2/CH4$ ratio, steam, and CO_2 on the syngas composition were studied. The results of the experiment indicate that the addition of CO_2 and steam into the reformer can be applied to change the syngas H_2/CO ratio. The reactor network model (RN model) was established according to the flow partition of industrial reformer and GRI-Mech 3.0. The RN model results agree well with the industrial data. The effects of steam, CO_2 on the syngas compositions were studied with the RN model.

Keywords : non-catalyst partial oxidation, natural gas, H_2/CO, CO_2 and H_2O addition, multi-reforming method

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