

# Development of reforming catalyst for hydrocarbon over C<sub>5</sub> in high caloric SNG synthesis process

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**Abstract:** SNG production using syngas produced from coal gasifier is a very important technology for energy security. Generally, the calorific value of SNG is about 9,400 kcal/Nm<sup>3</sup>, which is used to increase the calorific value by mixing the high-priced LPG to match the calorific value equivalent to the LNG grade. However, if SNG and LPG is synthesized in the process at the same time, economical efficiency is improved due to reduction of LPG purchase cost and calorific control equipment. In this study, we propose a process for synthesizing high calorific value SNG using syngas produced from coal gasification process and propose a methanation / reforming reaction catalyst among various catalysts in the process.

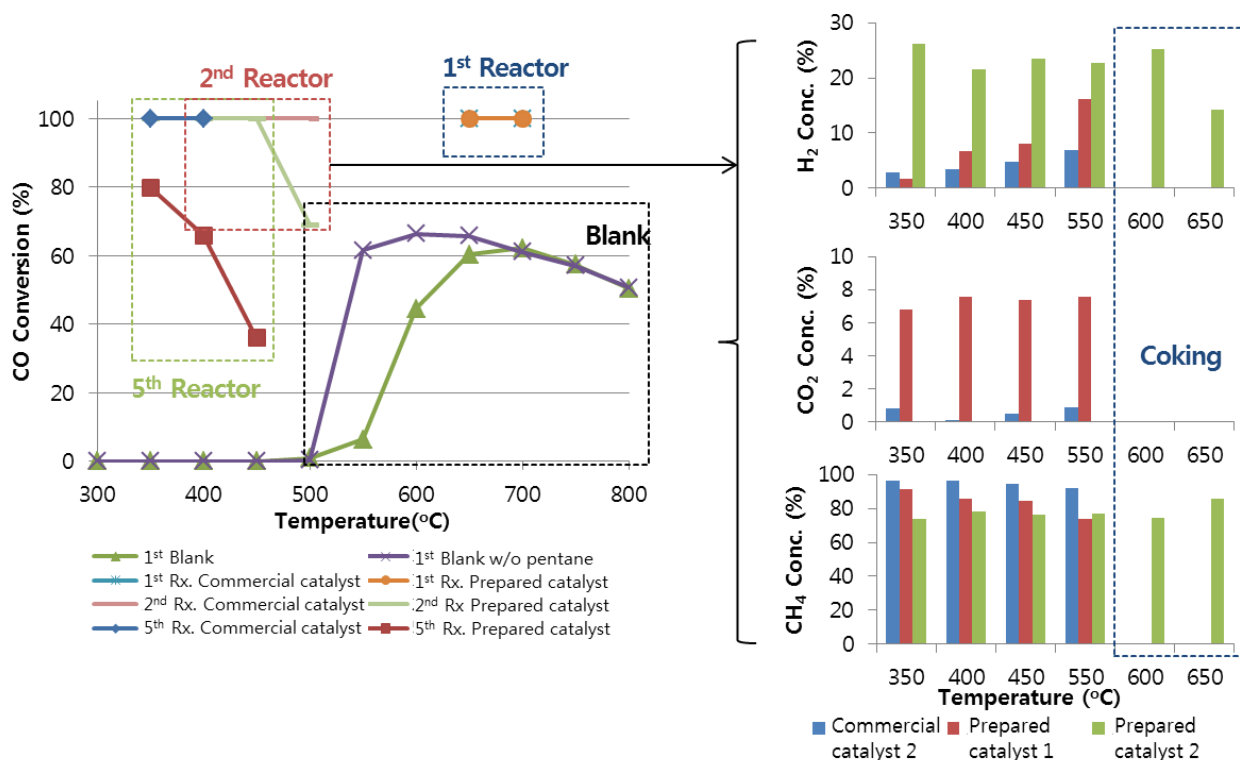
**Keywords:** SNG(Synthetic Natural Gas), Calorific value, LPG(Liquefied Petroleum Gas).

## 1. Introduction

International energy consumption is steadily increasing in all materials, especially natural gas is expected to exceed coal use in 2030. As Korea and Japan propose natural gas heating volume of 10,200 kcal / Nm<sup>3</sup>, low caloric of SNG (9,400 kcal / Nm<sup>3</sup>) produced from syn-gas need to add LPG [1,2]. However, if SNG with a calorific value of 10,200 kcal / Nm<sup>3</sup> are produced from syngas, the LPG mixing cost will be reduced. In this study, we introduce the simultaneous production technology of SNG using C<sub>5</sub> or higher high boiling hydrocarbons and syngas generated in LPG synthesis [3,4].

## 2. Results and discussion

The SNG synthesis process is used multiple adiabatic reactors due to exothermic reaction. The temperature of the gas produced at the rear of each reactor is increased due to exotherm and heat recovery is carried out to enter the next reactor. As methane concentration increases as it introduce each reactor and water is generated, it is hard to expect high heat from the reactor after the first stage. Therefore, the synthesis of SNG was conducted using a catalyst based on Ni for each reactor condition and the reaction was evaluated condition with introducing pentane. Figure 1 shows the CO conversion for each reactor of commercial catalyst and catalyst manufactured. Syn- gas is supplied from the first stage of the reactor, it generates the highest heat level than other reactor. Therefore, even if the feed is supplied at 300 degrees Celsius, the temperature increases rapidly to over 650°C by heat. The conditions of the second stage reactor include water generated at the first stage and the amount of synthetic gas is relatively low, which means the heat value is low. Therefore, about 50 degrees of heat is generated at each incoming temperature and the reaction is processed. Likewise, five-stage reactor responses are also low in degree of heating. Under the conditions of the second stage reactor, the CO conversion of each catalyst has a conversion rate of 100 percent from 300 to 400°C, and the catalytic activity decreases under higher temperature conditions. The results of product gases distribution in each catalyst with various temperature, concentration of methane is in the order of commercial catalyst > prepared catalyst 1 > prepared catalyst 2. The commercial catalyst and the prepared catalyst 1 are not affected by coking at over 600 °C, but the prepared catalyst 2 is improved. A Prepared catalyst 1 has a higher CO<sub>2</sub> production rate than other catalyst.



**Figure 1.** CO conversion with various reaction conditions (commercial catalyst vs. prepared catalyst)

### 3. Conclusions

In the case of SNG synthesis with synthetic gas, the reaction behavior was determined by supplying pentane and the following results were obtained. There is a temperature gradient depending on the length of the catalytic layer due to the exothermic heat generated during the methanation reaction using the syngas. Reaction temperature is very different as level of methane reaction varies between each reactor. In the high temperature conditions, the coking of the CO methanation catalyst occurred. The conversion of CO for methanation is excellent in cold region and decreases in conditions above 500°C. The selectivity of CH<sub>4</sub> synthesis was also reduced in hot response conditions, and the CH<sub>4</sub> selectivity was improved in the Ba added Catalyst. The heat and flow patterns varied depending on the methane reaction in the reactor according to the hydrocarbon added type.

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