Study on the reaction condition for biogas steam reforming based on thermodynamic equilibrium

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This study attempts to derive the reaction conditions for steam reforming of biogas to produce hydrogen from biogas through thermodynamic equilibrium analysis. The thermodynamic equilibrium was calculated using the Gibbs free energy minimization method, and the parameters were the steam per methane ratio (H_2O/CH_4=1.0-3.0) and temperature (500-1,000°C) in various biogas compositions (CH_4/CO_2=0.7-3.0). According to the analysis results, the temperature is 700°C or higher and the water vapor ratio is 1 or higher as conditions to minimize carbon deposition. Under the condition of minimizing carbon deposition, the yield of H_2 tended to decrease as the water vapor ratio increased, so the steam per methane ratio was fixed at 1. In addition, the yield of CO showed a tendency to increase as the temperature increased. The temperature was fixed at 700°C to maximize the hydrogen production. As a result of analyzing the conversion rate of CH_4 and CO_2 under the derived conditions, the conversion rate of CH_4 was over 80% regardless of the composition of the biogas, and the conversion rate of CO_2 changed significantly according to the composition of the biogas.