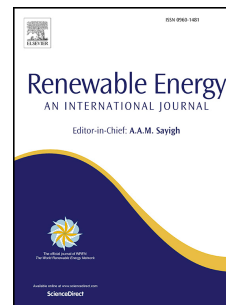


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Methanol synthesis from biogas: A thermodynamic analysis

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Abstract

A new approach for the direct conversion of syngas into methanol has been proposed as alternative to the conventional process requiring WGS and/or PSA clean-up steps for syngas upgrading. A comparative thermodynamic equilibrium analysis of biogas reforming processes (dry reforming, steam reforming and oxy-steam reforming) has been performed using the Gibbs free energy minimization method. The calculations have been carried out under different biogas composition ($\text{CH}_4/\text{CO}_2=1-2.3$), reaction temperature (400-900°C), S/CH_4 (0.0-3.0) and O_2/CH_4 (0.0-0.2) molar ratios. The effects of process variables on the reforming performances as well as on the syngas quality, in term of CH_4 and CO_2 conversion, H_2/CO and H_2/CO_2 ratios, coke deposition and energetic consumption, has been examined. Subsequently, methanol synthesis has been studied using the same mathematical approach, with the aim to identify the most adequate operating conditions for the direct conversion of the syngas obtained from reforming process into methanol. The simulations suggested that steam reforming of biogas, with high methane content, is the most appropriate route to produce a syngas quality suitable for the new proposed approach.

Keywords: Methanol synthesis; Biogas; Reforming processes; Thermodynamic analysis; PROII process simulator; Gibbs free energy minimization.

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