

The Simulation Study of Gasification System with Various Feedstocks and Products

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ABSTRACT

Gasification technology is recognized as next generation power plant technology which can replace conventional coal power plant. It produces not only electricity but also chemical energy as a form of syngas. The syngas can be further transformed into valuable chemicals such as H₂, DME and liquid fuel etc. Present investigation focuses on the evaluation of gasification performance based on the 300MW gasification plant with various feedstocks such as Illinois#6 coal, heavy residue oil and oil sand. The simulation model of the gasification plant is composed of sub-process such as fuel pretreatment, gasification, ash removal, AGR and combined cycle based on ASPEN plus. For estimating performance of gasification plant model, simulation results are compared with the actual operation data of demo plant. To do this, evaluating parameters are chosen as cold gas efficiency and carbon conversion of gasifier, power output of combined cycle and production rate of H₂ and DME.

KEY WORDS: gasification, oil sand, heavy oil, poly generation, ASPEN

1. INTRODUCTION

Many research and development for renewable energy technologies are being performed with the recognition of without novel technology producing energy, continuous high price of crude oil and climate change of the earth. However it is their efforts for getting technologies, it can not be supplied large capacity of required electricity in the industrial sector. Gasification technology such as IGCC can be satisfied former demand among the present power technologies. Moreover, climate of our earth is gradually changed by CO₂ emission of industrials. So the development for advanced CO₂ free power plant has been required until now. The representative case is generation of electricity applied gasification technology. Another advantage of IGCC is not able to produce electricity cleanly and efficiently but also produce chemicals such as hydrogen, methanol, DME with various feedstocks. Additionally, IGCC can obtain with the process of energy conversion without air pollutant emissions (SO_x, NO_x, PM etc). With compared to conventional power plant, this technology could be led to total cost reduction of 40~90%. Under the condition of generating 300 MW capability of electricity, it is indicated to characteristics of gasification plant by supplying various feedstocks such as coal, heavy

oil residues. The application range of gasification plant is indicated in Fig 1.

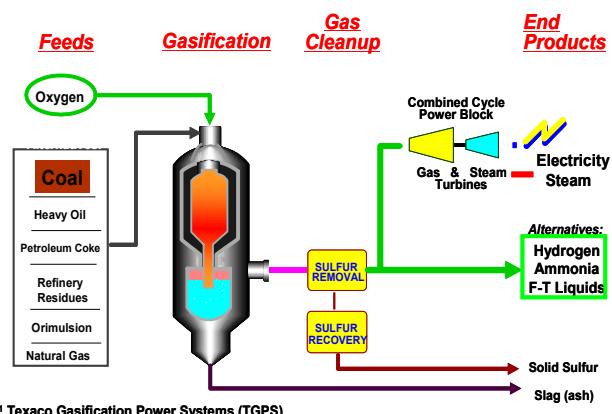


Fig. 1. Application range of gasification technology

2. SIMULATION OF GASIFICATION SYSTEM

To comprehend characteristics of gasification plant is dependent on the various feedstock, so that the simulation code was made with the parameters of 300MW gasification power plant using ASPEN plus. Then the developed model was compared to required flow rate of feedstock, oxidant and gasification performance index such as cold gas efficiency and carbon conversion of gasifier through syngas composition for each process. During the simulation, feedstocks were chosen as bituminous coal, heavy oil residues and bitumen from oil sand. After setting a base model of gasification plant, it was applied to various chemical plant models such as DME, hydrogen.

2.1. INITIAL CONDITIONS AND ASSUMPTIONS

Feedstocks for the gasification were selected to Illinois #6 coal, bunker-C and bitumen. Bitumen is extracted from oil sand produced in Alberta, Canada. Characteristics of sample feedstock were presented in Table 1 such as ultimate, proximate analysis and higher heating value. The following data were utilized during the simulation study for gasification power plant.