

能源和环境工程

## 双气头多联产系统的Aspen Plus实现及工艺过程优化( I )模拟流程的建立及验证

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摘要

通过流程模拟对煤基多联产系统进行过程优化是一种低成本、高效率的研究方法。通过稳态流程模拟软件Aspen Plus建立了二甲醚和电力为主要目标产品并副产甲醇的煤基多联产系统流程。采用气化煤气与焦炉煤气混合气作为气头, 以达到利用焦炉煤气中高浓度甲烷、下一步工艺调整氢碳比并实现温室气体减排的目的。模拟流程中包括了空分、煤气化及净化、 $\text{CH}_4/\text{CO}_2$ 重整、产品合成、燃气轮机联合循环发电等多联产系统中的5个主要工艺单元, 涉及化学反应的 $\text{CH}_4/\text{CO}_2$ 重整单元和二甲醚合成单元通过嵌入包含特定反应动力学参数的动力学子程序进行模拟。多联产系统综合考虑了化学反应的动力学和热力学, 系统总体及各工艺单元物料、能量衡算一致, 各个单元模拟数据与文献实验数据吻合。在建立流程的基础上, 计算比较了热值加和效率与当量发电效率, 发现考虑能量品质的当量发电效率更适合联产液体燃料和电能的多联产系统的评价。

关键词

[多联产系统](#) [焦炉煤气](#) [气化煤气](#) [二甲醚](#) [流程模拟](#)

分类号

## Modeling and optimization of polygeneration system with coke-oven gas and coal gasified gas by Aspen Plus ( I ) Establishment and verification of simulation process

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Abstract

With the shortage of petroleum, liquid fuel techniques are needed to reconstruct a reliable energy framework. To solve the problem with the greenhouse gases in utilization of fossil fuel, coal based polygeneration is now becoming one of the choices. The application of coal-based polygeneration depends on the conversion of raw material to liquid fuel and decrease in the waste gas to the environment. In this study, process simulation software Aspen Plus was used to setup the module of the polygeneration system based on its mass and energy balances. Coke-oven gas and coal gasified gas were input into the system as the feeding materials, in which methane mainly from the coke-oven gas and  $\text{CO}_2$  from the coal gasified gas reacted to adjust the ratio H/C in the syngas. The main components of the greenhouse gases ( $\text{CO}_2$  and  $\text{CH}_4$ ) were reduced due to the  $\text{CH}_4/\text{CO}_2$  reforming. The simulation includes five units, which are the unit of air separation, gas clean-up unit, reforming, production of chemical products, and combined turbine cycle. The processing units with the chemical reactions were included in the program through the dynamic and thermodynamic subroutines. Dimethyl ether (DME) and electric power are the main products from the simulated polygeneration system. The equivalent electric power efficiency ( $\eta_1$ ) and total heating efficiency ( $\eta_2$ ) were calculated. The results showed that  $\eta_1$ , which refers to the energy quality, is more appropriate for evaluating the coal-based polygeneration system.

Key words

### 扩展功能

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