

能源和环境工程

一种基于Zn/ZnO的新型煤气化系统理论能效分析及其环境性能评估

吕明, 周俊虎, 周志军, 杨卫娟, 刘建忠, 岑可法

浙江大学能源清洁利用国家重点实验室

收稿日期 2006-10-25 修回日期 2006-12-5 网络版发布日期 2007-7-13 接受日期

摘要 本文以基于Zn/ZnO的两步式热化学循环为基础构建了一种新型的煤气化系统。该系统流程主要由两步构成: 首先煤与ZnO在高温下发生吸热反应, 气化生成CO气体和锌蒸汽。锌蒸汽经冷凝后自动从混合气体产物中分离出来被送入下一步反应中与水发生放热反应, 生成氢气和ZnO固体。ZnO又可被回收进行第一步反应。本文在设计第一步反应供热系统时分别考虑了煤部分氧化自热和太阳能加热两种方式, 并对基于这两种加热方式的新型煤气化系统分别进行了理论能效评估和环境性能评估。评估结果显示: 自热式煤气化系统的理想热效率和火用效率分别达到了89%和80%; 而按现有太阳能加热系统的热效率计算, 太阳能加热式煤气化系统的整体理想热效率和火用效率最高分别可以达到67%和66%。从环境性能上来看, 太阳能加热式煤气化系统远远优于自热式系统, 前者的CHR(产CO与产H₂比)不到后者的1/6。

关键词 [煤气化](#) [锌](#) [氧化还原对](#) [部分氧化法](#) [太阳能](#)

分类号

Theoretical energy analysis and environmental evaluation of a new coal gasification system based on Zn/ZnO redox pair

LV Ming, ZHOU Junhu, ZHOU Zhijun, YANG Weijuan, LIU Jianzhong, CEN Kefa

Abstract

A new kind of coal gasification based on Zn/ZnO redox pair *via* a two-step cycle is proposed. Firstly, coal is mainly gasified to CO by reacting with ZnO in a highly endothermic step at about 1200°C. Secondly, in an exothermic step at a lower temperature of about 500°C, hydrogen gas and solid ZnO are produced *via* the hydrolysis of liquefied zinc produced from the first step. The produced ZnO can be then recycled to the first step. In this paper, both the auto-thermal reactor with partial oxidation of coal and solar reactor were considered as heat supply in the first step. The theoretical energy analysis of the new system based on the 1st and the 2nd law of thermodynamics was performed. The result showed that the system could reach an ideal thermal efficiency as high as 89% when equipped with the auto-thermal reactor, and 67% when solar reactor was used considering the current thermal efficiency of solar collector. The relative exergy efficiencies were 80% and 66% respectively. The major sources of exergy losses came from the irreversibility of reaction in auto-thermal reactor, and heat losses from solar reactor. A simple environmental evaluation for the system was also performed based on the ratio of produced CO to H₂ (CHR) in the system. Apparently, the solar heated system was more environmentally friendly than the auto-heated system, the CHR of the former was smaller than 1/6 of the latter.

Key words

[coal gasification](#) [zinc; redox pair](#) [partial oxidation](#) [solar energy](#)

DOI:

通讯作者 周俊虎 enejzhou@public.zju.edu.cn

扩展功能

本文信息

- ▶ [Supporting info](#)
- ▶ [PDF\(654KB\)](#)
- ▶ [\[HTML全文\]\(0KB\)](#)
- ▶ [参考文献](#)

服务与反馈

- ▶ [把本文推荐给朋友](#)
- ▶ [加入我的书架](#)
- ▶ [加入引用管理器](#)
- ▶ [复制索引](#)
- ▶ [Email Alert](#)
- ▶ [文章反馈](#)
- ▶ [浏览反馈信息](#)

相关信息

- ▶ [本刊中 包含“煤气化” 的相关文章](#)
- ▶ [本文作者相关文章](#)

- [吕明](#)
- [周俊虎](#)
- [周志军](#)
- [杨卫娟](#)
- [刘建忠](#)
- [岑可法](#)