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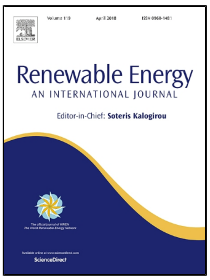

Catalytic gasification characteristics of cellulose, hemicellulose and lignin

Haimiao Yu, Zilu Wu, Geng Chen

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Catalytic gasification characteristics of cellulose, hemicellulose and lignin

Haimiao Yu*, Zilu Wu, Geng Chen

Institute of Thermal and Environment Engineering, Tongji University, China

* Corresponding author. Tel.: +86 (0)21 659 80273, mailing address: No.1239 Siping Road, Yangpu District, Shanghai, P. R. China.

E-mail address: hmyuzj@tongji.edu.cn (Haimiao Yu), 1628211876@qq.com (Zilu Wu), renxingdashu@163.com (Geng Chen)

Abstract

In this paper, catalytic gasification experiments of three major biomass components (cellulose, hemicellulose, and lignin), straw, and pine were performed with dolomite and Na_2CO_3 as catalysts on a small-scale entrained-flow gasifier. We focused on the differences of catalytic gasification characteristics among three major biomass components. Sodium carbonate and dolomite largely positively promoted hemicellulose gasification, significantly improved the gasification efficiency, calorific value of gas, and carbon conversion, and significantly reduced the tar yield. Sodium carbonate showed the optimal catalytic effect. Dolomite positively catalyzed the gasification of cellulose, hemicellulose, lignin, straw, and pine. Sodium carbonate significantly catalyzed the gasification of hemicellulose, but it inhibited the gasification of cellulose, lignin, straw, and pine. Sodium carbonate is suitable to catalyze the gasification of biomass with a high content of hemicellulose. The influences of different catalysts on the catalytic gasification characteristics of cellulose, hemicellulose and lignin were different. Therefore, the selection of biomass gasification catalyst should be based on the components and properties of biomass.

Keywords: Cellulose; Hemicellulose; Lignin; Catalyst; Gasification characteristics

1. Introduction

With the economic development, the two issues of energy crisis and environmental pollution have become the hotspots in the world. The increasing consumption of non-renewable energy sources further arouses the demand for renewable energy [1]. The biomass with abundant reserves is considered as one of renewable energy sources with the largest potential [2-4]. In recent years, some progresses have been made in biomass gasification, but gas cleaning always remains a major bottleneck hindering the development of biomass gasification. Tar in syngas corrodes and clogs equipment [5], reduces the overall efficiency and affects the gas quality. Selecting appropriate catalysts has become a major way to improve gas quality and lower the tar content.

Biomass gasification catalysts have been extensively studied. Sanna Tuomi [6] proved the addition of dolomite promoted the gasification of wood and bark and decreased tar yield significantly and found that the decreasing degrees of tar yield caused by the addition of dolomite were different between wood and bark. Devi L. [7-9] proved that both dolomite and olivine could decrease the tar yield in biomass gasification and that dolomite showed the significantly higher effect than olivine. Obid Tursunov [10] explored the pyrolysis of municipal solid waste catalyzed by Dolomite and found that the percentage of total product gas was increased by 41.99% after adding dolomite and that the tar content was significantly decreased. Meilina Widyawati [11] explored the pyrolysis of cellulose, hemicellulose, and lignin catalyzed by CaO and found that CaO could greatly increase the production of H_2 and reduce the content of tar and that CaO