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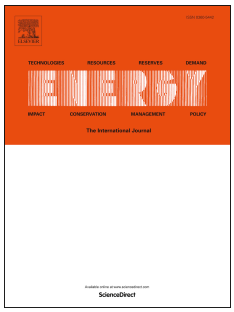

Catalytic fast pyrolysis of rice husk for bio-oil production

Wenfei Cai, Li Dai, Ronghou Liu

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Catalytic fast pyrolysis of rice husk for bio-oil production

Wenfei Cai [a, b], Li Dai [a, b], Ronghou Liu [* a, b]

a. Biomass Energy Engineering Research Centre, School of Agriculture and Biology, Shanghai Jiao Tong University, 800 Dongchuan Road, Shanghai 200240, PR China.
b. Key Laboratory of Urban Agriculture (South), Ministry of Agriculture, 800 Dongchuan Road, Shanghai 200240, PR China.

* Corresponding author: Ronghou Liu, E-mail: liurhou@sjtu.edu.cn, Tel: 0086 21 34205744

Highlights

1 A fluidized bed fast pyrolysis unit was developed with a catalytic fixed bed.
2 The effects of temperature and catalyst on the bio-oil properties were investigated.
3 The effects of catalyst on the properties of biochar was studied.
4 The biomass pyrolysis mechanism for bio-oil production was studied through Py-GC/MS analysis.

Abstract:

A lab-scale catalytic pyrolysis unit with the feeding rate of 100-500 g h^{-1} was designed and manufactured with a fluidized bed reactor. The effects of reaction temperature, catalyst weight and catalyst position on the properties of pyrolysis products were investigated. Subsequently, the mechanism of biomass pyrolysis was studied through Py-GC/MS analysis. The optimal pyrolysis temperature for a higher yield and quality of bio-oil was 500^{o}C. The highest bio-oil yield was 46.9 wt% with biochar, and non-condensable gas yields of 30.0 wt% and 23.1 wt%, respectively at 500^{o}C. The minimum value of the water content of bio-oil samples was 13.39±0.22% under 500^{o}C. The catalyst can significantly increase the water content of bio-oil and reduce the ash content, HHV, solid content and viscosity of bio-oil. In the process of biomass fast pyrolysis, the cellulose, hemicellulose and lignin were pyrolyzed to monomers. Then some chemicals were produced from these monomers through a series of reactions: isomerization reaction, dehydration reaction, retro-aldol reaction, esterification, carbonyl reaction and so on. In catalytic pyrolysis, the active site of catalyst acts as deoxidizer. Hydrocarbon radicals' pool was formed through monomers thermal cracking. Then some relatively stable chemicals were formed through reactions among those radicals.

Keywords: Rice husk; fluidized bed reactor; catalytic fixed bed reactor; ZSM-5; pyrolysis mechanism.

1 Introduction

Bio-oil derived from biomass fast pyrolysis can be used as a candidate to replace the fossil fuels or feedstock to produce some renewable chemicals [1-3]. The applications of this technology is handicapped, due to the low quality of bio-oil, such as high water content and viscosity, low pH value and heating value, and thermal instability [4, 5]. Catalytic fast pyrolysis is a promising and attractive approach for the production of renewable aromatic compounds with highly