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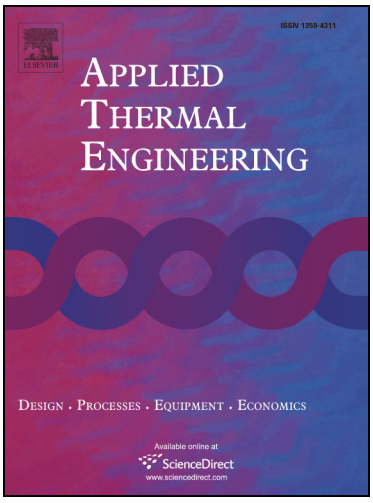

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ACCEPTED MANUSCRIPT

Parametric Studies on Corn Combustion Characteristics in a Fixed Bed: primary air flow rate and different corn lengths

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Abstract

In the present research, experiments were performed on corn straw in a one-dimensional bench fixed-bed combustion test rig. The effects of different corn straw lengths and primary air (supplied through the grate) on the combustion characteristics of corn straw were investigated. The two parameters will directly relate to the burning rate, which affect combustion efficiency, burnout rate and gas emissions. The bed temperature distribution and gas components such as CO_2, CO, O_2, CH_4, C_2H_6, NO, HCN, and SO_2 were measured in the bed. The results indicate that shorter corn straw combustion resulted the higher CO concentration in later stage of combustion, while a higher temperature and less unburned carbon in bottom ash. As the main pyrolysis production, the concentration of CH_4 emission was 2 orders of magnitude for C_2H_6. NO was the main product of NOx, and shared a similar trend to HCN in the combustion process of all parameters, while the yield was less than HCN. The C conversion to CO_2 was much higher than to CO. The emission factors of SO_2 and NO had the opposite trend with the length variation. With the flowrate increased, there is an increased tendency of C to CO_2 and a reduced CO/CO_2 ratio. This study improves the understanding of the operational characteristics of small-scale corn straw burning to help with the design and optimization of large-scale fixed-beds for power plants.

Keywords: corn straw; fixed-bed; combustion; primary air; straw lengths.

1. Introduction

Fossil fuels are currently the world's primary energy source for generating electricity. However, they are also the primary causes of global climate change and pollutant emissions [1, 2]. For instance, the current share of coal in global power generation, and the consumption of China's domestic primary energy is over 40% and 66% respectively, which makes a significant impact on greenhouse gas emission each year [3- 7]. Today, the World Energy Council and other international agencies are working on the development of biomass as a renewable energy to alleviate the pressure on energy demand and reduce the effects of greenhouse gas emissions [6, 8].

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