Experimental Assessment of Gas Warning Index for Low Temperature Oxidation of Lignocellulosic Biomass

Mengru Cai[1, 2], Qin Cao[1, 2], Jinhu Li[1, 2, *]

[1]College of Safety and Engineering, Anhui University of Science and Technology, Huainan, China

[2]State Key Laboratory of Mining Response and Disaster Prevention and Control in Deep Coal Mines (Anhui University of Science and Technology), Huainan, China

Email address:

cmr_aust@163.com (Mengru Cai), caoqin121411@163.com (Qin Cao), jhli@aust.edu.cn (Jinhu Li)

[*]Corresponding author

Abstract

Biomass is widely used in the field of energy because of its abundant yield, low pollution and renewable characteristics, but the self-heating and even spontaneous combustion phenomenon that may occur during the storage of biomass poses a potential threat to its safe use. In this study, three kinds of biomass, rice straw, wheat straw and corn straw, were selected as the research objects. Dewar bottle self-heating and programmed temperature heating system were used to carry out experiments, and their gas production rules were deeply analyzed. At the same time, the gas warning index is determined based on the gas change characteristics. The self-heating experiment revealed that the self-heating temperature of biomass accumulation could rise to 53.73 ℃, accompanied by the release of a large amount of CO_2 gas, and the CO_2 concentration was positively correlated with the sample temperature, while no CO and other hydrocarbon gases were produced during the whole accumulation process. The programmed temperature experiment shows that the occurrence time and concentration of each gas product vary. The carbon and oxygen compounds almost run through the whole temperature rise process, while the hydrocarbon gases appear one after another. Based on the experimental results and the variation law of gas product and ratio, it is suggested that the concentration of CO and the ratio of CO to O_2 concentration should be used as the main indicators for monitoring and early warning of biomass accumulation process. At the same time, the concentration of CH_4 and the production of C_2H_6 and C_3H_8 can be used as auxiliary indicators to comprehensively monitor the oxidation status of biomass.

Keywords

Prediction Index Gas, Programmed Temperature Rise, Biomass Self-Heating