

Kinetic Analysis of Wood Pellets by Isothermal Calorimetry for Evaluating its Self-heating Potential

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Abstract : The heat released by wood pellets during storage will cause self-heating and even self-ignition. In this work, the heat release rates of pine, fir wood and mahogany pellets at 30-70°C were measured by TAM air isothermal calorimeter, and the kinetic analysis was performed by iso-conversion ratio and non-steady-state methods to evaluate its self-heating potential. The results show that the reaction temperature can significantly affect the heat release rate. The higher the temperature, the greater the heat release rate. The heat release rates of different kinds of wood pellets are obviously different, and the order of the heat release rates for the three pellets at 70°C is pine > fir wood > mahogany. The kinetic analysis of the iso-conversion ratio method indicates that the distribution of activation energy for pine, fir wood and mahogany pellets under the release of 0.1-1.0 J/g specific heat are 58-102 kJ/mol, 59-108 kJ/mol and 59-112 kJ/mol, respectively. Their activation energies obtained from the non-steady-state kinetic analysis are 13.43 kJ/mol, 19.19 kJ/mol and 21.09 kJ/mol, respectively. Both kinetic analyses show that the magnitude of self-heating risk for the three pellet fuels is pine pellets > fir wood pellets > mahogany pellets.

Keywords : isothermal calorimeter, kinetics, self-heating, wood pellets

Conference Title : ICBPBB 2022 : International Conference on Biomass Processing for Biofuels and Bioenergy

Conference Location : Singapore, Singapore

Conference Dates : May 05-06, 2022