Preliminary study on food-based dust explosion: Effect of physicochemical properties & thermal behaviour

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ABSTRACT

Severe dust explosions occur frequently in the food processing industry, and explosion damage increases with the rate of flame propagation in pipes or plants. It is important for the food industry to recognize the potential hazards associated with food-based dust explosions. Appropriate investments are required to achieve sustainable industrial development and operational safety. In this study, the effect of the physicochemical properties of brown rice and tea powder on the severity of dust explosions was investigated over a size range of 1–138 µm. Thermogravimetric analysis (TGA) was applied to determine the physicochemical properties of the samples. Results showed that volatility, moisture content, and fixed carbon had a significant effect on the combustion. Brown rice, with a lower moisture content (6.52 wt%) and higher volatile matter (71.7 wt%) compared to tea powder, exhibited a higher explosion pressure (16.50 bar) and rate of pressure rise (95.0 bar/s). The lower moisture and fixed carbon content, combined with a higher volatile matter content, make it highly reactive in combustion. Its dryness also meant less agglomeration which contributed to its higher explosion pressure. It was observed that the physicochemical properties of the dust had a significant effect on the severity of the ensuing dust explosions. While there is a general understanding of the factors that contribute to dust explosions, there may be specific types of dust or mixtures of dust that require further study. Understanding the specific characteristics and behavior of these types of dust can inform safety guidelines and best practices for handling and processing them.

KEYWORDS

Dust; Explosion; Explosion severity; Physicochemical properties

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