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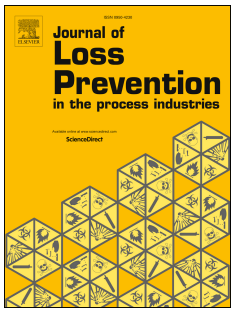

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Evaluation of the critical safety temperature of nitrocellulose in different forms

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Abstract

Evaluating the critical safety temperature of nitrocellulose is necessary to reduce the possibility of nitrocellulose accidents (thermal explosion and fire) and to implement effective loss prevention. In the present study, isothermal and non-isothermal experiments were performed on different forms of nitrocellulose using a differential scanning calorimeter. A scanning electron microscope was utilized to detect the aging process of nitrocellulose under different constant temperatures. Thermodynamic parameters were simulated by thermal safety software, and the results indicated that autocatalytic simulation rather than *n*th order simulation was applicable to assess the apparent activation energy of nitrocellulose samples. Moreover, iso-conversional methods, including Kissiger–Akahira–Sunose, Ozawa–Flynn–Wall, Friedman, Tang et al., and distributed activation energy model methods, were employed to validate the simulated activation energy. The average activation energy calculated by the five iso-conversional methods was lower than that simulated by autocatalytic simulation. Moreover, critical storage temperatures, including the time to maximum rate and the time to conversion limit, were evaluated. It was found that the critical storage temperatures of nitrocellulose in white chip form were lower than that of nitrocellulose in white silky fibre form. Finally, the critical thermal explosion temperatures of two