

Measurement of Explosive Compounds by DSC

Hazardous materials must be handled, preserved and transported according to applicable standards because of their intrinsic dangerous nature. Conforming to the fire protection law, self-reactive materials, including organic peroxides, nitro compounds and substances containing them, must be judged, depending on level of use, whether or not they belong to the Class 5 Material. Such judging is made based on thermal analysis of exothermic characteristics through decomposition reaction. Reported herein are the steps of a test method applicable when the above judgment is rendered, as are the results of measurements where self-reactive materials were analyzed by the test method.

Steps of test (thermal analysis) of hazardous material per Class 5 Material under fire protection law

1) Measuring method

Fill a sample in a stainless steel pressure-proof airtight cell, and take measurement at a heating rate of 10° C/min using Differential Thermal Analyzer (DTA) or Differential Scanning Calorimeter (DSC).

2) Analysis of measurement results and judging

- (1) Use benzoyl peroxide (BPO) and 2,4-dinitrotoluene (DNT) as standard reference materials and acquire their heat quantities by thermal analysis through decomposition reactions and decomposition start temperatures.
- (2) Plot logarithms of values where the heat quantities of BPO and DNT are multiplied by 0.8 and 0.7, respectively, on the axis of ordinate, and those where the decomposition start temperatures are subtracted by 25° C on the axis of abscissa. Then, connect the two points with a straight line.
- (3) By the same method, take measurements of a test material, and plot obtained data. When the result comes on or above the straight line connecting the two points of BPO and DNT, it shall be judged a hazardous material.

Example of measurement

Concerning BPO and DNT the standard reference materials, the heat quantities and temperatures obtained from the measurement results (Figures 2 and 3) were plotted in Figure 1 according to the above method, and two points (O) were connected each other.

Results of measurements of test materials (Figures 4-7) were also plotted (·).

All of the samples consequentially came above the straight line and thereby judged the Class 5 Materials.

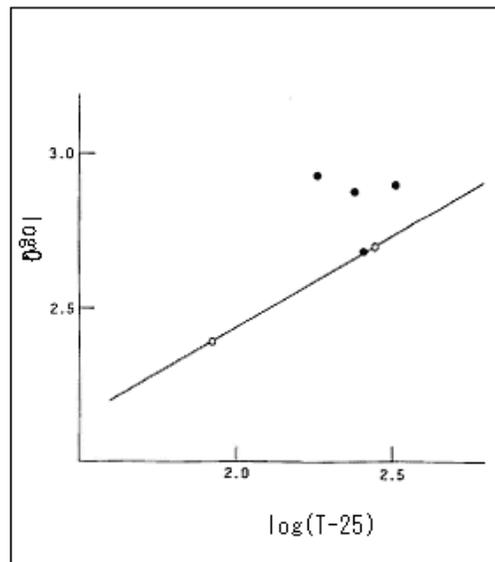


Fig. 1
Correlation plot of heat quantity and temperature

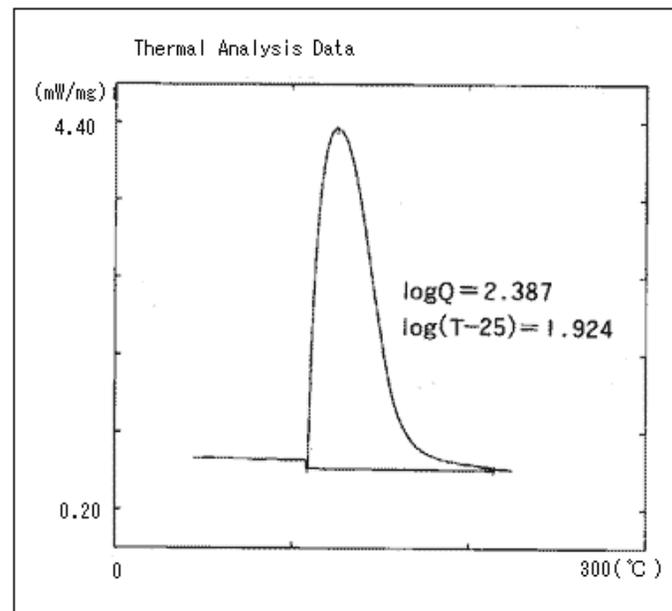


Fig. 2 Benzoyl Peroxide (BPO)

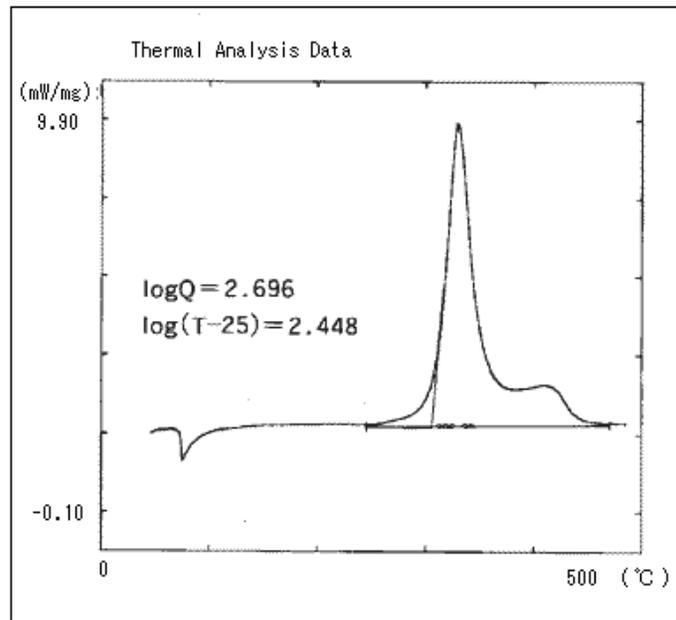


Fig. 3 2,4-dinitrotoluene (2,4-DNT)

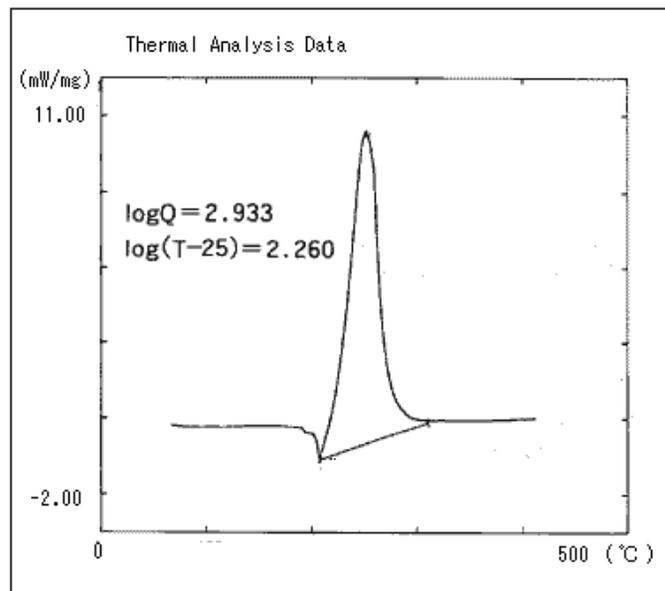


Fig. 4 Trimethylenetrinitramine (RDX)

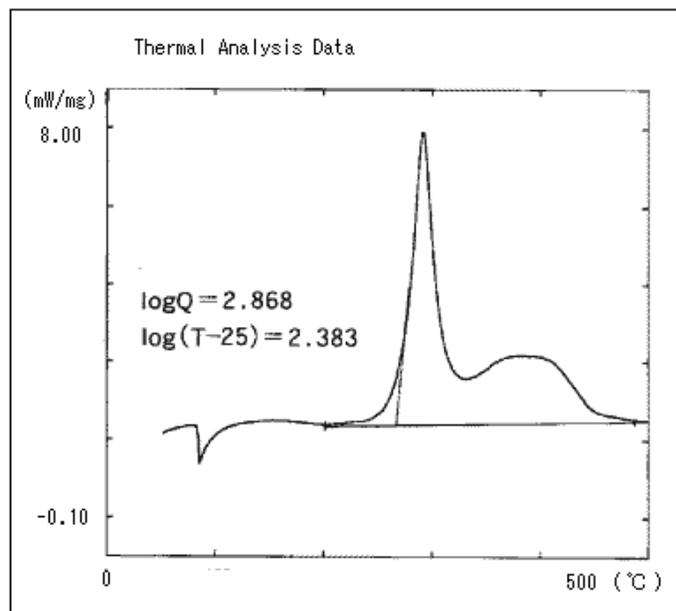


Fig. 5 2,4,6-trinitrotoluene (TNT)

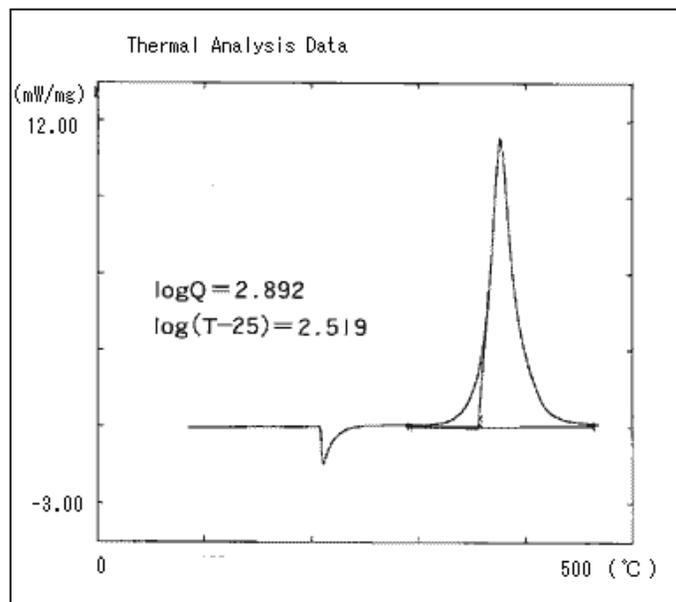


Fig. 6 3,5-dinitrobenzoic acid

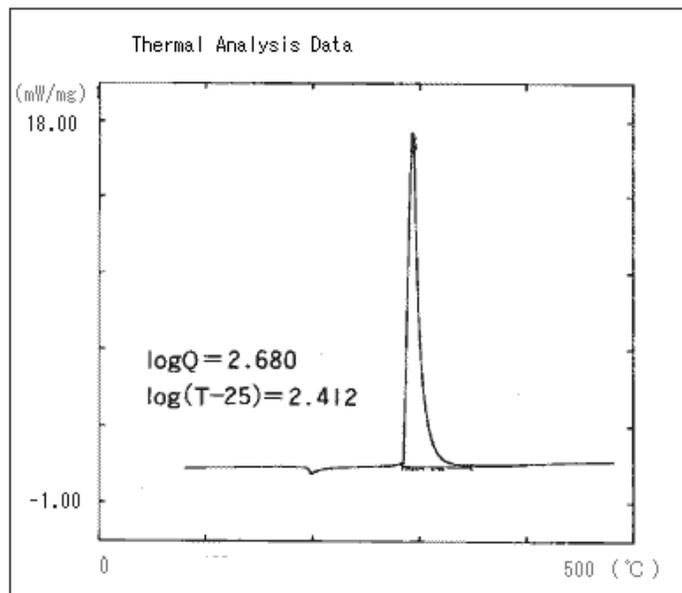


Fig. 7 Tetramethylenetetranitramine (HMX)

* Please be advised that data obtained before the implementation of the current Weights and Measures Law may be presented in terms of gravimetric unit.



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