

SIMULATION OF THE THERMAL BEHAVIOR OF ENERGETIC MATERIALS BASED ON DSC SIGNALS

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Kinetic parameters of the decomposition of propellant can be applied for the estimation of their thermal behavior under any temperature profile. Presented paper describes the application of the advanced kinetic approach for the determination of the thermal behavior in case of different storage conditions.

The prediction of the shelf life of energetic materials requires (i) the precise determination of the kinetics of their decomposition and (ii) the knowledge of the heat balance in the system and external parameters as e.g. exact storage temperature profiles. Due to the fact that for the energetic materials the decomposition processes result in the evolution of heat, the thermoanalytical methods such as Differential Scanning Calorimetry (DSC) are often used for the evaluation of the kinetic parameters of these reactions.

DSC technique compared to HFC is less sensitive but it is very useful for the investigation of the total course of the decomposition i.e. for the reaction progress range α from 0 to 1. The experiments are generally carried out with heating rates varying from ca. 0.25-8 K/min with the scanning time being in the range from few minutes to few hours in both, iso- and non-isothermal modes. The conversion of the DSC signals into the data used for the kinetic calculations requires the knowledge of the exact course of the baseline which shape can significantly influence the proper evaluation of the relationships: reaction rate and progress vs. time (or temperature) what, in turn may influence the determination of kinetics.

This technique is illustrated by results of the investigation of a double base propellant used for defence applications in small caliber types.