

Kinetics of thermo-chemical decomposition of RDX in cyclohexanone and gamma-butyrolactone determined with ARCTM and heat flow microcalorimetry

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To improve its crystalline quality RDX is processed in suitable solvents, among them are cyclohexanone and gamma-butyrolactone. In spite of its relatively high thermal stability RDX can decompose to a certain extend during processing. Several qualities of RDX were investigated: so-called insensitive RDX (I-RDX) from Eurenco, Sorgue, France and so-called sensitivity reduced RDX (S-RDX) from Chemring, Saetre, Norway. In addition, both types were used in a coarse (class 1) and a fine (class 5) particle size.

With ARCTM (Accelerating Rate Calorimetry) solutions between 6 mass-% and 10 mass-% of RDX in the two solvents have been used with 1 inch titanium ARCTM bombs. The used instrument was so-called ES-ARC from THT Inc. Bletchley, MK1 1SW, UK. It was operated in the so-called 'heat-wait-search' mode to register the decomposition exotherm reached by pseudo-adiabatic selfheating. The temperature range of detected decomposition is between 130°C and 230°C. The amount of RDX was used-up during the course of the full decomposition curve, means after the end of selfheating all RDX was consumed. The curves show an initial faster increase in self-heat rate. Mostly this is indicative for chemical species which accelerate decomposition. Such features can be caused autocatalytically or by impurities. The curves were described with reaction kinetic models and Arrhenius parameters have been obtained.

The heat flow microcalorimetry (HFMC) measurements were performed with TAMTM III and a modified TAMTM II instruments from TA Instruments. Isothermal measurement temperatures were 90°C, 100°C, 110°C and 120°C. The data evaluation was done by differential iso-conversional description.

To have an indication about the amount of RDX decomposition in the HFMC runs the solution were analysed with HPLC to find out the residual RDX content in the solutions.

Keywords: ARC, heat flow microcalorimetry, RDX, solution in cyclohexanone, solution in gamma-butyrolactone, kinetic evaluation