Name: Maria Donnelly

Class: CHM 644

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Title: Thermal Analysis of Explosive Formulations

Abstract:
Explosive mixtures have found widespread use both in military applications and as components of improvised explosive devices (IEDs). Knowledge of how the components of these formulations interact with each other is beneficial to military and anti-terrorism organizations. In this study, thermal analysis techniques were used to analyze both fuel/oxidizer explosives (FOX) and a new insensitive explosive formulation containing 2,4-dinitroanisole (DNAN) that has been developed as a replacement for TNT. Differential scanning calorimetry (DSC) and simultaneous differential scanning calorimetry/thermogravimetric analysis (SDT) were used to gain insight into the differences in stability and heat release among a variety of potential fuel/oxidizer explosives (FOX). It was found that the reactions of these mixtures were often initiated by a change, such as a melt, phase change, or decomposition, occurring in either the oxidizer or the fuel. Overall, mixtures containing potassium chlorate and ammonium nitrate released the most heat, while those containing potassium dichromate exhibited the smallest exotherms. The insensitive munitions formulations were analyzed by DSC and through isothermal decomposition studies followed by high pressure liquid chromatography (HPLC) analysis, and the results were compared to similar formulations containing 2,4-dinitrotoluene (DNT) in place of the DNAN. It was found that while DNAN by itself is more thermally stable than DNT, its stability is decreased significantly when mixed with the other components of the insensitive formulation (nitroguanidine and 3-nitro-1,2,4-triazol-5-one).