Thermal Characterization of Ammonium Dinitramide (ADN) - Hydroxylammonium Nitrate (HAN) Mixture

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The Utility of Ammonium Dintiramide (ADN) as A high energy oxidizer has several advantages over conventional propellants currently in use. It has good stability compared to other derivatives because of de-localized negative charge, which resonates among seven atoms in $(N(NO_2)_2^-)$ [1]. In addition, it also gives better specific impulse (*Isp*) than conventional oxidizers. However, low thermal characteristics and relatively high degree of hygroscopic nature are the main hurdles in the development of large scale plants for ADN production [2].

In this paper, the synthesis and thermal properties of ADN will first be reported, followed by the ADN-HAN solution, which has seldom been discussed.

ADN was produced in house using nitration process followed by slow addition of ammonium sulfamate as described [1], which is based on nitration process. Next, prilled ADN was produced using the ADN solution available, according to method as described [3]. 90ml of paraffin oil was heated in a 100ml glass beaker on a hot plate. ADN was introduced under strong agitation when the temperature of the solution increased above 80 ^{0}C, and allowed to rise up to 92-93 ^{0}C. The entire assembly was immersed in a cold bath throughout the process.

At the end of experiment, ADN in shape of large spherical balls formed at the bottom of the beaker, allowed to settle and washed with hexane to remove oil. DSC result shows the prilled ADN samples has melting point of 88 ^{0}C, as shown in Figure 1. Characterisation on the mixture of 85% ADN-HAN solution shows first decomposition at 107 ^{0}C followed by 2nd decomposition of 43% and lastly of 32%, residue: 4%, as shown in Figure 2.

Although more work is currently being carried out in characterizing ADN-HAN mixtures at various ratios, preliminary result indicating the mixture may have outperform conventional ADN

solution. In addition, HAN-ADN solution investigated somewhat retains their inherit properties, but lowering of 1st decomposition point to 100-120 ^{0}C is new and yet to be theorized.

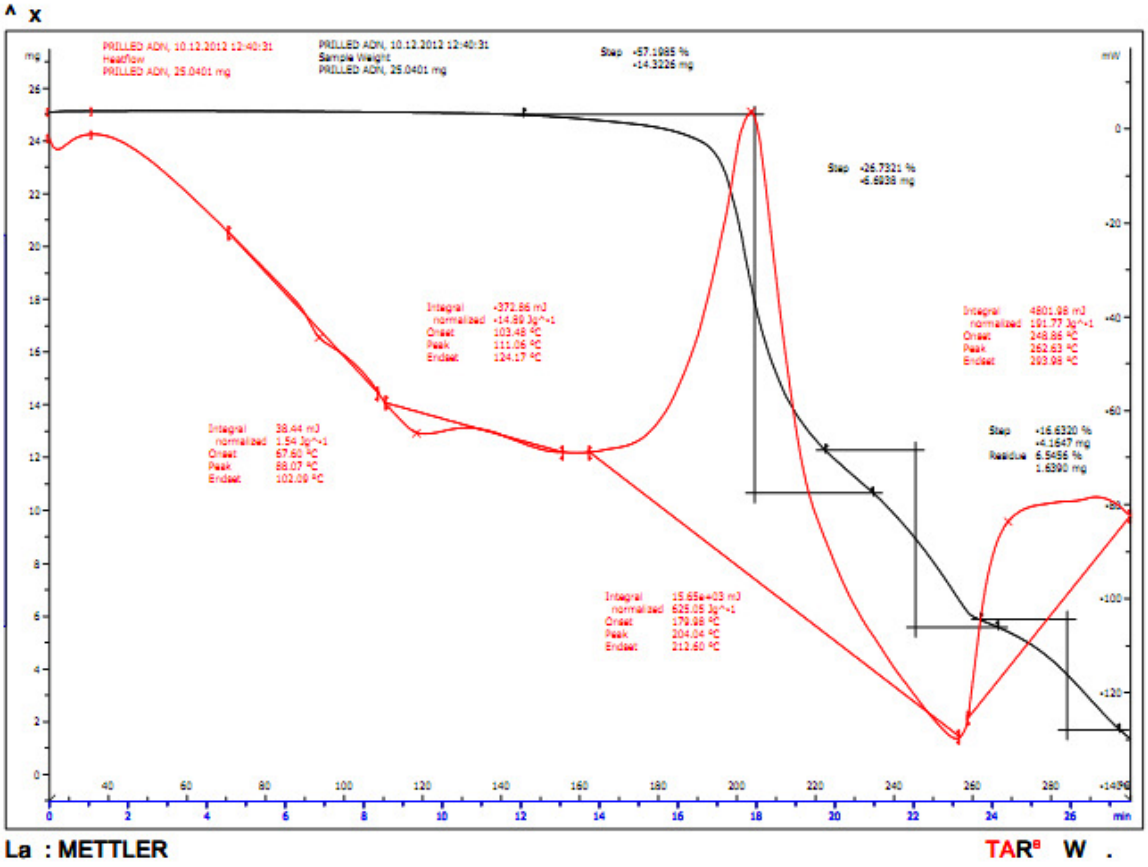

Figure 1: Decomposition of prilled ADN in a TGA/DSC.

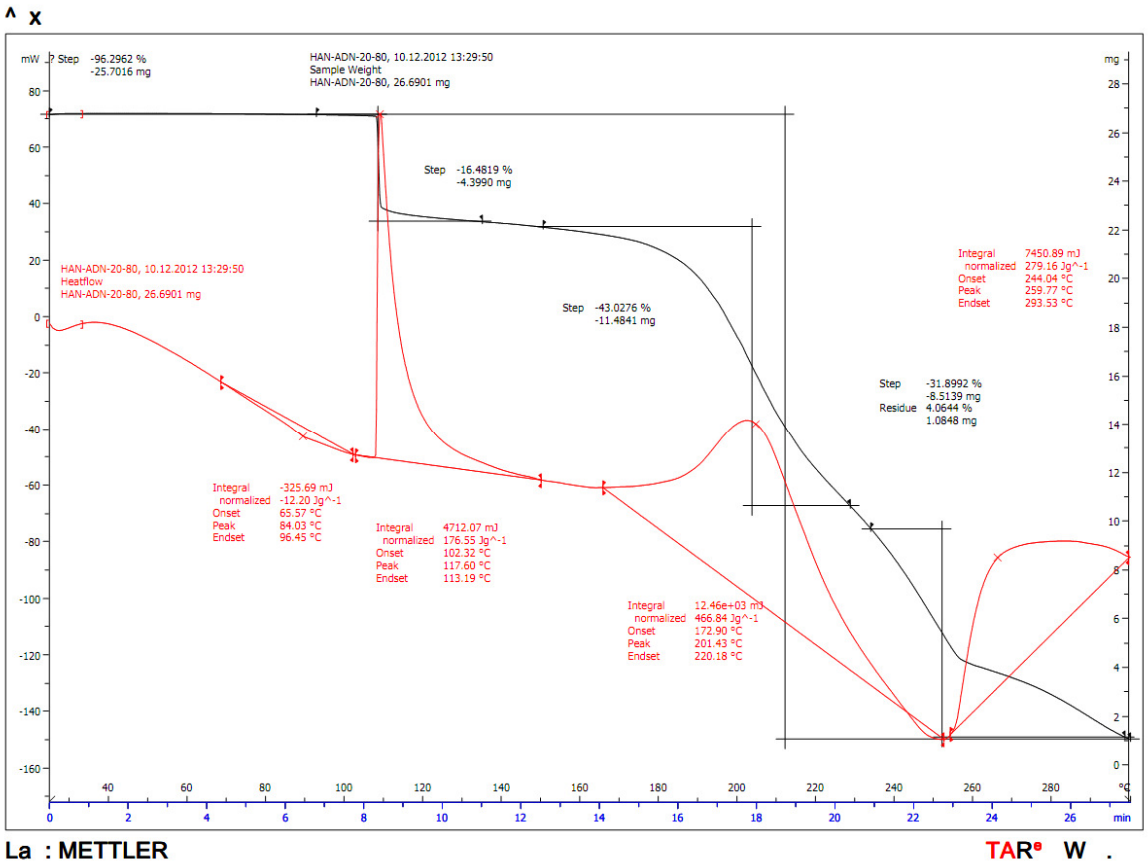

Figure 2: Thermal characteristics of 85% ADN-HAN solution.

Reference:

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3. G. Santhosh, Ang How Ghee, 2008, Synthesis and kinetic analysis of isothermal and non-isothermal decomposition of ammonium dinitramide prills, *Journal of Thermal Analysis and Calorimetry*, 94(1), 263 – 270.