HENKIN TIME-TO-EXPLOSION FOR TATB - PART I

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DEVELOPMENT DIVISION

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Process Development
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ABSTRACT

The times-to-explosion were determined for 11 samples of triaminotrinitrobenzene (TATB) and the average times at 367 C varied from 9 to 200 seconds. These data show that the Henkin test can indicate lot-to-lot variations in TATB.

To obtain reproducible times-to-explosion values it was necessary to develop a new method of sealing the TATB samples in aluminum blasting caps.

INTRODUCTION

Triaminotrinitrobenzene (TATB) is a thermally stable and an insensitive high explosive. TATB is either insoluble or only slightly soluble (a few ppm) in most solvents making chemical analysis difficult. Currently, TATB analyses include total chlorine by Parr bomb, inorganic chloride, and percentage extractables.

The purpose of this investigation is to determine if lot-to-lot differences in TATB can be determined by the Henkin test.

- (1) E. D. Loughran, R. N. Rogers, "The Influence of Metals on the Thermal Decomposition of TATB," LASL, December 1974, p. I-E-1.

^aThe Lee Company, Westbrook, Connecticut.

DISCUSSION

The Henkin test is normally conducted with sealed samples in bronze blasting caps, but Loughran, et al(1) has shown that TATB reacts with bronze. Therefore, it was necessary to conduct the test in aluminum blasting caps.

Previous investigations by the author using aluminum blasting caps gave a much greater scatter in the time-to-explosion value than in bronze caps. The increased scatter is believed to be caused by inadequate sealing of the aluminum blasting caps. Also, the scatter was greater at high test temperatures.

For test temperatures above 300 C, Lee^a plugs are used to seal the sample in the blasting caps. The Lee plug consists of a cone which is pressed into a cup causing the cup to expand and seal the blasting cap.

Preliminary tests were made with the aluminum blasting caps and Lee plugs but there was considerable scatter in the data resulting in an improvement to the method of sealing the samples in the aluminum blasting caps.

Several techniques to improve the sealing of the samples in the blasting caps were evaluated and the most successful was a ferrule system shown in Fig. 1. The ferrule's outer dimension is the same as a 5/16 Swagelok front ferrule but the inner diameter was changed to match the blasting cap. A standard 5/16 tubing fitting was used to swage the special ferrules to the blasting cap as shown in Fig. 2.

Fig. 1. Sealing System Used to Seal the Aluminum Blasting Caps for the Henkin Test

Fig. 2. System Used to Swage the Ferrule to the Blasting Caps

The 80 mg samples of TATB were weighed into the aluminum blasting cap, followed by a sized gas check and the outer Lee plug which was pressed using a punch and die at 135 MPa. The cone of the Lee plug was pressed in the Lee plug cup at 135 MPa. The blasting cap and ferrule were placed in another fixture to swage the ferrule on the blasting cap at the Lee Plug. This assembly was then tested in the standard metal temperature bath.

Eleven samples of TATB were selected because of purity, abnormal color, trash in sample and the percentage extractables. These data are given in Table I. The times-to-explosion varied from 9 to 200 seconds. The available chemical analysis data for these samples are given in Table II.

Table I. Henkin Time-To-Explosion for Various Lots
of TATB at 367 C

(Time in Seconds)

<u>Sample No.</u>	<u>Time-To-Explosion (Seconds)</u>	<u>Mean</u>	<u>σ</u>	<u>Comments</u>
Pantex Lots				
4274-16-01	120 118 110 122	118	5	Control sample
6036-16-01U	215 190 200 190	200	10	Recrystallized from Biphenyl
5223-16-01	9 7 9 10	8.8	1.3	Very dark color with trash
5042-16-01	78 72 79 97	82	11	Dark color with trash
5280-16-01R2	160 174 188 170	173	12	Reused Toluene from previous amination
5281-10-01R3	166 144 140 153	151	12	Reused Toluene from previous amination but different color from 5280-16-01R2
5072-16-02	139 158 165 159	155	11	Normal color with trash
Cordova Lots				
1A-034-02	83 80 86 85	86	7	Approximately 4.5% extractables, early lot, dark color
1B-034-054	127 120 110 129	122	9	Approximately 0.55% extractables
0828-111	171 157 111 131	143	37	Extra fine H ₂ O amination
Teledyne Lots				
Batch No. 2	31 50 31 42	39	9	Teledyne Batch No. 2

Table II. Analysis of the 11 Samples of TATB

	Particle Size		Total	Solubles
	% < 20 μm	% < 44 μm	C1 (%)	(%)
<u>Pantex Lots</u>				
4274-16-01	15.6	36.2	0.77	NA
5042-16-01	4.0	23.2	0.59	NA
5072-16-02	1.9	18.3	0.53	NA
5223-16-01	5.3	15.9	1.79	NA
5280-16-01R2	12.87	40.7	0.66	NA
5281-16-01R3	9.16	53.6	0.67	NA
6063-16-01U	NA	NA	> 0.02	NA
<u>Teledyne</u>				
Batch No. 2	94	16	3.45	
<u>Cordova</u>				
1A-02			1.15	4.5
1B-054	9.1	21.0	0.73	
1B-111	26.1	57.2	0.50	0.55

DTA thermograms were run on the 11 samples of TATB and these are shown in Figs. 3 through 12. The thermogram of Sample No. 6063-16-01U which had the longest time-to-explosion is superimposed on the other thermograms to show differences in their decomposition temperature.

This investigation has shown that it is possible to obtain reproducible

time-to-explosion data for TATB samples at 367 C. These data also show variations in the times-to-explosion for different samples of TATB.

The cause for these variations in the times-to-explosion will be discussed in Part II of this investigation.

Fig. 3. DTA Thermograms of TATB

Fig. 4. DTA Thermograms of TATB

Fig. 5. DTA Thermograms of TATB

Fig. 6. DTA Thermograms of TATB

Fig. 7. DTA Thermograms of TATB

Fig. 8. DTA Thermograms of TATB

Fig. 9. DTA Thermograms of TATB

Fig. 10. DTA Thermograms of TATB

Fig. 11. DTA Thermograms of TATB

Fig. 12. DTA Thermograms of TATB