COMPATIBILITY OF EXTEX WITH TETRYL

By
THERMAL METHODS

L. C. Myers

DEVELOPMENT DIVISION

OCTOBER - DECEMBER 1971

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The purpose of the project is to evaluate the long-term compatibility of Extex, tetryl, and stainless steel felt metal.

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ABSTRACT

A final report is given on the study of the compatibility of Extex and tetryl. The 100 C coupon test samples were discarded after 8 weeks because of excessive decomposition. The 80 C coupon test evaluations have been completed and an analysis of the data made. There is no indication of a compatibility problem of Extex with tetryl as long as they are in a solid phase.

DISCUSSION

The purpose of this study is to evaluate the compatibility of Extex, tetryl, and "felt metal" (a porous stainless steel).^a Differential thermal analysis and the chemical reactivity test (CRT) were used as initial screening tests for Extex and tetryl and the data from these indicated that these explosives are compatible at temperatures below 100 C.

Initial runs made on Extex and tetryl in the CRT run at 120 C gave a definite indication that the two were reactive. But runs made at 100 C did not show any indication of reactivity (Table I). This difference results from the partial melting of tetryl at 120 C, liquid phase kinetics being considerably different from the solid phase kinetics.

Coupon test assemblies were made using 1/2-inch pellets of tetryl, felt metal and Extex sandwiched together as shown in Fig. 1. Twenty of these coupons were sealed in stainless steel containers, evacuated, and backfilled with helium. Ten were stored at 80 C and the others at 100 C.

A 100 C sample was taken at weekly intervals for evaluation which included gas analysis of the atmosphere, a visual inspection of the coupons and then DTA of the Extex and tetryl. The 100 C test was terminated after 57 days due to considerable decomposition of the explosive because the tetryl was in a liquid phase.

The gas analyses of the atmosphere in the 100 C samples ~~are given in Table II to~~ show that there are no serious compatibility problems with these materials until a liquid phase exists. There was very little reactivity between the Extex and tetryl for five weeks (35 days) or before the tetryl passed into a liquid phase.

^aBrunswick Technical Products, Milford, Connecticut

The 80 C samples were sampled every three or four weeks for twenty-five weeks and the same evaluation is made on the samples as was made on the 100 C samples.

The gas analyses of the atmosphere in the 80 C samples are given in Table ^{II} III. These data show no serious compatibility problems with these materials.

As the test containers were disassembled, photographs of the samples were taken. These are shown in Figs. 2-8. After 42 days at 100 C the tetryl began to pass onto a liquid phase (Fig. 8). The gas analysis began to show a definite increase in the decomposition gases after 35 days.

The gas analyses of the 80 C test show no significant increase in the decomposition gases after 176 days. This indicates that the tetryl, felt metal, and Extex have not reacted.

On comparing the control samples (Figs. ^{Fig 12} 9-12), to the heated sample it is evident that there are color changes in the materials. The tetryl becomes much darker and the Extex turns to a light yellow on the surface. It remains white below the surface.

The DTA thermograms show no significant changes in the Extex or tetryl until the tetryl passes into a liquid phase and then there is a definite change in the thermograms.

CONCLUSIONS

The volumes of gas evolved from the coupon test before the tetryl passed into the liquid phase were too small for an accurate analysis, so decomposition rates could not be determined for this system. This rate was to be used to calculate the equivalent stockpile age.

Thermal decomposition rates were determined for PETN and tetryl data taken from a modified Henkin's time-to-explosive test. From these time-to-explosive curves for PETN and tetryl (Figs. 13-14) it was determined that a 10 C increase in temperature increased the decomposition rate by approximately 2.

If one assumes the decomposition kinetics at 30 C to be the same as those in the Henkin's time-to-explosion test and the coupon assemblies then an extrapolated stockpile age for these components at 30 C would be 14.7 and 15.4 years based on 42 days at 100 C and 176 days at 80 C, respectively. Therefore, these data indicate that these materials are compatible.

Table I. Chemical Reactivity Test
Extex and Tetryl

(0.25 g sample heated 22 hrs. for specified temperature)

(Gas evolved in μl @ STP)

(no findings)

Sample	N_2	CO	NO	CO_2	H_2O	Total
Extex	8.24	3.44	12.9	7.04	1.75	33.4
@ 120 C	6.96	3.47	7.70	7.48	1.89	27.5
Tetryl	18.7	.31	4.64	11.1	.88	33.6
@ 120 C	29.1	1.40	3.21	16.9	1.82	52.4
Tetryl with Extex @ 120 C	6570.	2750.	2520.	3480.	500.	15,800.
Tetryl	6.10	T	-0-	1.34	T	7.44
with Extex	19.2	T	-0-	2.72	T	21.9
@ 100 C	12.4	T	-0-	2.23	T	14.6

T indicates a trace > .1 μl

Table II. Analysis of the Atmosphere in the EXTEX
and Tetryl Coupon Test Assemblies Conditioned
at 100 C

Sample No.	43	44*	42*	45	46	47
Days @ 100 C	8	14	21	29	35	42
	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>	<u>%</u>
N ₂	.31	3.87	75.68	1.43	1.11	2.08
O ₂			21.08	.18		
CO						
NO	.50			.63	1.03	1.54
CO ₂	.25			.45	.90	1.79
N ₂ O		.79	.13			
He	98.62	95.08	2.22	96.94	96.68	94.32
H ₂	.09			.08		
Acetone	.23	.26		.29	.28	.27
Argon			.89			

* Samples appeared to have leaked.

Table III.

Analysis at the Atmosphere in the EXTEX
and tetryl Coupon Test Assemblies conditioned
at 80°

Sample No.	51	52	53	54*
Days @	75	96	125	176
80 C	%	%	%	%
N ₂	.90	.17	.29	3.42
O ₂				.10
NO	.07	.47	.58	.31
CO ₂	T	T	T	T
N ₂ O	.37	.31	.14	.34
He	98.38	98.89	98.72	95.58
Acetone	.16	.16	.27	.19

* The increase in N₂ and the presence of O₂ indicates a small
air leak. Otherwise, there is no apparent change.

Fig. 1. Extex, Tetryl, and Felt
Metal Assemblies

Fig. 2. Assembly No. 43, 8 Days
at 100 C

Fig. 3. Assembly No. 44, 14 Days
at 100 C

Fig. 4. Assembly No. 42, 21 Days
at 100 C

Fig. 5. Assembly No. 45, 29 Days
at 100 C

Fig. 6. Assembly No. 46, 35 Days
at 100 C

Fig. 7. Assembly No. 47, 42 Days
at 100 C

Fig. 8. Assembly No. 48, 56 Days
at 100 C

Fig. 9. Assembly No. 51, 75 Days
at 80 C

Fig. 10. Assembly No. 52, 90 Days
at 80 C

Fig. 11. Assembly No. 53, 125 Days
at 80 C

Fig. 12. Assembly No. 54, 176 Days
at 80 C

Fig. 13. Time-to-Explosion for PETN

Fig. 14. Time-to-Explosion for Tetryl

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