TATB PARTICLE SIZE EXPERIMENT -
30-LITRE REACTOR

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SUMMARY

Three small lots of TATB, which were categorized as having normal, bi-modal, and fine particle size distributions, were used to make RX-03-BB PBX. The physical strength of the PBX did not appear to be significantly altered by the different particle size distributions. Tensile and compression data of all three lots were comparable with the exception of compression data from the batch made with the fine particle size TATB which gave a lower strain-at-rupture.

INTRODUCTION

Traditionally the properties of a PBX are expected to be significantly affected and altered by the particle size distribution of the crystalline explosive. Previous attempts to correlate the TATB particle size to the physical properties of the finished RX-03-BB TATB PBX have not been definitive. Therefore, using the 30-litre reactor, batches of RX-03-BB TATB PBX were made from different TATB particle size distributions and tested for physical strength.

DISCUSSION

PROCESSING

Small lots of RX-03-BB PBX were made in the 30-litre reactor using the standard slurry procedure which involves the use of an air sweep and a 133 g/litre HE to water ratio. Because of the capacity of the 30-litre reactor and the necessity to supply 3.6 kg of material for pressing, each lot consisted of a wet blend of two 1.8 kg batches.

PHYSICAL STRENGTH AND TATB PARTICLE SIZE

Physical strength values for RX-03-BB along with TATB particle size data are summarized in Table I. The physical strength data were obtained using the standard 20.3 mm diameter specimens at a constant crosshead speed of 0.002 mm/s for the tensile test and 0.001 mm/s for the compression test. Testing was for screening purposes only. Tensile stress/strain curves are shown in Fig. 1 and compression curves are shown in Fig. 2. Fig. 3 contains photographs of broken tensile specimens. Tables II through VII include details of the physical properties tests shown in the stress/strain curves. The TATB particle size distributions are shown in Fig. 4. These data were obtained by A. A. Duncan by sieve analysis.

CONCLUSIONS

The tensile strength results indicate that there is very little difference between the three batches. The compression stress levels are very similar; however, it appears that the compression elongation or strain-at-rupture could be slightly affected. Strain from the batch made with the fine TATB is somewhat reduced though the effect may not be significant since strain at ultimate stress is not affected.

FUTURE WORK

In order to further investigate the possible effect of TATB particle size on physical strength two 45 kg batches have been made in the 300-gallon reactor using two distinctive TATB particle sizes; one is relatively fine with 53.1% < 44 μ and 25.6% < 20 μ while the other batch is much coarser with 20.98% < 44 μ and 3.65% < 20 μ . These two batches have been formulated and treated as nearly identical as possible so as to diminish the effect of other variables. Physical strength screening data are being obtained.

Table I. Physical Strength TATB Particle Size Experiment

TATB Lot No.	% < 40 μ	% < 20 μ	RX-03-BB Lot No.	Compression		Tensile	
				Stress (MPa)	Strain (%)	Stress (MPa)	Strain (%)
5226-16-01 Bimodal	55.74	34.39	5311-145-03	18.92	5.68	8.51	0.24
5260-16-01 Normal	47.72	8.44	5314-145-03	19.40	5.89	8.54	0.25
5195-16-01 Fine	93.34	35.76	5316-145-03	18.99	4.10	7.95	0.23

Fig. 1. Tensile Tests - RX-03-BB TATB Particle Size Experiments

Fig. 2. Compression Test - RX-03-BB TATB Particle Size Experiments

No. 5311-03
Bimodal

No. 5314-03
Normal

No. 5316-03
Fine

Fig. 3. Broken Tensile Test Specimens

Fig. 4. TATB Particle Size Distribution

Table II. Tensile Test at 0.002 mm/s at 21 C for RX-03-BB

(Lot No. 5311-145-03, Pressing No. 83323Y3104,
Density 1.907 Mg/m³)

Piece No.	Rupture Mode ^a	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
1	4	535	8.19	0.16
2	2	660	8.69	0.24
3	4	572	8.72	0.32
4	6	554	8.44	0.24
Mean		581	8.51	0.24
Std. Dev.		55	0.25	0.07

^a1 and 7 are in the curve section, 2 and 6 are in the straight section outside the extensometers, 3 and 5 are at the knife edges and 4 is between the knife edges

Table III. Compression Test at 0.001 mm/s at 21 C for RX-03-BB

(Lot No. 5311-145-03, Pressing No. 83323Y3104,
Density 1.906 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
5	2382	18.69	1.87	4014	5.13
6	2334	19.24	1.79	4578	5.99
7	2430	18.93	1.84	4776	5.68
8	2262	18.82	2.23	4350	5.93
Mean	2352	18.92	1.93	4430	5.68
Std. Dev.	72	0.24	0.20	327	0.39

Table IV. Tensile Test at 0.002 mm/s at 21 C for RX-03-BB

(Lot No. 5316-145-03, Pressing No. 83323Y3103,
Density 1.911 Mg/m³)

Piece No.	Rupture Mode ^a	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
4	4	260	7.89	0.24
3	2	235	7.59	0.21
2	2	289	8.08	0.24
1	6	272	8.23	0.25
Mean		264	7.95	0.23
Std. Dev.		23	0.28	0.02

^a1 and 7 are in the curve section, 2 and 6 are in the straight section outside the extensometers, 3 and 5 are at the knife edges and 4 is between the knife edges

Table V. Compression Test at 0.001 mm/s at 21 C for RX-03-BB

(Lot No. 5316-145-03, Pressing No. 83323Y3103,
Density 1.911 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
5	2550	19.03	2.16	3486	4.27
6	2334	19.07	2.08	3012	3.49
7	2382	18.93	2.10	3330	4.02
8	2466	18.93	2.07	3534	4.53
Mean	2433	18.99	2.10	3341	4.08
Std. Dev.	95	0.07	0.04	236	0.44

Table VI. Tensile Test at 0.002 mm/s at 21 C for RX-03-BB

(Lot No. 5314-145-03, Pressing No. 83324Y3101,
Density 1.903 Mg/m³)

Piece No.	Rupture ^a Mode	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
1	3	635	8.52	0.22
2	4	557	8.78	0.27
3	4	570	8.30	0.25
Mean		587	8.54	0.25
Std. Dev.		42	0.24	0.03

^a1 and 7 are in the curve section, 2 and 6 are in the straight section outside the extensometers, 3 and 5 are at the knife edges and 4 is between the knife edges

Table VII. Compression Test at 0.001 mm/s at 21 C for RX-03-BB

(Lot No. 5314-145-03, Pressing No. 83324Y3101,
Density 1.903 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
5	2598	19.75	2.17	4482	4.90
6	2370	19.41	2.19	4518	6.24
7	2448	19.48	2.20	4938	6.48
8	2352	18.96	1.99	4524	5.93
Mean	2442	19.40	2.14	4616	5.89
Std. Dev.	112	0.33	0.10	216	0.70