WET BLENDING EVALUATION -
30-LITRE REACTOR

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DEVELOPMENT DIVISION

MASTER

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SUMMARY

A series of small scale experiments was conducted to evaluate TATB PBX blending. These included (1) washing a small quantity of LLL B9 PBX to remove dust, (2) reworking a portion of the LLL B9 lot and (3) blending some LLL B7 PBX in the 30-litre reactor duplicating as nearly as possible the same conditions as were used for LLL B9 blending. Results from this limited study do not clearly define and isolate problem areas; however, the indications are sufficiently strong to warrant a change in our blending procedure. These changes have been made.

INTRODUCTION

The large lots of RX-03-BB TATB PBX produced for LLL were comprised of batches made and blended in the 300-gallon kettle. Blending is desirable to provide large homogeneous lots of material. Blend sizes have ranged from 279 to 490 kg. The 490 kg blend (LLL B9) is the latest completed lot produced. Observation of the blending process and the slight discoloration of the processing water strongly suggested that 490 kg approaches or possibly exceeds the blending limit in the 300-gallon kettle. Therefore, it was deemed necessary to examine the blending process to determine if any of the properties of LLL B9 had perhaps in some way been impaired by blending and if the 490 kg batch was beyond the upper limit of blending capacity in the 300-gallon kettle.

DISCUSSION

The three batches of material included in these experiments this quarter were subjected to the physical properties screening tests. Standard 3.6 kg pressing sizes were made to minimize the influence of pressing. Physical strength data include tensile and compression stress-strain curves. The basic data are given in Table I and the detailed data are given in Tables II through VII. Representative photographs of broken test specimens are shown in Fig. 7.

HAND WASHING - NO. 5353

A 3.6 kg batch of LLL B9 PBX was placed in a container and gently washed two times using a hand spatula to reduce any grinding action in an attempt to remove any dust that may have been in the PBX. There was no evidence of discoloration in the water. Physical data shown in Figs. 1 and 2 are very similar to some of the early screening data obtained on the LLL B9. This procedure offers no obvious change or significant improvement in physical properties.

REWORKING - NO 5342

Two small 1.8 kg batches of LLL B9 were reworked in the 30-litre reactor and subsequently blended to provide 3.6 kg for pressing and physical properties testing. The procedure is a different process from the one used to reclaim machine cuttings. The reworking procedure is patterned as nearly as possible after the standard slurry process. The PBX, solvent and water are stirred in a small quantity of water before adding the balance of water and removing the solvents with heat and an air sweep. Physical data are presented in Figs. 3 and 4. Note that although the results are similar to the hand-washed batch, there does appear to be some improvement in the tensile stress and strain.

BLENDING CONDITIONS DUPLICATED WITH LLL B7 - NO. 6028

LLL B7 RX-03-BB is categorized as having the best overall physical properties of any blend made to date. Therefore, the conditions used for blending LLL B9 were simulated on a small-scale in the 30-litre reactor with LLL B7. Using an HE-to-water ratio of 650 g/litre, which is several times that used in the regular slurry process, 5.2 kg of LLL B7 were mixed at a very low agitation rate, sufficient only to keep the granules suspended for approximately 1 hour (the time required to load and unload the 300-gallon kettle when the LLL B9 was blended). The PBX was removed and washed in the same style as the LLL B9. After drying, a standard 3.6 kg pressing was made for physical properties evaluation.

Some dust was evident in the blending water; 30 g of dried dust was obtained upon filtration. The physical properties data, Figs. 3 and 4 show that the tensile data were virtually unaffected when compared to the original LLL B7 data (this point is noted on Fig. 5). Although the tensile specimens failed in the radius section as shown in Table VI the data were closely grouped and considered acceptable for comparing with the original LLL B7 screening data. The compression data do show some decrease in strain-at-rupture, although the strain is very nearly the same at ultimate. The most significant finding can be seen in the photograph shown in Fig. 7. Note that the compression sample shows failure at the granule interface.

CONCLUSION

Based on limited experiments it appears that RX-03-BB physical properties have not been severely impaired by blending. However, the failure at the granule interface of the LLL B7 PBX which was blended is a sufficient reason to modify the blending procedure for the larger lots. Tentatively, the decision has been made not to exceed 400 kg of material in the kettle in any given single blend. Large lot sizes will require cross blending. Also, a large loading chute has been provided which will cut the loading time from minutes to seconds, and several receivers have been prepared to facilitate the rapid unloading of the vessel.

Table I. Physical Strength - RX-03-BB 30-Litre Reactor

<u>TATB Lot No.</u>	<u>Treatment</u>	<u>Compression</u>		<u>Tensile</u>	
		<u>Stress</u> <u>(MPa)</u>	<u>Strain</u> <u>(%)</u>	<u>Stress</u> <u>(MPa)</u>	<u>Strain</u> <u>(%)</u>
5353-145-01	Hand Washed LLL B9	18.07	7.74	7.91	0.17
5342-145-01	Reworked LLL B9	18.51	6.65	8.73	0.24
6028-145-01	Blended LLL B7	19.68	4.72	9.26	0.27

Fig. 1. Tensile Test, RX-03-BB, Hand Washed LLL B9 PBX

Fig. 2. Compression Test, RX-03-BB, Hand Washed LLL B9 PBX

Fig. 3. Tensile Test, RX-03-BB (LLL B9 Reworked)

Fig. 4. Compression Test, RX-03-BB (LLL B9 Reworked)

Fig. 5. Tensile Test, RX-03-BB (LLL B7 Blending Exp.)

Fig. 6. Compression Test, RX-03-BB (LLL B7 Blending Exp.)

COMPRESSION

TENSILE

No. 5342
Reworked LLL B9 PBX

No. 5353
Hand Washed
LLL B9 PBX

No. 6028
Blending Experiment
LLL B7 PBX

Fig. 7. RX-03-BB Broken Test Specimens

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

(Lot No. 5353-145-01, Pressing No. 83413Y3107,
Density 1.904 Mg/m³)

Piece No.	Rupture ^a Mode	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
1	3	569	8.00	0.14
2	2	580	8.39	0.23
3	6	529	7.47	0.12
4	3	518	7.79	0.20
Mean		549	7.91	0.17
Std. Dev.		30	0.38	0.05

^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. 5353-145-02, Pressing No. 83413Y3107,
Density 1.905 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
1	2250	18.10	1.83	4719	7.28
2	2256	18.17	1.85	5034	7.65
3	2142	17.82	1.61	5280	7.74
4	2256	18.20	1.53	5592	8.28
Mean	2226	18.07	1.71	5156	7.74
Std. Dev.	56	0.17	0.16	370	0.41

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

(Lot No. 5342-145-01, Pressing No. 83413Y3104,
Density 1.911 Mg/m³)

Piece No.	Rupture ^a Mode	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
1	6	260	7.83	0.21
2	6	299	8.92	0.32
3	4	324	9.36	0.24
4	4	307	8.81	0.21
Mean		298	8.73	0.24
Std. Dev.		27	0.65	0.05

^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. 5342-145-01, Pressing No. 83413Y3104,
Density, 1.911 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
1	2370	18.44	1.81	4371	6.04
2	2229	18.62	1.63	4686	7.30
3	2136	18.51	1.73	3888	7.15
4	2253	18.48	1.85	4305	6.12
Mean	2247	18.51	1.76	4313	6.65
Std. Dev.	96	0.08	0.10	328	0.67

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

(Lot No. 6028-145-01, Pressing No. 83433Y3101,
Density 1.903 Mg/m³)

Piece No.	Rupture ^a Mode	Time (s)	Rupture	
			Stress (MPa)	Strain (%)
2	1	677	9.31	0.27
3	1	640	8.95	0.25
4	1	605	9.52	0.28
Mean		640	9.26	0.27
Std. Dev.		36	0.29	0.02

^a 1 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. 6028-145-01, Pressing No. 83433Y3101,
Density 1.903 Mg/m³)

Piece No.	Failure			Rupture	
	Time (s)	Stress (MPa)	Strain (%)	Time (s)	Strain (%)
5	2496	19.96	2.17	4365	5.14
6	2409	19.58	2.06	3555	4.20
7	2544	19.55	2.06	4275	4.63
8	2547	19.62	2.15	3663	4.89
Mean		19.68	2.11	3965	4.72
Std. Dev.		0.19	0.06	415	0.40