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THERMAL GROWTH AND MECHANICAL PROPERTIES OF RX-03-BB

H. D. Johnson

DEVELOPMENT DIVISION

JANUARY - MARCH 1976

Normal Process Development
Endeavor No. 106

MASTER

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ABSTRACT

Heat treatment at 124 C for 8 days of TATB powder or RX-03-BB granules was found to give no improvement in the mechanical properties or thermal growth of the subsequently pressed RX-03-BB. The results indicate that prior heat treatment may cause an increase in thermal growth.

Strain rate control compression tests for LLL Blend 9 were completed. No significant difference was observed in rupture strain measured with strain rate control (6.7%) and the constant crosshead test (6.8%).

DISCUSSION

Tensile, compression and growth specimens of RX-03-BB (92.5% TATB - 7.5% Kel-F 800) were fabricated from materials pretreated prior or after formulation by the following methods:

Group A: 3.6 kg TATB powder (LLL B6) was placed in an open tray and heated in an oven for 8 days at 124 C. The powder was then formulated into RX-03-BB (Batch No. 5363-145-01) by a formulation procedure described previously(*1*).

Group B: 3.6 kg of RX-03-BB (LLL B9) was heat treated for 8 days at 124 C (Batch No. 5351-145-01).

The finished densities of press parts from Groups A and B were 1.901 Mg/m^3 and 1.905 Mg/m^3, respectively. The tensile specimens were tested at 21 C at a constant crosshead speed of 0.002 mm/s. The tensile test results of Groups A and B are given in Tables I and II, respectively, and shown graphically in Fig. 1. End points of typical tensile data for LLL B6 and B9, Groups A and B, respectively noted on Fig. 1, indicate that tensile strength are virtually unaffected by the heat treatment.

The compression test results obtained at 0.001 mm/s and 21 C given in Tables III and IV and plotted in Fig. 2 verify the trend shown by the tensile results; there is little difference caused by heating (comparative curves are shown in Fig. 2).

Dimensional test specimens (two) fabricated from Groups A and B were thermally cycled from -54 to 74 to -54 C each 24 hours. The parts were monitored twice each week for thermal growth. The Group A test specimens average dimensional growth was near 4.5 mm/m compared with a growth of 3 mm/m for RX-03-BB made from untreated LLL B9 TATB. The Group B specimens exhibited a growth of 5.1 mm/m. Comparable tests have not been conducted for untreated LLL B9 RX-03-BB. The above growth values were obtained after 20 thermal cycles.

(1) "TATB Particle Size Experiments - 30-Litre Reactor," A. G. Osborn, T. L. Stallings and H. D. Johnson, MHSMP-~~76-1~~7F, January - March 1976.

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

(Lot No. 5363-145-01, Pressing No. 83412Y3102, Density 1.902 Mg/m^3)

GROUP A

Piece No.	Rupture Mode[a]	Initial Modulus[b] (GPa)	Rupture Time (s)	Rupture Stress (MPa)	Rupture Strain (%)
1	4	6.2	276	7.90	0.29
2	4	7.9	302	7.49	0.23
3	4	6.8	284	8.30	0.29
4	6	6.2	291	8.05	0.29
Mean		6.8	288	7.94	0.29
Std. Dev.		0.8	11	0.34	0.03

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

(Lot No. 5351-145-01, Pressing No. 83413Y3101, Density 1.906 Mg/m^3)

GROUP B

Piece No.	Rupture Mode[a]	Initial Modulus[b] (GPa)	Rupture Time (s)	Rupture Stress (MPa)	Rupture Strain (%)
1	6	10.0	536	7.71	0.22
2	6	10.6	561	7.97	0.19
3	6	10.0	616	8.03	0.19
4	4	9.9	509	7.68	0.17
Mean		10.1	555	7.85	0.
Std. Dev.		0.3	46	0.18	0.02

[a] *1 & 7 are in curved section, 2 & 6 are in the straight section outside the extensometer, 3 & 5 are at the knife edges and 4 is between the knife edges*

[b] *Initial Modulus: (20% Rupture stress)/strain*

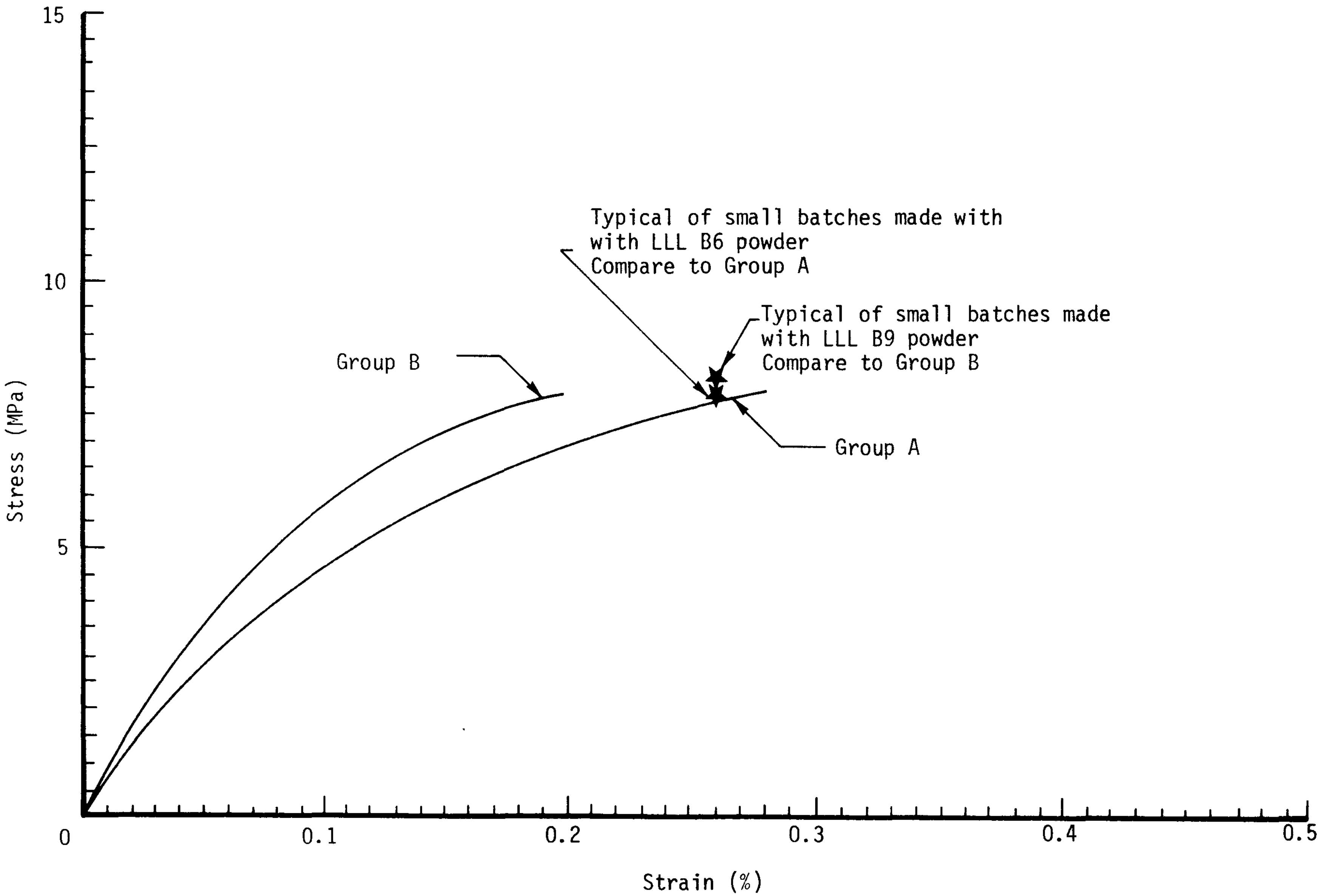

Fig. 1. RX-03-BB Tensile Test at a Constant Crosshead Rate of 0.002 mm/s at 21 C

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

(Lot No. 5363-145-01, Pressing No. 83412Y3102
Density 1.901 Mg/m^3)

GROUP A

Piece No.	Failure Time (s)	Failure Stress (MPa)	Failure Strain (%)	Rupture Time (s)	Rupture Strain (%)	Work To Rupture (MJ/m^3)
1	2250	17.86	1.87	4797	6.98	1.07
2	2391	18.10	1.83	5127	7.41	1.14
3	2250	17.75	1.81	4761	6.60	1.01
Mean	2297	17.90	1.84	4895	7.00	1.07
Std. Dev.	82	0.18	0.03	202	0.41	0.06

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

(Lot No. 5351-145-01, Pressing No. 83413Y3101,
Density 1.905 Mg/m^3)

GROUP B

Piece No.	Failure Time (s)	Failure Stress (MPa)	Failure Strain (%)	Rupture Time (s)	Rupture Strain (%)	Work To Rupture (MJ/m^3)
1	2304	18.96	1.90	4494	6.38	1.07
2	2250	18.89	1.80	4899	7.28	1.22
3	2244	18.86	1.60	4815	7.05	1.14
4	2695	18.58	1.87	-	6.90	1.10
Mean	2266	18.82	1.79	4736	6.90	1.13
Std. Dev.	33	0.17	0.14	214	0.38	0.06

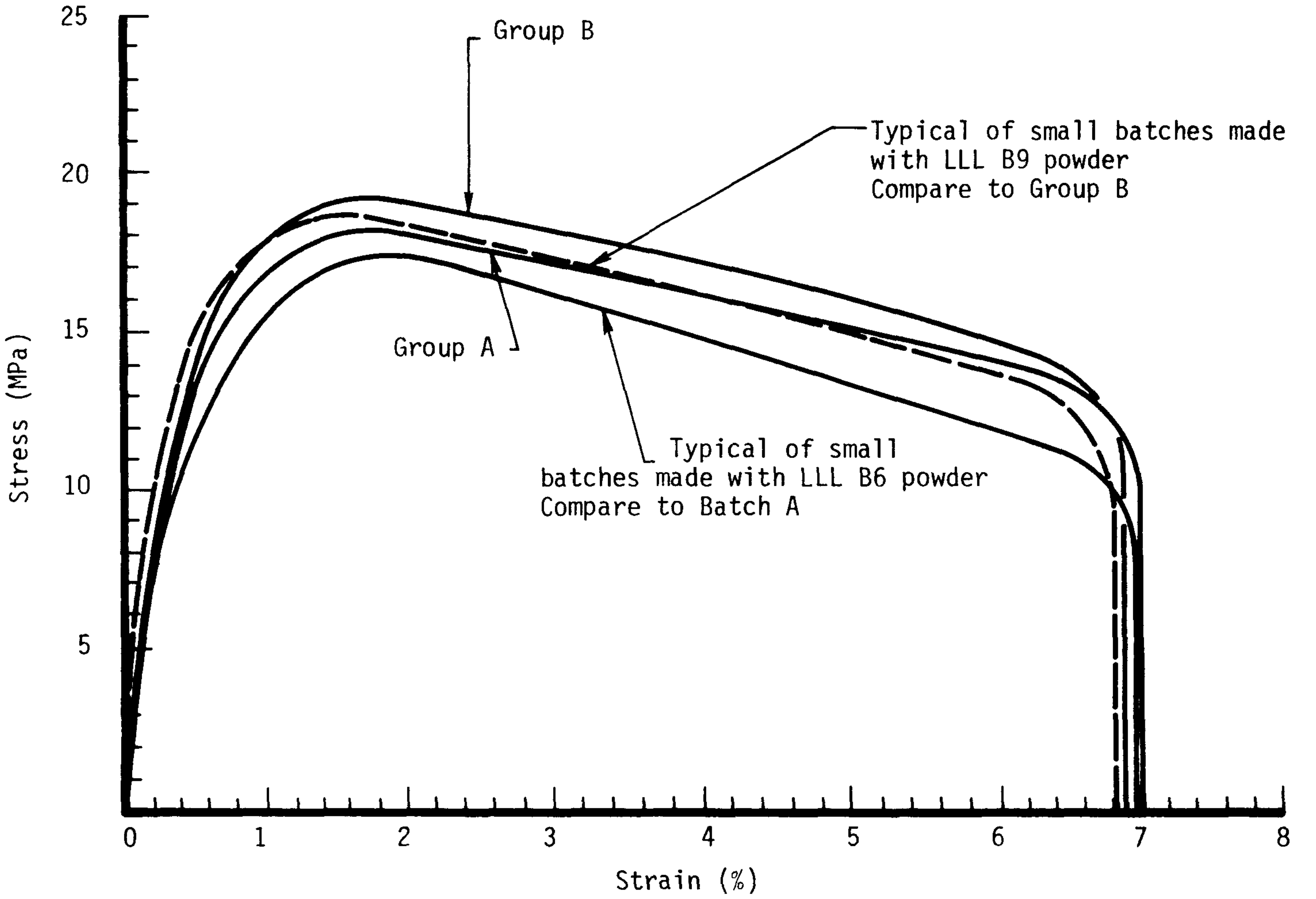

Fig. 2. RX-03-BB Compression Test at a Constant Crosshead Rate of 0.001 mm/s at 21 C

Table V. Compression Test at 16.67$\mu\varepsilon$/s at 21 C for RX-03-BB

(Lot No. 5315-145-04, Pressing No. 83318Y4601, Density 1.909 Mg/m^3)

Piece No.	Failure Time (s)	Failure Stress (MPa)	Failure Strain (%)	Rupture Time (s)	Rupture Strain (%)	Work To Rupture (MJ/m^3)
3	1008	19.42	1.54	3861	6.72	1.10
4	958	19.91	1.61	4080	6.90	1.17
91	876	19.33	1.42	3948	6.80	1.09
92	870	19.31	1.60	3630	6.28	1.03
Mean	928	19.49	1.54	3880	6.68	1.10
Std. Dev.	67	0.29	0.09	189	0.27	0.06

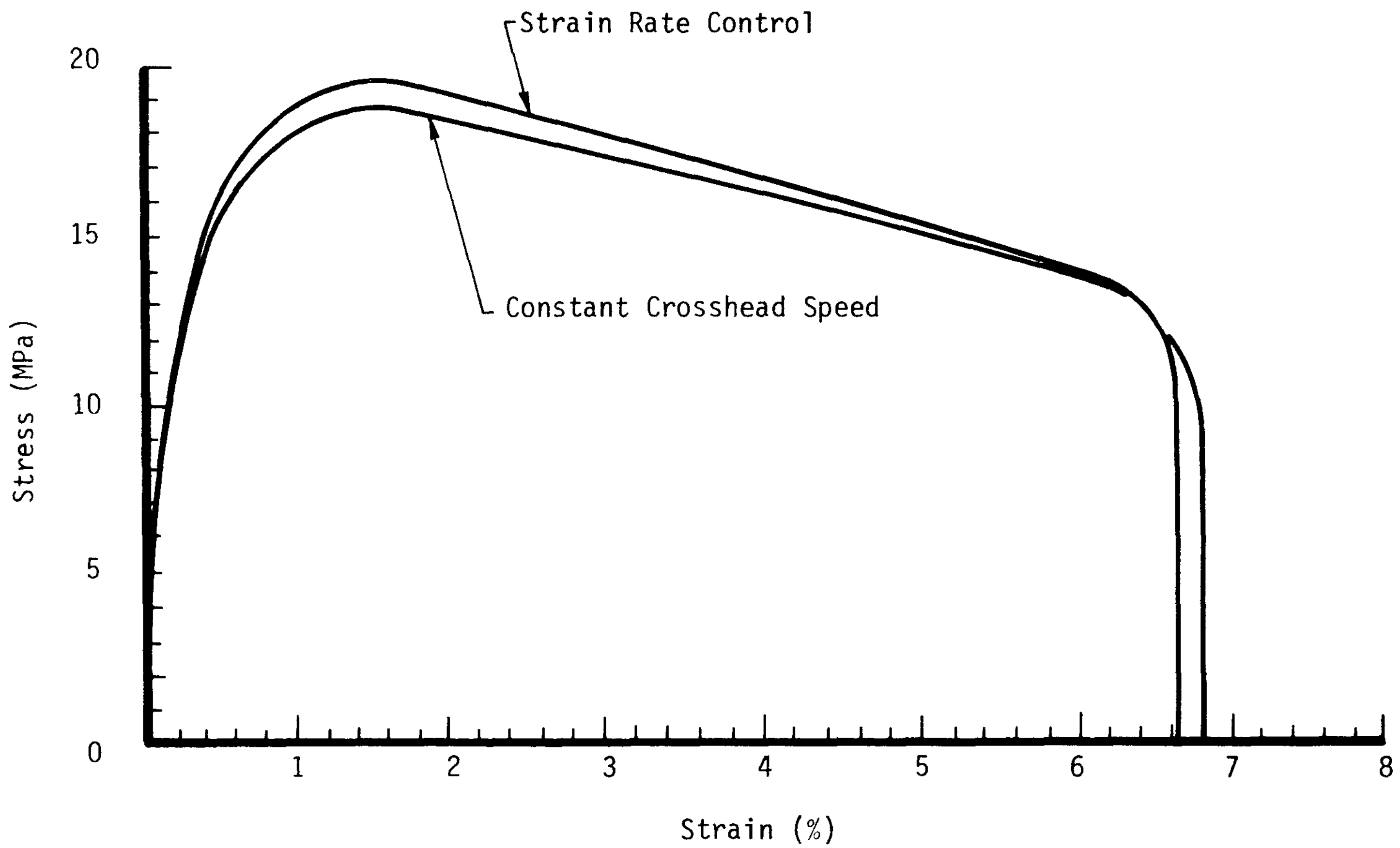

Fig. 3. RX-03-BB Blend 9 Test at 21 C

The densities of both Groups A and B parts were approximately 0.026 Mg/m^3 less after 20 cycles than originally. This compares to a density reduction of 0.019 Mg/m^3 for untreated material.

To complete physical property screening of normal LLL B9 material, four compression specimens were fabricated for constant strain rate tests. The B9 pressing (No. 83318Y4601) used for these specimens gave a finished pressed density of 1.909 Mg/m^3. The specimens were tested at 16.67 $\mu\varepsilon/s$ and 21 C. As shown in Table V the average compression strain-at-rupture was 6.68%. Previous measurements using the constant crosshead test gave an average compression strain-at-rupture of 6.8%. In Fig. 3 the average strain control curve is plotted with the constant crosshead curve superimposed for comparison.

CONCLUSIONS

Heat treatment of TATB powder and RX-03-BB granules were found to not significantly affect the tensile and compression properties of the subsequently pressed RX-03-BB. Heat treatment of TATB powder appeared to increase the thermal growth of RX-03-BB, however.

There is no significant difference between compression strain-at-rupture as measured by strain rate control and constant crosshead methods.