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CONTROLLING TATB GROWTH WITH BINDERS

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DEVELOPMENT DIVISION

AUGUST 1978

Process Development
Endeavor No. 106

&

For
Lawrence Livermore Laboratory
Livermore, California
(SANL No. 614-016 & -067)

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ABSTRACT

TATB PBX growth was reduced significantly by using binders other than the Kel-F 800. Kraton G-6500 (a co-polymer of styrene and ethylenebutylene) and three polyester resins exhibited less growth than formulations containing Estane, Vistanex, and Viton A binders.

INTRODUCTION

Thermal cycling of pressed TATB PBX parts made from TATB with the Kel-F 800 binder has typically resulted in dimensional growth of the parts. Various methods that have been explored to date in an attempt to eliminate or reduce the growth have met with only limited success. Therefore, the emphasis has been shifted to binders and their effect on the dimensional stability of the TATB. TATB powder was formulated into a PBX with various binders and the dimension changes as a result of thermal cycling measured.

DISCUSSION

Ten binders were evaluated to determine their effect on TATB growth. This was done by formulating a PBX with each of the binders at 5% by weight, and then pressing pellets which were subsequently thermally cycled. The pellets (32 mm high by 19 mm in diameter) were pressed directly to shape in a double acting mechanical press. The same temperature and pressure were used for making all the pellets (345 MPa at 121 C). Two pellets were made from each formulation and the results given in Table I are an average of the two pellets.

Table I. TATB PBX Growth After 20 Cycles

Batch No.	Binder (% by Weight)	T _g (C)	Binder Density (Mg/m ³)	TMD (Mg/m ³)	Density (Mg/m ³)		% TMD		Growth (mm/m)	
					Before Cycling	After Cycling	Before Cycling	After Cycling	Diameter	Length
7340-159B-01	Kraton G-6500	+100	0.91	1.834	1.798	1.795	98.04	97.87	1.38	0.90
7340-158B-01	Polyester 7500S3	-80	1.14	1.873	1.831	1.827	97.70	97.54	1.13	1.00
7340-155B-01	Polyester 7500S1	-80	1.00	1.851	1.830	1.826	98.87	98.65	1.25	1.08
8041-157B-01	Polyester 7500S2	-80	1.32	1.893	1.834	1.822	96.88	96.25	1.38	1.23
7340-166-01	Estane 5703-F1	-73.3	1.20	1.880	1.845	1.832	98.14	97.45	3.00	1.51
7341-134-01	Estane 5702-F1	-73.3	1.20	1.880	1.836	1.828	97.66	97.23	3.13	1.51
7341-168-01	Estane 5714-F1	-62.7	1.13	1.868	1.833	1.827	98.13	97.81	1.82	1.54
7341-154B-01	Vistanex L-120	N/A	0.92	1.836	1.795	1.784	97.77	97.17	1.94	1.54
8041-132-01	Viton A	N/A	1.83	1.931	1.885	1.871	97.70	96.89	2.88	2.26
7341-167-01	Estane 5713	+79.4	1.20	1.880	1.843	1.836	98.03	97.66	2.07	2.33
7258-145-02	Kel-F 800*	+27-30	2.02	1.944	1.908	1.888	98.15	97.12	3.22	2.46
7341-141-01	Kel-F 800	+27-30	2.02	1.942	1.904	1.879	98.04	96.76	3.70	3.16

*7.5% Binder

Some difficulties were encountered in pressing the pellets. The large length-to-diameter ratio of the pellets required a double acting press and some anomalies were observed in pellet perpendicularity and parallelism, which affects the accuracy of the absolute measurements. However the measurements are sufficient for a relative comparison of growth. For this reason, results are considered to be only preliminary.

Final dimensional growth after 20 cycles from -36 to 73 C is given in Table I along with basic information on each of the binders. The differences observed between the diametrical and length readings are those typically observed in pressed-to-shape pellets. Mechanically pressed pellets respond differently from those machined from isostatic pressings.

Growth along the linear axis of specimens are graphically shown in Fig. 1 along with the two control specimens for comparison. The linear axis was chosen because it is the longest dimension yielding more accurate measurements. All binders exhibited less growth than the controls. The PBX 9502 control with 5% by weight binder showed the highest growth rate.

Coefficient of thermal expansion data were not obtained in this phase of the experiment procedure. The gathering of CTE data is rather complex, requiring the measurement of specimens at temperature extremes which ties up equipment for long periods of time and interferes with other critical testing. Growth data, on the other hand, may be obtained simply by measuring and recording final dimensional changes after cycling.

Fig. 1. TATB PBX Growth (20 cycles -36 to 73 C)

CONCLUSIONS

TATB growth can be significantly altered and reduced by the use of binders other than the Kel-F 800. There are considerations other than growth to be made in a choice of a binder for TATB. The experimental work reported here gives a relative comparison of growth rate of TATB made with various binder materials. Based on these results binders can be selected and tested further to more accurately determine the absolute growth rates and to determine CTE.

A promising binder appears to be the Kraton G which exhibits less growth than the controls. A preliminary evaluation of mechanical strength properties of TATB made with Kraton G was obtained by the diametric disc test and was reported in MHSMP-76-46D(1). Data obtained then showed the stress to be lower than the RX-03-BB with strain being much higher. Kraton G PBX, however, may be somewhat more

difficult to press from a production standpoint than other binders because of the minimum temperature of 120 C which must be maintained during the pressing cycle. A temperature drop below this level will adversely affect mechanical properties.

Another interesting binder because of its low growth and its pressability is polyester 750051. The final TMD of 98.65% was the highest of the binders surveyed. The diametric disc stress and strain values as previously reported(1) were less than the Kel-F 800, but higher than some of the other binders tested at that time.

The physical properties data reported in MHSMP-76-46D for these two binders are summarized and reported again here with a control of Kel-F 800 for comparison.

	Diametric Disc Test	
	Stress (MPa)	Strain (%)
Polyester 750051*	3.07	0.46
Kraton G-6500*	3.31	0.91
Kel-F 800**	4.28	0.67

(1) A. G. Osborn & T. L. Stallings, *TATB PBX Development Low Percent Binder Survey, MHSMP-76-46D (July-September 1976)*.

*95% TATB/5% Binder

**92.5% TATB/7.5% Binder

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