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INITIATION SENSITIVITY OF HNS I BY HNS II MDF

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DEVELOPMENT DIVISION

JULY - SEPTEMBER 1975

Normal Process Development
Endeavor No. 107

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ABSTRACT

A sensitivity test previously developed to study the configuration dependent excess transit time for transfer of detonation from a small diameter confined donor to a larger diameter unconfined acceptor via the detonation electric effect technique has been utilized for evaluation of Pantex synthesized HNS.

DISCUSSION

Two 4.5 kg batches of HNS II, Lots 5171-137-01 and 5178-137-01, were made for Sandia by conversion of HNS I using DMF as the recrystallization solvent. The conversion process, purity analysis, particle characterization, pressing characteristics, and drop hammer results were reported to Sandia in an undistributed report.

Aluminum-sheathed, drawn and hydraulically compacted MDF was manufactured from samples of each batch. Pertinent properties(*1*) are listed in Table I. MDF produced from each powder batch was tested in a sensitivity test(*2*) which was developed at Pantex to measure the excess transit time in a relatively large acceptor pellet when initiated by a small confined donor. The acceptor pellets were all pressed from Pantex-synthesized, high-purity HNS I(*3*), Lot PX-11.

EXPERIMENTAL TECHNIQUE AND RESULTS

The detonation electric effect technique(*4*) was utilized to measure detonation front arrival times at various interfaces in an explosive train. The train consisted of an RP-2 detonator, selected lengths of MDF (6.35, 6.35, 12.70, 19.05, and 6.35 mm) and an acceptor pellet stack, the length of which was varied from 2.54 to 10.16 mm in order that excess transit time could be measured by the cutback method. The segments of MDF were separated by 25 μm air gaps to create the interfacial signals. There was no air gap, and therefore no interfacial signal between the final MDF segment and the pellet stack. The typical transit time for the final air gap-MDF segment combination was calculated from those measured for all the other gap-segment pairs. This average was then subtracted from the total time measured on each shot for the final air gap-MDF-pellet stack combination, giving the transit time for the pellet stack. The tests were done at five pellet densities - 1.45, 1.50, 1.55, 1.60 and 1.65 Mg/m^3.

The shot series for the 5171-137-01 compacted MDF is complete; that for 5178-137-01 is not and will be reported next quarter. Some pertinent properties of the two MDF's, which are listed in Table I, indicate that they have very similar characteristics. In addition they are essentially equivalent in these respects to the MDF's which were manufactured from commercial HNS II and tested last quarter(*2*).

Acceptor pellet transit times as a function of density and length are given in Table II. Representative distance-time plots for two densities are shown in Fig. 1. The dashed lines are least squares fits from which the excess transit times and detonation velocities listed in Table III were obtained. Detonation velocity as a function of density is shown in Fig. 2. The solid circles are experimental data. The dashed line is a least squares fit for the density range of 1.45 to 1.65 Mg/m^3. The open circle is the linear fit value of detonation velocity at 1.74 Mg/m^3, the theoretical maximum density. The solid triangles are calculated detonation velocities that should occur at a density of 1.74 Mg/m^3. These values were derived using the empirical equation on Page 8-3 of Reference 5 and the experimental data in Table III. The open triangle and one-sigma bars shown for the 1.74 Mg/m^3 density represent the average and standard deviation of the solid-triangle values.

At a density of 1.55 Mg/m^3, the excess transit times can be compared with those obtained and reported last quarter for MDF and pellets produced from commercially obtained HNS lots. Comparison shows that at this density the Pantex-synthesized materials exhibit an excess transit time of only one-fourth that for the commercial materials. Unlike the previous work in which there were probable failures of the MDF to initiate the pellet, in this series there has not been a single failure of the pellet being initiated.

About ten percent of the shots for each MDF type failed because the detonation wave did not propagate down the MDF train. The remains of two shots distinctly proved that the failures occurred at the air gap between segments; that is, the detonation wave did not propagate from one segment to the next. The other three shots which failed did so in an area close enough to the detonator that evidence of the failure point was destroyed. The air gap size can probably be reduced without affecting the detonation electric effect signals significantly. An optical pickup method of monitoring the interfacial arrival times is now being investigated. If the optical method can be implemented the air gap can be reduced to essentially zero thickness. Examination of the records obtained and reported upon last quarter(2) for HNS indicates that at least one of the three "NO GO's" was probably due to failure of the detonation wave to propagate through the MDF train, rather than failure to initiate the acceptor pellet. The other two records have all of the air gap signals indicating that either the final MDF segment or the acceptor pellet did not initiate.

CONCLUSIONS

The lower excess transit time for the PX-11 at 1.55 Mg/m^3 indicates that its threshold to initiation by MDF may be lower than that for the two commercially obtained HNS I lots.

FUTURE WORK

The 5178-137-01 MDF series should be completed and reported next quarter.

The optical pickup method of monitoring arrival times at the interfaces will be investigated next quarter.

A more absolute comparison of the initiation sensitivity of PX-11 as compared to the two commercial batches of HNS I may be made by firing a series with the commercial materials initiated by the 5171-137-01 MDF at same densities of 1.45 through 1.65 Mg/m^3.

Table I. Pertinent Properties of Compacted MDF Containing HNS II

Property	Lot 5171-137-01	Lot 5178-137-01
MDF ID (mm)	0.51	0.51
MDF OD (mm)	1.12	1.12
MDF Load Size (g/m)	0.38	0.38
MDF Velocity (m/s)	7060	7050

Table II. Acceptor Pellet Transit Time Data

Density (Mg/m^3)	Length (mm)	Transit Time (μs)
1.45	2.54	0.395
1.45	5.08	0.815
1.45	7.62	1.195
1.45	10.16	1.605
1.50	2.54	0.395
1.50	5.08	0.785
1.50	7.62	1.165
1.50	10.16	1.565
1.55	2.54	0.385
1.55	5.08	0.765
1.55	7.62	1.125
1.55	10.16	1.515
1.60	2.54	0.385
1.60	5.08	0.755
1.60	7.62	1.115
1.60	10.16	1.505
1.65	2.54	0.375
1.65	5.08	0.745
1.65	7.62	1.105
1.65	10.16	1.455

Table III. Experimental Results for PX-11 HNS I Pellets Initiated by Compacted 5171-137-01 HNS II MDF

Density (Mg/m^3)	Excess Transit Time (ns)	Detonation Velocity (m/s)
1.45	0	6330
1.50	5	6540
1.55	10	6770
1.60	10	6830
1.65	20	7060

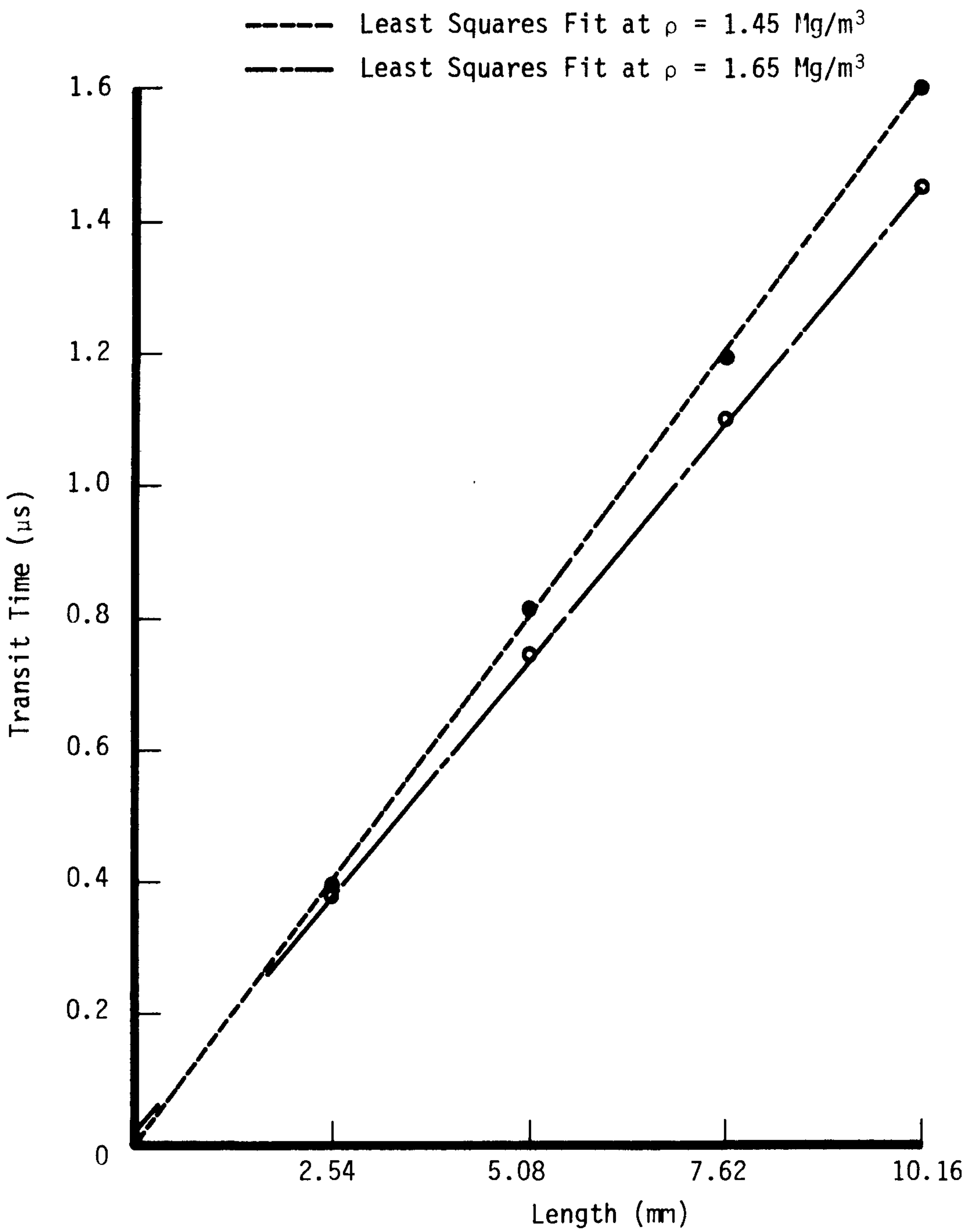

Fig. 1. Representative Data at Density Extremes

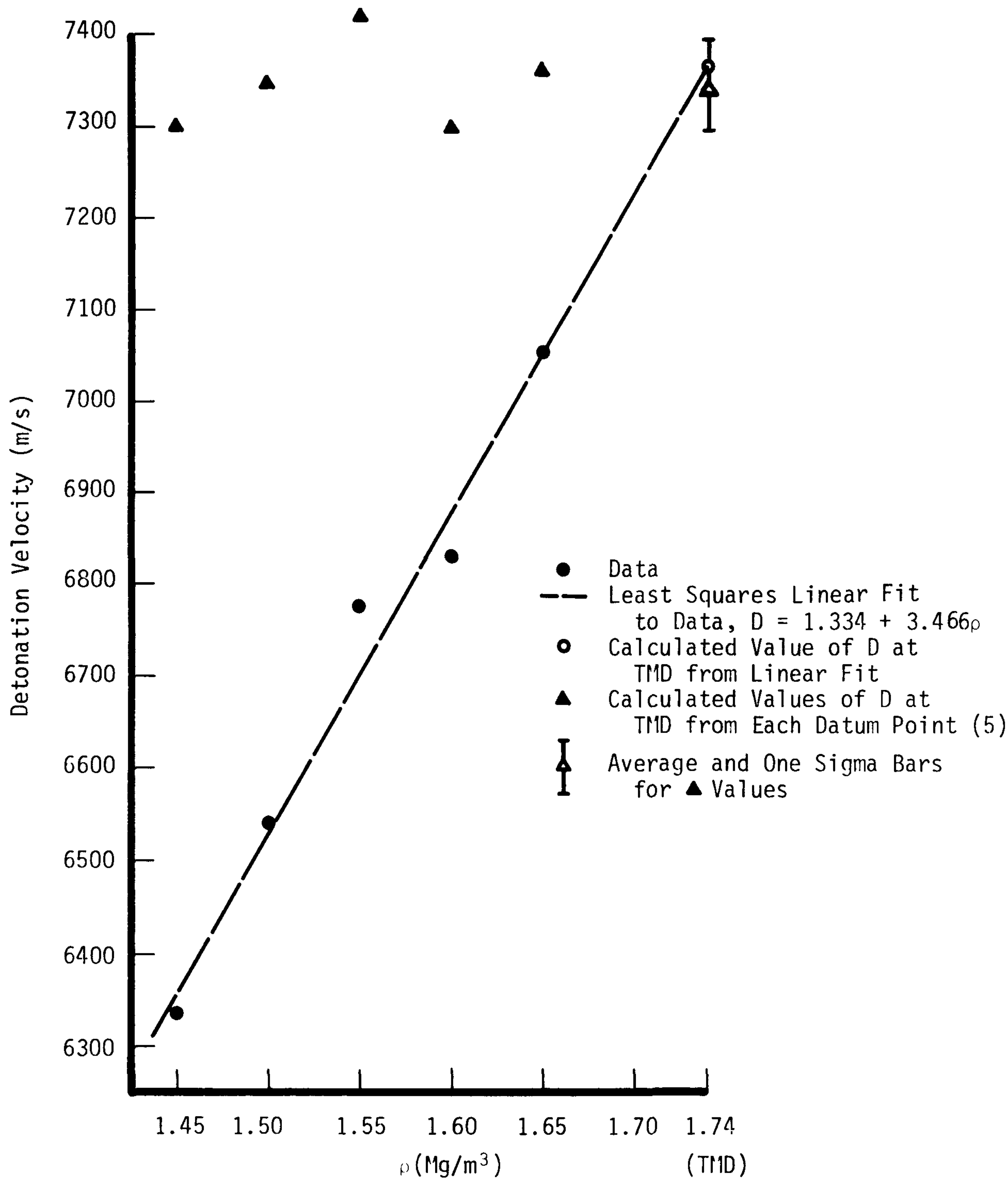

Fig. 2. Calculated Detonation Velocity Data

REFERENCES

1. H. W. Lichte, Private Communications.

2. C. E. Canada and L. D. Hanes, "Detonation Electric Effect Studies," MHSMP-75-24L (June 1975).

3. T. W. Stull, "Synthesis of High Purity Hexanitrostilbene," MHSMP-75-37 (September 1975).

4. Bernard Hayes, "The Detonation Electric Effect," Journal of Applied Physics, Vol. 38, No. 2 (February 1967).

5. B. M. Dobraty, Properties of Chemical Explosives and Explosive Simulants, UCRL-51319 (July 31, 1974).