MHSMP-70-10 C

Mason & Hanger-
Silas Mason Co., Inc.

ENGINEERS AND CONTRACTORS
SINCE 1827

Pantex Plant

DETONATION SPHERE

SANL 712-004

Jacob Sandoval

April, May, June 1970

DISCLAIMER

DEVELOPMENT DIVISION

DETONATION SPHERE

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ABSTRACT

Evaluation of the test data from numerous experiments indicates that large scale calorimeter experimentation in the Pantex detonation sphere is impractical.

Detailed quantitative and qualitative measurements of the detonation products will continue to be made to provide data for the evaluation and comparison of explosive performance.

DISCUSSION

The original function of the 48-inch detonation sphere was to confine the detonation products of HE, so as to make qualitative and quantitative measurements of these products, to provide data for increased understanding of the detonation process. It was later proposed that an investigation be pursued to study the feasibility of large scale calorimeter experimentation. The results of several tests indicate that the unit is impractical for calorimetric determinations unless there were extensive and costly modifications. The detonation products of HE will continue to be characterized and analyzed but the measurement of the heats of detonation will be discontinued.

In late May a heavily confined charge of 2-4-6 trinitrotoluene (TNT) was tested in the sphere. As a result of the fragmentation of the confining copper cylinder and/or of the shock wave, an air leak developed in the evacuated system. This leak was found at the base of the sphere adjacent to the drain plug. The brass union joining the plug to the sphere had been stripped. This brass union has been replaced with a stainless steel counterpart and the test unit readied for further testing.

Two gaseous samples were collected and submitted for analysis by mass spectroscopy. The ensuing analyses revealed the air content in the samples was in excess of 50%. As a result of the air leak the pressure of the confined gases, when recorded, was probably erroneous resulting in an inaccurate volume determination. Thus after the data were compiled the product analysis and the material balance were found to be in disagreement with the values established for this explosive at LRL. The test conditions and results are tabulated below:

PDS-12

May 25, 1970

Charge Data:

HE: TNT, Lot 73057Y3103 (ρ 1.5614)
199.4006 g = 0.8779 moles

Detonator: XI - 84 - 1
PETN = 0.2457 g = 0.00077 moles

Volume:

(a) Water-Free

Volume Sphere = 947.7 l
Pressure = 162.0 mm
Temperature = 25.8°C
n = PV/RT = 6.969 moles

(b) Air-Free

LRL Analysis: % air = 59.48 = 4.1455 moles
n gas = 2.8241

Pantex Analysis: % air = 56.86 = 3.9629 moles
n gas = 3.0067

Trap Condensates:

H_2O = 26.7595 g = 1.48130 moles
NH_3 = 2.2460 g = 0.07315 moles

Recorder Conditions (L & N Amplifier 9835; HP Moseley Recorder 7100 B)

1/amplification	= 2000
Recorder sensitivity	= 1 V/full scale = 1000 μV (full scale on chart)
Absolute temperature reading	= 0.647 of full scale (amplifier @ 2000; recorder @ 1)
ΔT	= 0.298°C

Product Analysis:

Species	Mole % (Air-free)	Moles (Total)	Moles PETN	Moles TNT	Moles/Mole TNT
		Pantex Mass Spectroscopy			
CO	38.47	1.1566	0.0013	1.1553	1.316
CO_2	22.38	0.6729	0.0026	0.6703	0.764
O_2	-	-	-	-	-
N_2	27.50	0.8268	0.0015	0.8253	0.940
Ar	-	-	-	-	-
CH_4	1.76	0.0529	Nil	0.0529	0.0623
H_2	9.93	0.2986	0.0003	0.2983	0.3398
C(s)	(6.149 - 1.882) =	4.267	Nil	4.267	4.860
H_2O	26.7595 g	1.4853	0.0029	1.4824	1.689
NH_3	1.246 g	0.07315	Nil	0.07315	0.0833
		LRL Mass Spectroscopy			
CO	37.05	1.0463	0.0013	1.0450	1.190
CO_2	23.50	0.6637	0.0026	0.6611	0.753
O_2	-	-	-	-	-
N_2	28.79	0.8131	0.0015	0.8116	0.924
Ar	-	-	-	-	-
CH_4	1.83	0.05168	Nil	0.05168	0.0589
H_2	8.82	0.2505	0.0003	0.2502	0.2850
C(s)	(6.149 - 1.762) =	4.387	Nil	4.389	4.997
H_2O	26.7595 g	1.4853	0.0029	1.4824	1.689
NH_3	1.246 g	0.07315	Nil	0.07315	0.0833

Material Balance:

Elements	Moles Fired	Pantex		LRL	
		Moles Found	% Recovered	Moles Found	% Recovered
C	6.149	1.762	28.6	1.882	30.6
H	4.396	3.897	88.7	3.993	90.8
N	2.637	1.699	64.4	1.727	65.5
O	5.276	3.859	73.1	3.988	75.6

FUTURE WORK; COMMENTS; CONCLUSIONS

A vacuum tight system is a prerequisite if meaningful data are to be obtained. In the past air has frequently leaked into the evacuated system but the source of these leaks has not always been specifically located. To preclude recurrence of leakage the sphere and all related lines will be rechecked for vacuum and pressure stability. When it is determined that the system is leak-proof, testing will be resumed.

Testing will be accomplished in conjunction with specific LRL requirements with guidance and coordination provided by that agency. The specific explosive and the configuration of the charges to be utilized will be determined through liaison.