Development of Promising New Cast Cure Explosives

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Outline

- Objective and approach
- Performance
- Formulation processing
- Shock Sensitivity
- Bullet Impact
- Cook-off
- Summary

Objectives and Approach

Objectives: Develop new cast cure explosives which meet the following criteria:

- **Improved performance over PBXN-110**
- **Equivalent IM response to PBXN-110**
  - Measured by shock sensitivity, bullet impact sensitivity, and cook-off

Approach: Increase solids loading to 89% in an HTPB binder system

- **Non-aluminized formulation DLE-C051 for metal-driving applications**
- **Aluminized formulation DLE-C050 for dual purpose applications – metal driving and blast**

Theoretical Performance

Cheetah performance prediction comparison to PBXN-110:

- **DLE-C051 has 4.5% increase in Energy @V/V_0=6.5**
- **DLE-C050 has 31% increase in total mechanical energy (blast)**
- **Cylinder expansion testing is planned to quantify delivered energy**

Formulation	DLE-C050	DLE-C051	PBXN-110
HMX	74	89	88
Aluminum	15	0	0
HTPB/Plasticizer	11	11	12
Total Solids (%)	89	89	88
Density (g/cc)	1.776	1.705	1.678
P_{cj} (Kbar)	247	264	249
V_d (km/s)*	7.59	7.89	7.75
CJ Temperature (°K)	4734	3757	3682
Energy @ V/V_o =6.5 (kJ/cc)	8.15	7.22	6.91
Total Mechanical Energy (kJ/cc)	11.46	9.10	8.77

Processing

Processing at 89% solids with a bimodal blend of HMX (coarse and fine) was a significant challenge

- **A new plasticizer reduced mix viscosity compared to IDP used in PBXN-110**

Formulations at 88% Solids		
Formulation	**PBXN-110**	**HMXcast 02**
HMX	88%	88%
Plasticizer	IDP	New Plasticizer
EOM Viscosity (kp)	**35**	**9.5**

Cast surface of DLE-C050

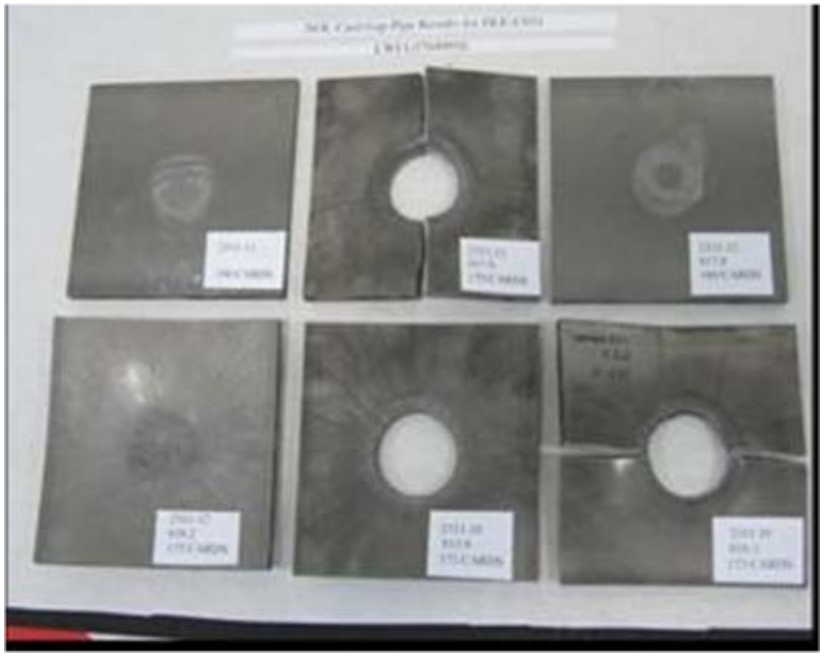
- **A special grind of fine HMX reduced viscosity about 6 kP**
- **Excellent casting and flow of mixes**

Shock Sensitivity

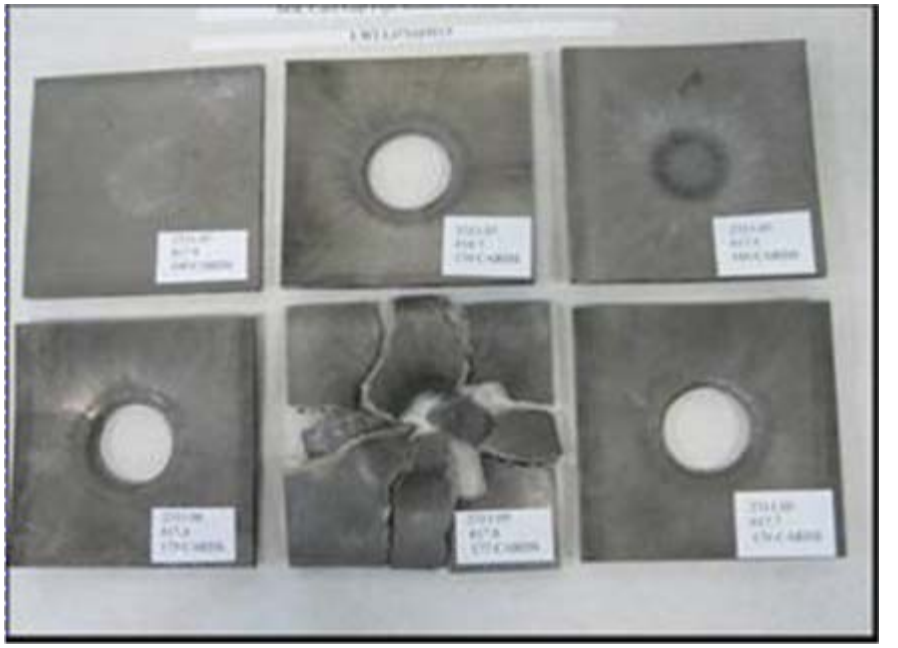
Large Scale Gap Test (LSGT) conducted

- **Sensitivity similar to PBXN-110**

Formulation	Go/No-go # Cards
DLE-C050	173/175
DLE-C051	176/177



LSGT of DLE-C050



LSGT of DLE-C051

Bullet Impact Testing

50 caliber impact of bare ½ lb billet is used for initial screening

- **Data acquisition**
  - Pressure
  - High speed digital video
  - Both were very useful!

Close-Up Of Billet

Bullet Impact Results

No reaction evident in bullet impact of DLE-C050

- **Blast overpressure same as inert sample**

Bullet impact of bare billet of DLE-C051 is planned along with bullet impact of 3.2 in. generic shaped charges of both formulations

Cook Off Sensitivity

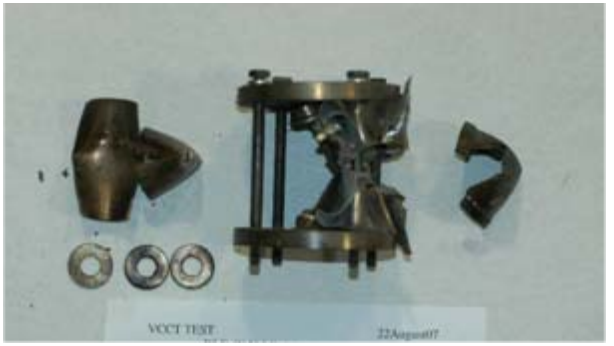
Variable Confinement Cookoff Testing (VCCT) used to evaluate formulations

- **VCCT testing of DLE-C050 showed excellent results**

VCCT of DLE-C050		
Wall Thickness (in.)	**Reaction Temperature (ºC)**	**Reaction Level**
0.030	182	burn
0.045	167	pressure rupture
0.060	182	pressure rupture
0.075	186	pressure rupture
0.090	172	deflagration

- **VCCT planned with DLE-C051**
- **Slow cookoff testing planned with 3.2 in. generic shaped charges**

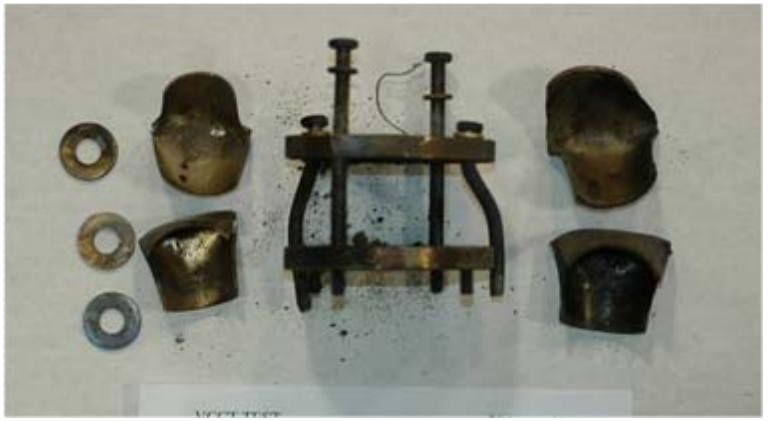
VCCT of DLE-C050



0.030”

0.045”

0.060”



0.075”

0.090”

Summary

New cast cure HMX-based explosives developed

- Aluminized (DLE-C050) and non-aluminized (DLE-C051) formulations

89% solids improves on the performance of PBXN-110

Mixes have excellent processing characteristics

Shock sensitivity similar to PBXN-110

Bullet impact and VCCT response of DLE-C050 are excellent

- Similar tests are planned with DLE-C051

Further IM testing is planned using 3.2 in. generic shaped charges