DNDA GUN PROPELLANTS

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41st Annual Armament Systems:
Gun and Missile Systems Conference & Exhibition
March 27 – 30, 2006, Sacramento Convention Center
Sacramento, CA, U.S.A.
Content

♦ Processing Technologies

♦ DNDA Gun Propellants
  ● Temperature behaviour
  ● Influence of the Processing Technology
  ● Sensitivity datas
  ● ARC
  ● Longterm Stability
  ● Closed Bomb Tests
  ● Gun Test Firing

♦ Results & Conclusion
Batch - Process using Duplex Mixer
Solvent Process
Continuous Shear Roller Process
Process for water wet Paste
Twin - Screw Extruder Process
Temperature behaviour of gun propellants
Max. gas pressure vs propellant temperature

[Graph showing temperature behaviour of gun propellants with the maximum gas pressure plotted against propellant temperature. The graph compares DNDA Propellant (LTC) and Conventional Propellant.]
Behaviour of DNDA - Propellant at -40°C, +21°C, +50°C in Closed Vessel

Dynamic Vivacity

200 ml Bombe; ICT DNDA-TLP; Ladedichte: 0,3 g/ccm
Influence of the Processing Technology / DNDA Propellant

Vivacity of the Propellants

Low Friction

High Friction

Batch - Process Mixer

Shear Roller Continuous Process Waterwet Paste
Influence of the Processing Technology

Los 250199/W - \( \Delta \gamma = 0.2 \text{g/ml in } V_b = 310 \text{ ml} 

Los 180705 - \( \Delta \gamma = 0.2 \text{g/ml in } V_b = 310 \text{ ml} 

Los 190705 - \( \Delta \gamma = 0.2 \text{g/ml in } V_b = 310 \text{ ml} 

Gaspressure in the Gun

LOS 250199

LOS 180705

LOS 190705

Fraunhofer ICT

DIEHL BGT Defence
DNDA - PROPELLANTS

DNDA Gun Propellants

- RDX
- Binder, Nitrocellulose
- DNDA Plasticizer

✿ Plasticizer mixed into the Propellant – Dough

NO SURFACE COATING

◆ energy density adaptable
◆ flame temperature approx. 500 K lower than that of conventional propellants

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Impetus (J/g)</th>
<th>Flame Temp (K)</th>
<th>Mol wt (g/mole)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1080</td>
<td>2540</td>
<td>19.4</td>
</tr>
<tr>
<td>B</td>
<td>1180</td>
<td>2910</td>
<td>20.8</td>
</tr>
<tr>
<td>C</td>
<td>1300</td>
<td>3390</td>
<td>21.6</td>
</tr>
</tbody>
</table>
## Safety datas

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of weight after 18 days</td>
<td>&lt; 1.10 %</td>
</tr>
<tr>
<td>Loss of weight after 30 days</td>
<td>&lt; 1.65 %</td>
</tr>
<tr>
<td>Sensitivity to friction</td>
<td>160 N</td>
</tr>
<tr>
<td>Sensitivity to impact</td>
<td>4 J</td>
</tr>
<tr>
<td>Ignition temperature</td>
<td>approx. 200 - 220°C</td>
</tr>
<tr>
<td>Fast cook off test</td>
<td>burning</td>
</tr>
<tr>
<td>Shaped charge impact test</td>
<td>burning</td>
</tr>
<tr>
<td>Cook – off Temp.</td>
<td>approx. 205 °C</td>
</tr>
</tbody>
</table>
Viscosity of the DNDA Plasticizer
Rotational Rheometer Results

+ 50 °C  20 mPa*s
+ 20 °C  137 mPa*s  Newton Behaviour
  0 °C  1532 mPa*s

- 6 °C  5595 mPa*s
- 7 °C  6928 mPa*s  Structurally Viscose Behaviour
- 8 °C  9059 mPa*s
- 9 °C  11351 mPa*s
ARC
Accelerating Rate Investigations of DNDA - Propellants compared with CAB-Lova, M30 and Single Base Prop.
DNDA compared with NENA
DNDA - PROPELLANTS

Shaped Charge Test (cal. 44 mm)
Cartridge cal. 35 mm

CAB - LOVA
Propellant

DNDA
Propellant
Longterm Stability at 90°C / DNDA - Propellant
Longterm Stability of JA2 at 90 °C
40 mm Gun Firing Tests of 3 propellants
from -40 °C till +50 °C
40 mm Gun Firing Tests
Temperature behaviour unaffected by loading density and pressure level
75 mm Scale model gun derived from 120 mm tank gun

♦ based on interior ballistic similiary laws

♦ less cost (combustible paper case, less propellant mass)
Test Firing in 75 mm cal. Model Gun

Optimized Propellant for firing at 21°C

Gas pressure vs Temp.

P_m vs T

<table>
<thead>
<tr>
<th>Temp. [°C]</th>
<th>P_m [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40</td>
<td>3500</td>
</tr>
<tr>
<td>+21</td>
<td>4500</td>
</tr>
<tr>
<td>+50</td>
<td>5500</td>
</tr>
</tbody>
</table>

JA 2
LTC Prop
Test Firing in 75 mm cal. Model Gun

Optimized Propellant for firing at 21°C

Muzzle velocity vs Temp.

Muzzle velocity of LTC Propellant same at 21°C like JA2

**V₀ vs T**

<table>
<thead>
<tr>
<th>Temp. [°C]</th>
<th>V₀ [m/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40</td>
<td>1550</td>
</tr>
<tr>
<td>+21</td>
<td>1600</td>
</tr>
<tr>
<td>+50</td>
<td>1750</td>
</tr>
</tbody>
</table>

JA 2
LTC Prop
Erosivity of LTC - Propellants and Conventional Propellants
Results & Conclusion

- DNDA - Propellants (LTC) for a wide Caliber - Range
- High Cook-Off Temperature $\geq 205$ °C
- High Selfignition Temperature $> 210$ °C
- Less Sensitive (Shaped Charge Test etc.)
- Excellent Longterm Stability
- Low Barrel Erosion
- Easily to Ignite by Pyrotech.