A NEW FAMILY OF MALLEABLE PLASTIC EXPLOSIVE BLOCKS

Bernard MAHE
1- Introduction
2- Formulation / characteristics
3- Characterization of plasticity
4- Characterization of adhesion
5- Depletion of tagging agent / ageing
6- IM Signature
7- Production line
8- Conclusion
CONTEXT

Eurenco was producer of PE blocks: PLA-NP87
- 87 % PETN
- 13 % naturel rubber + oil

Other products
- C4 (US)
- Semtex (CZ)
- PE4 (UK)

Montreal Convention 1991
- obligation to use only plastic explosives (PE) containing a chemical taggart
- obligation to destroy stock of non marked product

☞ EURENCO decided to develop a new and improved malleable PE
FORMULATION: B2269A
- liquid polymer > 10 %
- RDX > 85 %
- Additives < 1 %
- DMNB 1.0 %

PERFORMANCES
- density: 1,50
- detonation velocity: 7 850 m/s

Trade name: HEXOMAX®

PE7 for UK MoD application
PLASTICITY

*French method GEMO FE 371-A-1*

<table>
<thead>
<tr>
<th>Conditions</th>
<th>PLA. NP87</th>
<th>HEXOMAX®</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours at + 60°C</td>
<td>6.2</td>
<td>5.5</td>
</tr>
<tr>
<td>24 hours at + 20°C</td>
<td>5.5</td>
<td>5.1</td>
</tr>
<tr>
<td>24 hours at - 40°C</td>
<td>13.2</td>
<td>7.3</td>
</tr>
</tbody>
</table>

The liquid polymer ensure excellent malleability of HEXOMAX®, even in cold conditions.
Development of a new process to characterize PE in the way that best represents its perception by human senses

Using a new a specific measurement device

Brookfield CT-3 Texture Analyser
Measuring principle

-plunge a probe in the product to analyze
   -defined geometry of the probe
   -constant speed
   -define depth
-plcompletely remove the probe
-perform a second cycle

Continuously measuring force exerted on the probe
Maximum force
representative of hardness

Total force
ability of the product to recover its initial position, after deformation

Total force
representative stickiness
Characterisation of adhesion

- Wooden post
- Cinderblock wall
- Metal plate

T0: Before treatment
After 4 hours:
- +60°C
- -40°C
Evolution of the weight of blocks of non wrapped Hexomax®

size 100×45×60 mm - 1% DMNB content

room temperature, 40 °C and 60 °C.

<table>
<thead>
<tr>
<th></th>
<th>+20 °C</th>
<th>+40°C</th>
<th>+60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>501.7</td>
<td>501.0</td>
<td>500.0</td>
</tr>
<tr>
<td>T0 + 56 days</td>
<td>501.6</td>
<td>500.3</td>
<td>498.1</td>
</tr>
<tr>
<td>T0 + 81 days</td>
<td>501.3</td>
<td>499.7</td>
<td>497.2</td>
</tr>
<tr>
<td>T0 + 205 days</td>
<td>500.1</td>
<td>499.2</td>
<td>495.2</td>
</tr>
</tbody>
</table>

☞ At +60°C, after 7 months, the loss weight is equivalent to DMNB content

☞ No exudation observed
Evolution of weight at + 60°C of packed blocks of explosive

three grades of packaging were considered:

wax Kraft paper ~ Mylar ~ OPP (Oriented Poly Propylene)

<table>
<thead>
<tr>
<th>Time</th>
<th>Wax Kraft paper</th>
<th>Mylar</th>
<th>OPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>505.3</td>
<td>511.7</td>
<td>506.5</td>
</tr>
<tr>
<td>T0 + 7 days</td>
<td>504.2</td>
<td>511.5</td>
<td>506.5</td>
</tr>
<tr>
<td>T0 + 14 days</td>
<td>503.3</td>
<td>511.6</td>
<td>506.5</td>
</tr>
<tr>
<td>T0 + 29 days</td>
<td>501.6</td>
<td>511.2</td>
<td>506.1</td>
</tr>
<tr>
<td>T0 + 63 days</td>
<td>500.5</td>
<td>511.5</td>
<td>506.3</td>
</tr>
<tr>
<td>T0 + 186 days</td>
<td>498.7</td>
<td>511.3</td>
<td>506.9</td>
</tr>
<tr>
<td>T0 + 375 days</td>
<td>497.3</td>
<td>510.4</td>
<td>505.3</td>
</tr>
</tbody>
</table>

(OPP was selected as wrapping paper)
Evolution of hardness of PE7 wrapped in OPP

size 200×30×60 mm - 1% DMNB content

room temperature, 40 °C and 60 °C.

No exudation observed
Tests performed

- Fast Cook Off test (FCO)
- Slow Cook Off test (SCO)
- Bullet Impact (BI)
- Sympathetic Detonation (SD)

A wooden box

Total content: 9 kg of Plastic Explosive

2 layers of 9 blocks of 500 grams put in a cardboard box
FAST COOK OFF TEST (FCO)

Initiation of the first box by the upper layer of PE7
SLOW COOK OFF TEST (SCO)
8 hours at 50°C then + 3.3 °C/h

Temperature of the explosive at reaction time: 149 °C < < 155°C
BULLET IMPACT (BI)

12.7 mm – velocity: 881 m/s
SYMPATHETIC DETONATION

TYPE I - DETONATION

acceptor          donor          acceptor

4,5 cm

Witness plate
Works in progress to determine a design which guarantees non transmission of detonation
PRODUCTION LINE

overview

twin screw  extrusion and cutting  wrapping

PE block  packing in cardboard box, in wooden box and on pallet
HEXOMAX® is an improved plastic explosive developed by EURENCO

compliant with Montreal Convention of 1991

improved malleability in a wide range of temperature (even in cold conditions)

suppression of exudation

improved aging behaviour

UK MoD has selected this new product (under reference PE7)

A new production line has been commissioned.

Hundreds of tons of HEXOMAX® and PE7 have yet been produced
Acknowledgments to EURENCO cast PBX team

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