EURENCO
GROUPE SNPE

A NEW FAMILY OF MALLEABLE PLASTIC EXPLOSIVE BLOCKS

Bernard MAHE

UNIQUE KNOW-HOW

MULTIFACETED RANGE

OUTLINE

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 taggant
- obligation to destroy stock of non marked product

☞ **EURENCO decided to develop a new and improved malleable PE**

FORMULATION / CHARACTERISTICS

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

CHARACTERISATION OF PLASTICITY

PLASTICITY

French method GEMO FE 371-A-1

	PLA. NP87	HEXOMAX®
24 hours at + 60°C	6.2	5.5
24 hours at + 20°C	5.5	5.1
24 hours at - 40°C	13.2	7.3

The liquid polymer ensure excellent malleability of HEXOMAX®, even in cold conditions

CHARACTERISATION OF PLASTICITY

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

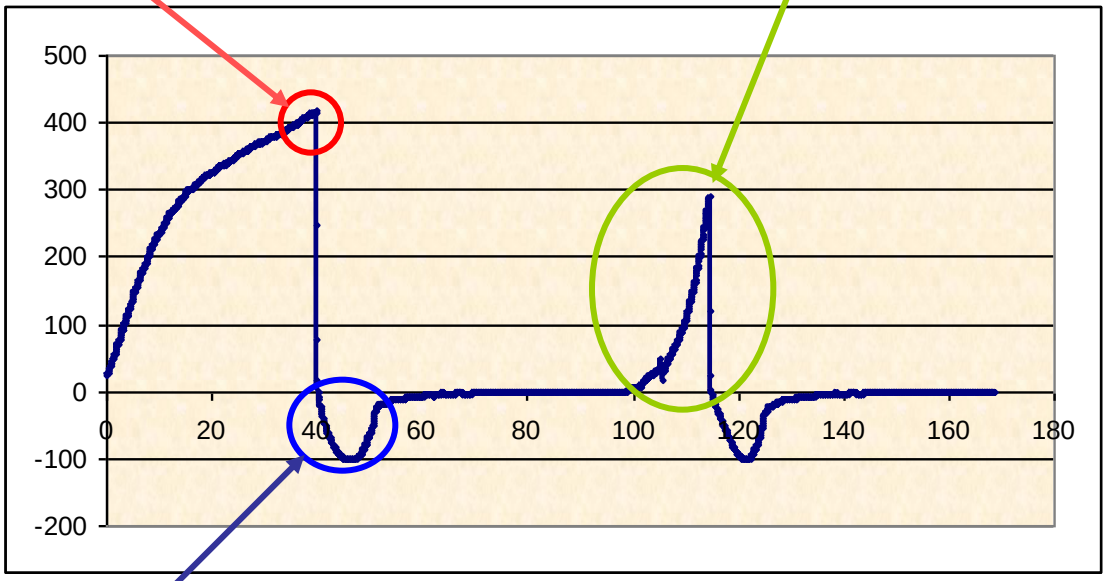
-completely remove the probe
-perform a second cycle

Continuously measuring force exerted on the probe

CHARACTERISATION OF PLASTICITY

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

Maximum force
representative of hardness



Total force
representative stickiness

Characterisation of adhesion

wooden post

a cinderblock wall

T0

+ 60°C

After 4 hours

T0

-40°C

After 4 hours

metal plate

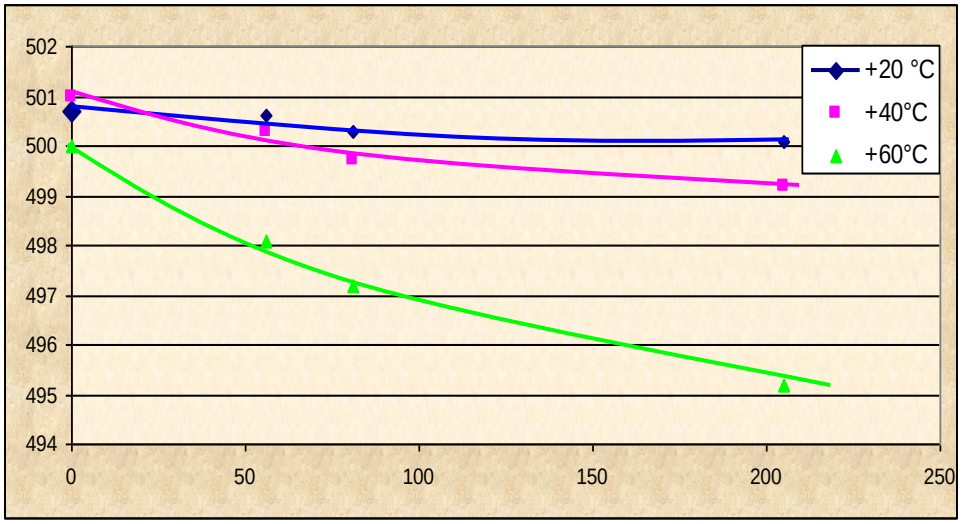
DEPLETION OF TAGGING AGENT / AGEING

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.

	+20 °C	+40°C	+60°C
T0	501.7	501.0	500.0
T0 + 56 days	501.6	500.3	498.1
T0 + 81 days	501.3	499.7	497.2
T0 + 205 days	500.1	499.2	495.2



- ☞ **At +60°C, after 7 months, the loss weight is equivalent to DMNB content**
- ☞ **No exudation observed**

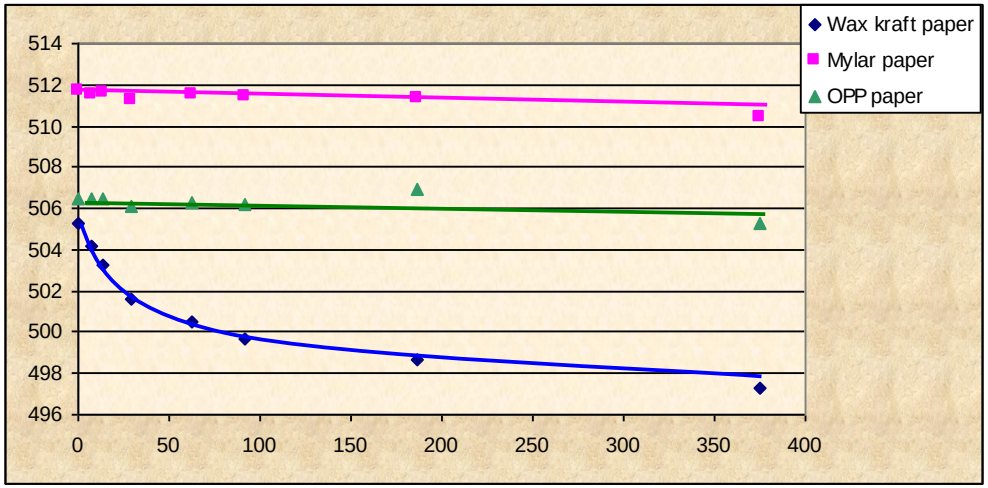
DEPLETION OF TAGGING AGENT / AGEING

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)

	Wax Kraft paper	Mylar	OPP
T0	505.3	511.7	506.5
T0 + 7 days	504.2	511.5	506.5
T0 + 14 days	503,3	511.6	506.5
T0 + 29 days	501.6	511.2	506.1
T0 + 63 days	500.5	511.5	506.3
T0 + 186 days	498.7	511.3	506.9
T0 + 375 days	497.3	510.4	505.3

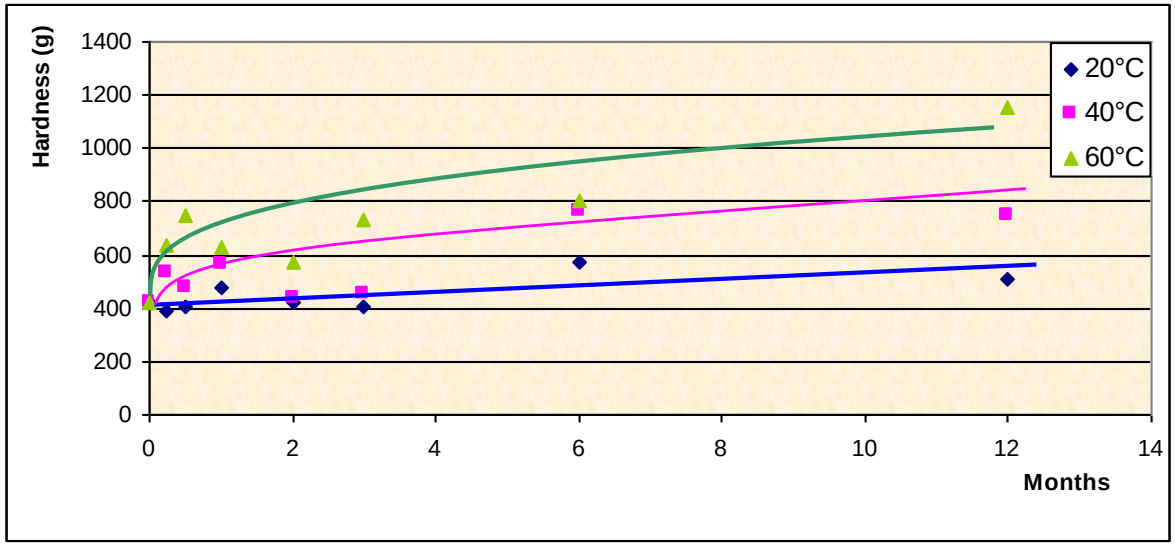


☞ **OPP was selected as wrapping paper**

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**

IM SIGNATURE

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

TYPE V - COMBUSTION

SLOW COOK OFF TEST (SCO)

8 hours at 50°C then + 3,3 °C/h

TYPE V - COMBUSTION

Temperature of the explosive at reaction time : 149 °C < < 155°C

T0 + 47h29min3s

T0 + 47h29min6s

T0 + 47h29min10s

T0 + 47h29min56s

T0 + 47h30min27s

T0 + 47h29min57s

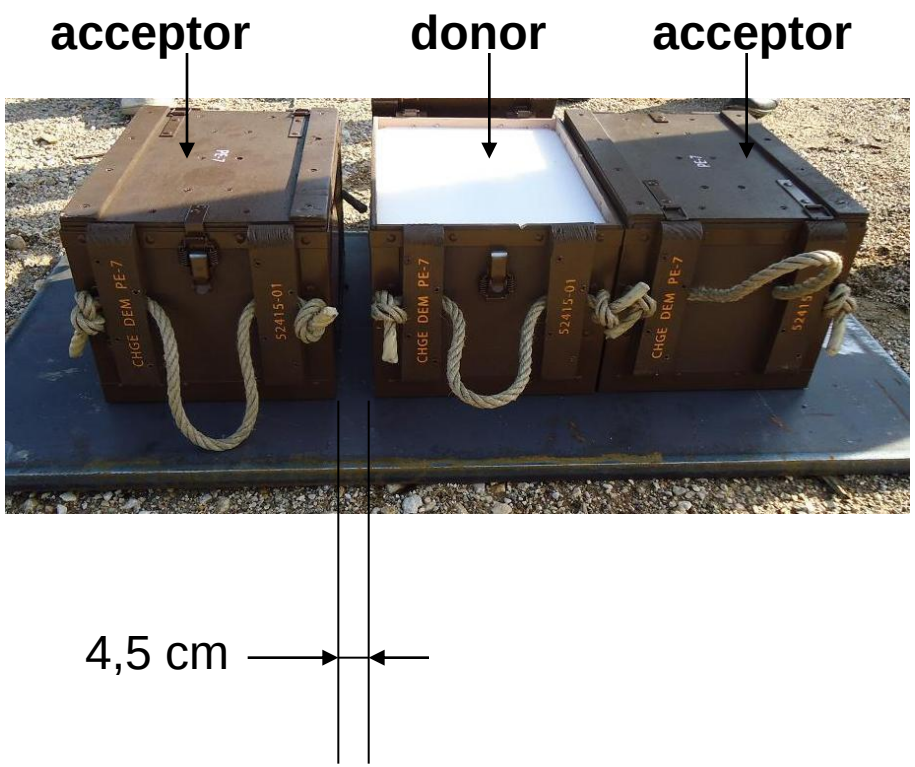
BULLET IMPACT (BI)

TYPE VI - NO REACTION

12,7 mm – velocity: 881 m/s

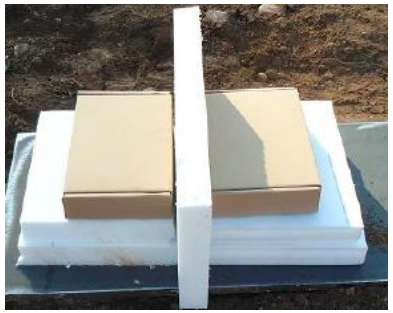
SYMPATHETIC DETONATION

TYPE I - DETONATION



Witness plate

Works in progress to determine a design which guarantees non transmission of detonation



50 mm foam A

105 mm foam B

100 mm foam A

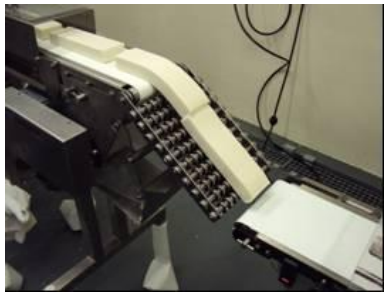
50 mm foam A

witness plate

PRODUCTION LINE

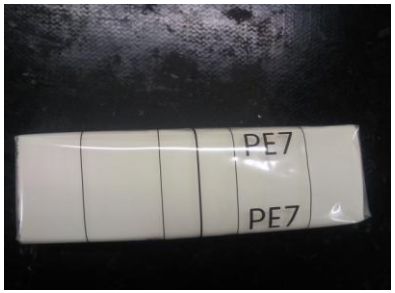
overview

twin screw



extrusion and cutting

wrapping



PE block

packing in cardboard box, in wooden box and on pallet

CONCLUSIONS

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

CONCLUSIONS

Acknowledgments to EURENCO cast PBX team

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EURENCO
GROUPE SNPE

A MEMBER OF

IMEMG
MURAT
EUROPEAN MANUFACTURERS GROUP