



QUALIFICATION OF A NEW IM COMPOSITION AND FIRST EVALUATION IN 90 MM HESH-T AMMUNITION

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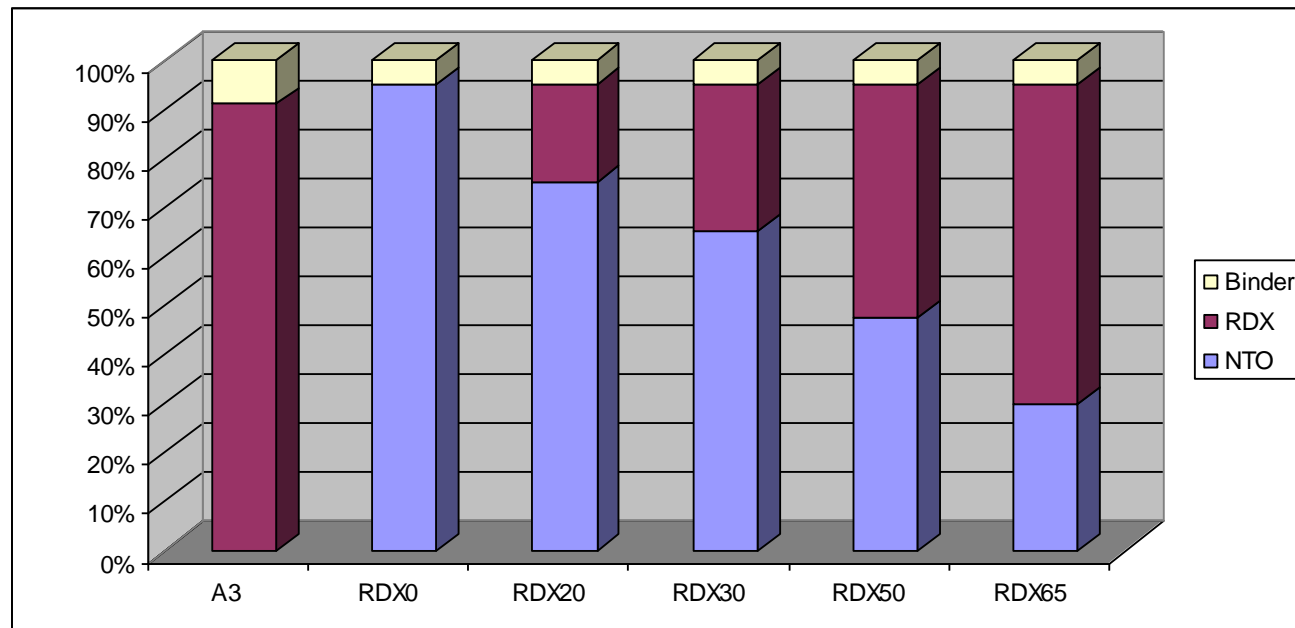
- Introduction
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- Qualification according to STANAG 4170
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Introduction

- Leader in energetic materials, Eurenco developed a pressed IM composition, called the P16945, based on NTO, RDX and a specific binder to replace composition A3.
- MECAR SA, a subsidiary of NEXTER SYSTEMS, develops and produces medium and large caliber ammunition for land forces, such as 90 mm and 105 mm HESH ammunition.
- In the aim to upgrade the whole range of ammunitions, MECAR selected the composition P16945 for its application of 90 mm as the replacement of the composition A3.
- The objectives are :
 - To qualify the composition P16945 according to the STANAG 4170
 - To evaluate the processability of this composition with the current equipment in production - at ambient temperature and without using a vacuum process.
 - To evaluate dynamic performances compared to composition A3
 - To evaluate IM properties according to STANAG 4439.

Development work of the composition P16945

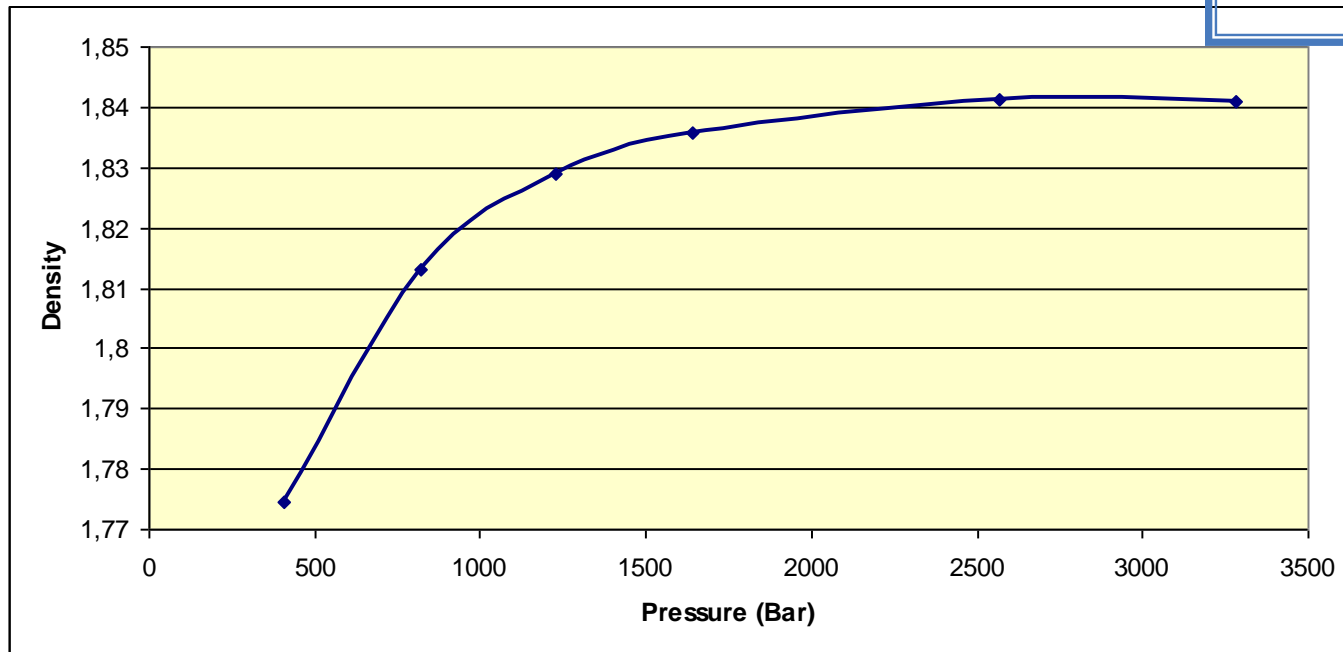
- Studies were performed at EURENCO laboratory scale to develop a replacement of the composition A3.
- The composition P16945 has been chosen from 5 other compositions having various ratio of NTO and RDX :
 - From 0 to 65% RDX
 - From 30% to 95% NTO



Development work of the composition P16945

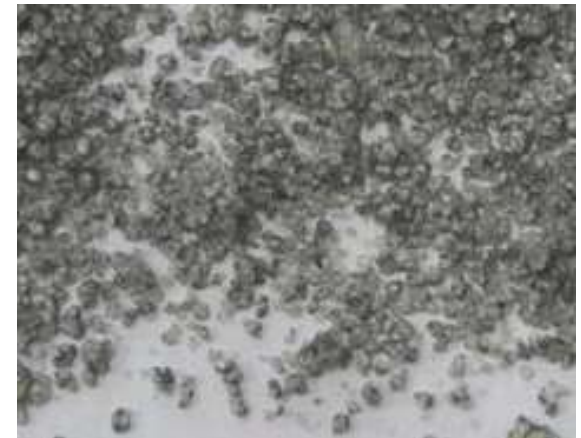
- Preliminary evaluation was made with these 5 compositions :
 - Detonation velocity and critical diameter
 - Gap Test (SSWGT)
 - Mechanical properties
 - Compressibility at room temperature and pressure

Compressibility of P16945
 Max density : 1.84
 % TMD : 98



Scale-up of the composition P16945

- Based on all the results, the composition P16945 with 20% RDX is the best compromise between insensitiveness and performance.
- After development at laboratory scale, P16945 has been scaled-up at the industrial facilities of Sorgues plant.



- 600 kg are produced by batch.

Qualification of P16945

- The composition P16945 has been qualified according to STANAG 4170 :
 - Detonation performance
 - Sensitivity : shock, friction and thermal
 - Mechanical properties from -45°C to +70°C
 - Behaviour regarding sensitivity and mechanical properties after ageing

Qualification of P16945

- **Sensitivity :**

- Impact and shock :

	Composition P16945	Composition A3
Impact sensitivity (J.)	10 J	6 – 15 J
Friction sensitivity (N.)	353N	256 N
Gap test (ISGT)	180-190 cards	265 cards



The composition P16945 is less sensitive regarding strong shock

- Thermal :

	Composition P16945	Composition A3
Self-ignition temperature (°C)	209°C	214°C
Combustion under confinement	No explosion	Not evaluated



The composition P16945 is stable

Qualification of P16945

- **Detonation performance :**

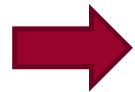
	Composition P16945	Composition A3
Detonation velocity	7920 m/s	8470 m/s – calculated
Critical diameter	8 mm	2.2 mm
Detonation pressure	28.5 GPa	29.9



The detonation pressure of composition P16945 is similar to composition A3
The higher critical diameter can be linked to the IM behaviour

- **Mechanical properties :**

Temperature	Sm (MPa)	E (N)	em (%)
-45°C	19,9	6328	7,3
+20°C	6,2	1975	5,4
+70°C	4,0	1287	5,1



Normal decrease of strain and stress from -45°C to +70°C

- **Ageing :** Same results are obtained before and after ageing.



The composition P16945 keeps its properties and its integrity after ageing.

Evaluation of P16945 in 90 mm HESH-T ammunition

- The 90 MK8 HESH-T M691A2 ammunition has been selected by Mecar for the evaluation of the composition P16945 as a replacement for the composition A3.
- The objectives are :
 - Compression with the current equipment.
 - Performances equivalent to composition A3 :
 - *“The 90mm MK8 HESH-T M691A2 shall create an opening in a double reinforced, 20cm thick, concrete wall at 60 meters minimum from the muzzle. The opening shall be 60cm wide by 120cm high (threshold) and 75cm wide by 125cm high (objective). The opening shall have all reinforced bars severed or effectively moved out of the opening. The opening shall be achieved with 5 rounds (threshold); 4 rounds (objective).”*
 - The 90mm shall defeat the standard infantry bunker, LAV and infantry squad.
 - IM performances : in line with the requirement of STANAG 4439.



Loading P16945 in 90 mm HESH-T ammunition

- Processability with 350 ton computer controlled press
 - Density higher than 1.8 g/cm³ obtained during the different compression tests.
 - Repeatability of the process within the standard conditions of compression – at room temperature and without vacuum.



- The processability of the explosive P16945 has been proven and shells have been loaded to perform the first dynamic and vulnerability tests.

Performances – Dynamic test

Target compliant with ITOP 5-2-503
Double reinforced concrete wall



Shot 1 : 50 cm



Shot 2 : 76 cm (H); 100 cm (V)



Shot 3 : 87 cm (H); 120 cm (V)

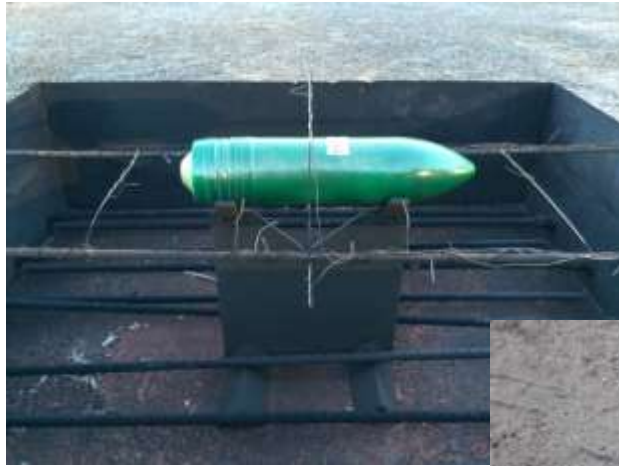


Shot 4 : 135 cm (H); 125 cm (V)

 **OBJECTIVE ACHIEVED**

Performances – Vulnerability test

- Fast Cook-Off test with LPG as fuel.



TYPE V REACTION

Result : The object has been opened by a pneumatic explosion mechanism and the explosive contained in the projectile has been completely consumed by burning.

Performances – Vulnerability test

- Bullet Impact test (STANAG 4241)



TYPE V REACTION



- Burning of some explosive during a few milliseconds.
- The projectile body opened due to the reaction.
- Two-thirds of unreacted explosive recovered inside the body.

Conclusions and Way Forward

- The results obtained during the qualification of the composition P16945, according to STANAG 4170, confirm the expected IM behaviour of the product.
- The processability of the compression has been demonstrated on current pressing equipment at room temperature and pressure.
- In parallel, the evaluation of the composition P16945 loaded in 90 MK8 HESH-T M691A2 is successful regarding the first tests performed :
 - Compliant with the requirements for dynamic functioning.
 - Compliant with STANAG 4439 for FCO and BI (Type V)
- Mecar will continue the evaluation of the IM behaviour (SCO, FI, SR and SCJ) of the warhead filled with composition P16945.

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EURENCO

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Thank you for your attention
Questions ?