



VI-RDX FROM LAB TO PILOT SCALE

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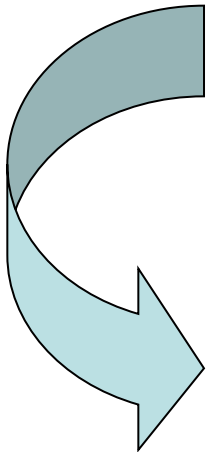
UNIQUE KNOW-HOW

MULTIFACETED RANGE

- **Introduction**
- **VI-RDX at lab scale**
- **Scale up to pilot scale**
- **Conclusion**



INTRODUCTION

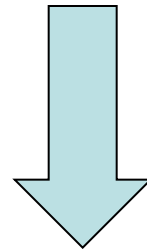


Reduction of some RDX formulations towards shock by using RS-RDX or EURENCO I-RDX®



INTRODUCTION

**SENSITIVITY OF EXPLOSIVE FORMULATIONS
TOWARDS SHOCK**

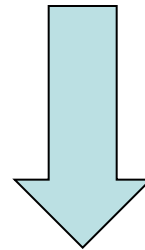


- **Binder nature**
- **Explosive particle size**
- **Explosive particle shape / surface**
- **Defects, intragranular voids**
- **Any heterogeneities in the material**



INTRODUCTION

DEVELOPMENT OF A NEW GRADE OF RDX



- **Easy to process**
- **Shock sensitivity as good as measured on a fine product**
- **Reduced internal defects in RDX crystal**



- **Introduction**
- **VI-RDX at lab scale**
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VI-RDX AT LAB SCALE

→ Synthesis of Very Insensitive RDX at lab scale under a well-controlled crystallization process



RDX particles with very few internal defects and smooth shapes

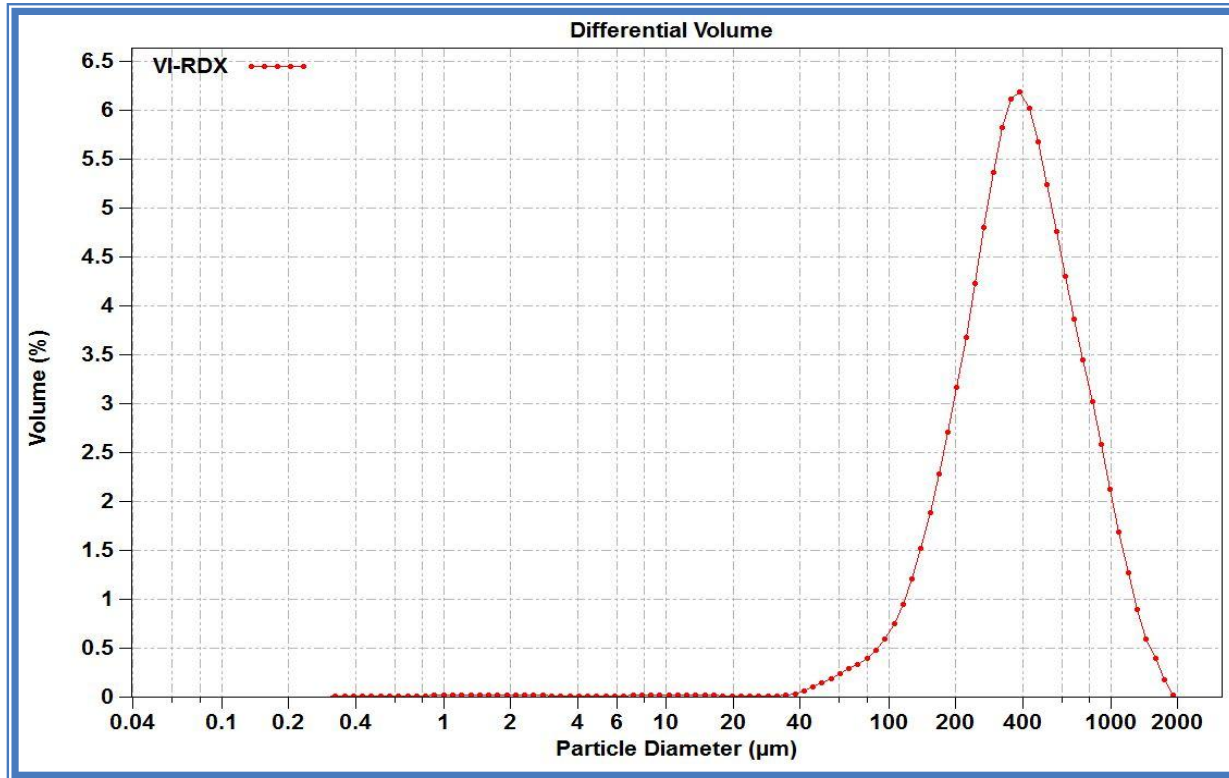


Characterizations compared with other RDX grades



**VI-RDX AT LAB SCALE
Characterizations**

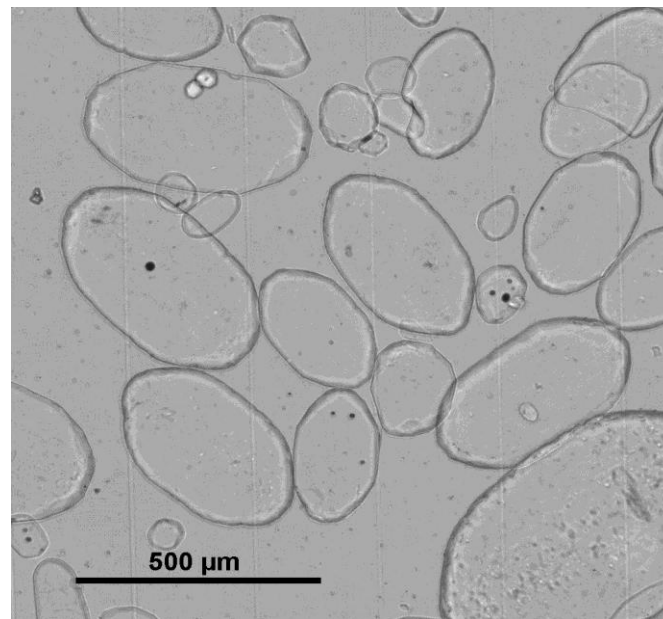
PARTICLE SIZE



- **Narrow distribution**
- **Mean diameter $\approx 400 \mu\text{m}$**

**VI-RDX AT LAB SCALE
Characterizations**

MICROSCOPY



- **Rounded shape single crystals**
- **Very few macles or agglomerates**
- **Quite few inclusions**



**VI-RDX AT LAB SCALE
Characterizations**

PARTICLE APPARENT DENSITY

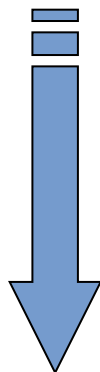


- **Allows the characterization of internal defects**
- **Results compared with the 2 less sensitive lots of the Round Robin program**

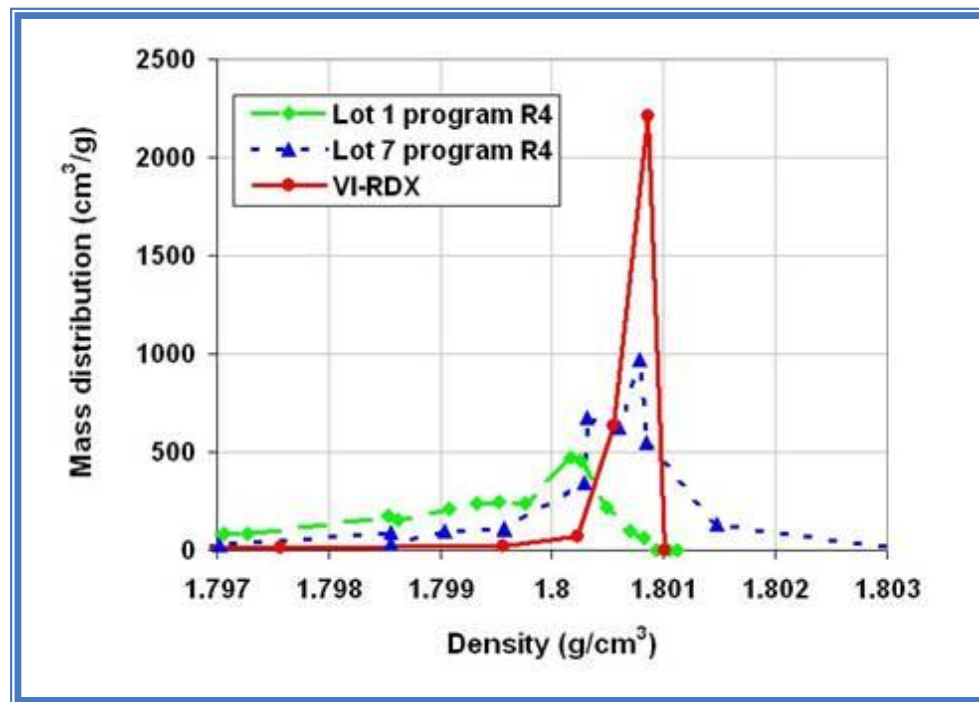
**VI-RDX AT LAB SCALE
Characterizations**

PARTICLE APPARENT DENSITY

- **Narrowest and highest curve for VI-RDX**
- **Close to 1.801 g/cm³**



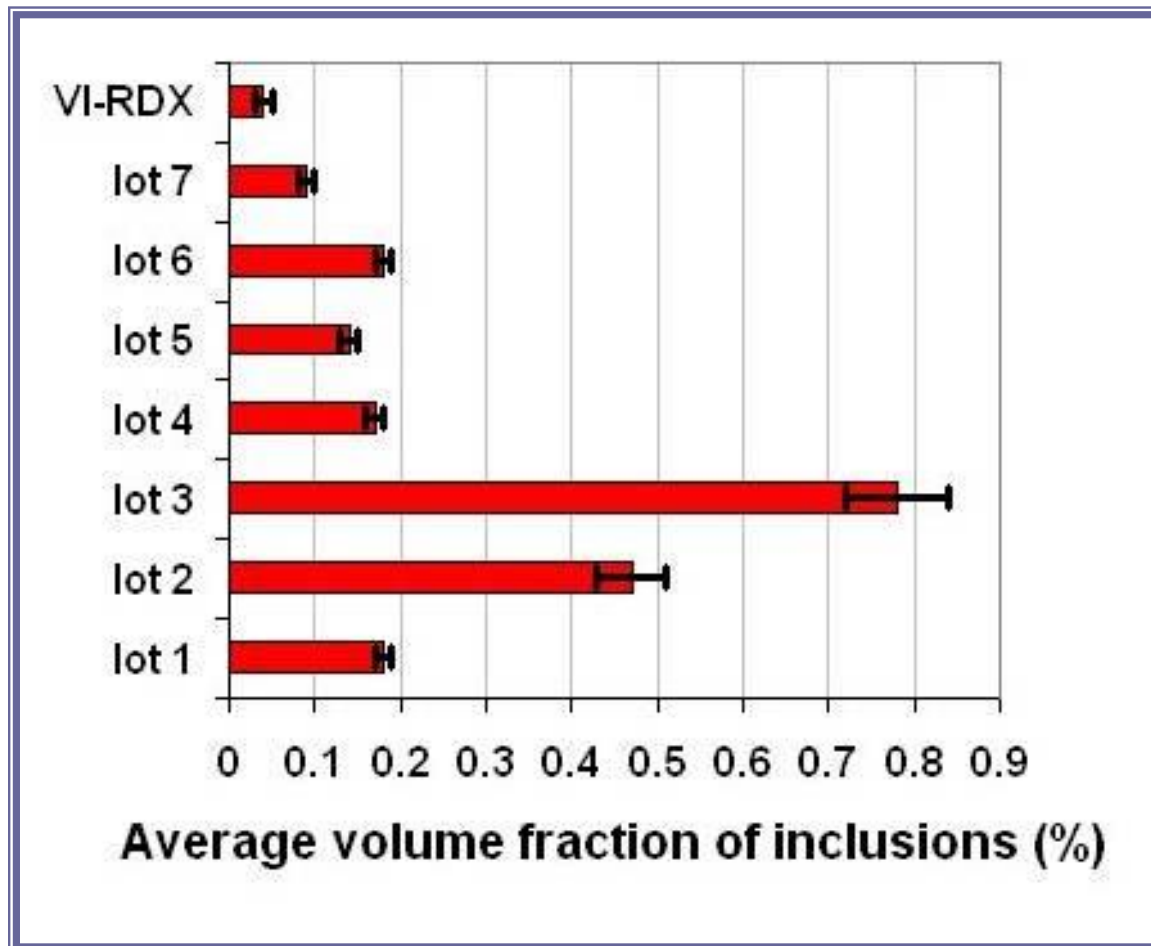
- **Most homogeneous particles**
- **Very few internal defects**



VOLUME FRACTION OF INCLUSIONS

**VI-RDX AT LAB SCALE
Characterizations**

- **VI-RDX has about half of inclusions that the best RDX from the Round Robin program**



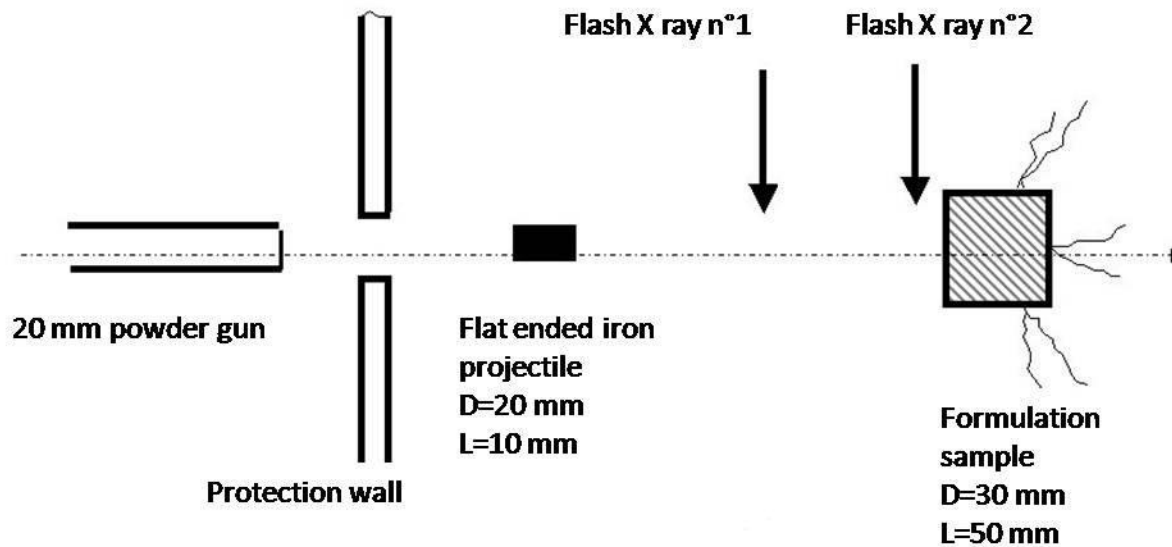
VI-RDX AT LAB SCALE
Characterizations

**ISL LAB SCALE SCHOCK
SENSITIVITY TEST**



**VI-RDX AT LAB SCALE
Characterizations**

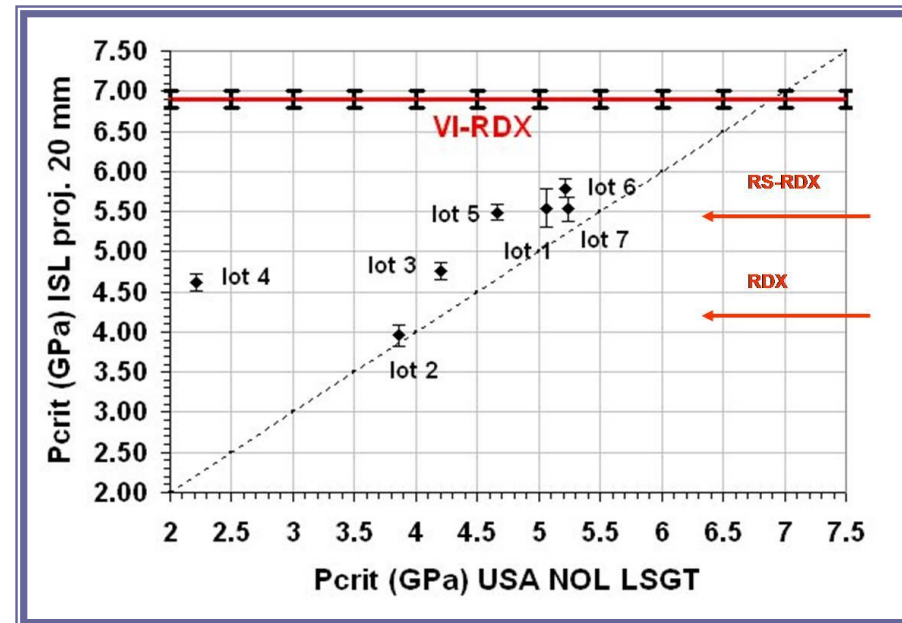
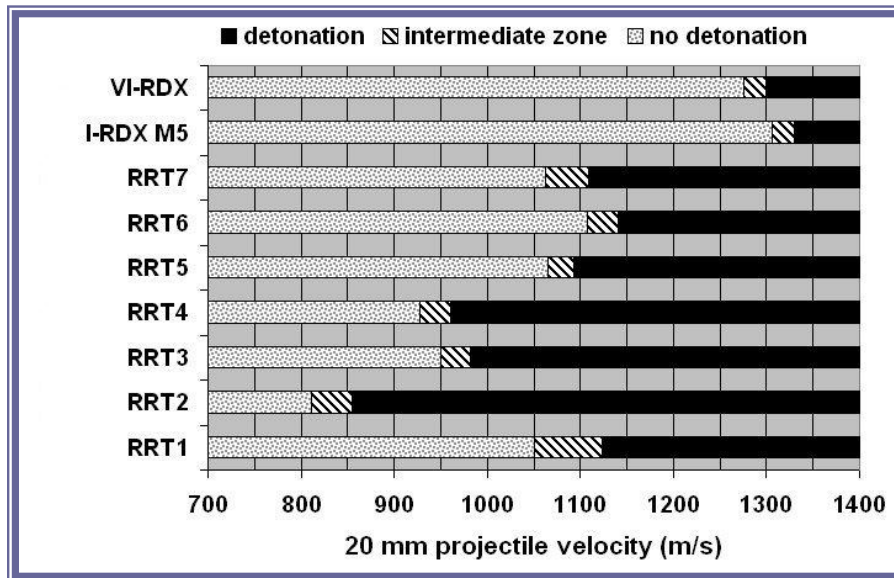
**ISL LAB SCALE SCHOCK
SENSITIVITY TEST**



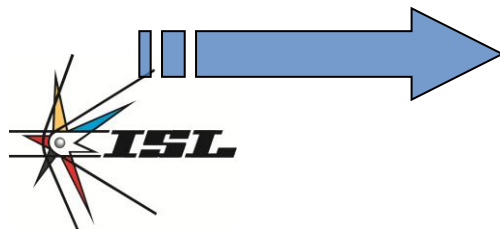
VI-RDX AT LAB SCALE Characterizations

Performed on RDX/Wax 70/30

ISL LAB SCALE SCHOCK SENSITIVITY TEST



- VI-RDX much less sensitive than the less sensitive RS-RDX from Round Robin program
- VI-RDX shock sensitivity similar to that measured on a 5 μ m RDX



VI-RDX AT LAB SCALE Conclusion

- **It is possible to produce at lab scale a new grade of RDX : Very Insensitive RDX**
- **VI-RDX is less sensitive to shock than the best commercially available RDX**
- **VI-RDX shock sensitivity similar to that of fine RDX without the drawback of a high viscosity paste due to fine particles during processing**

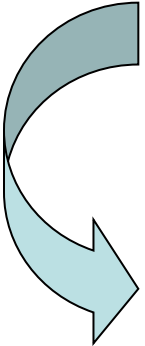


- **Introduction**
- **VI-RDX at lab scale**
- **Scale up to pilot scale**
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VI-RDX AT PILOT SCALE

**PRODUCTION OF 10/20 KG OF VI-RDX AT EURENCO
PILOT SCALE**

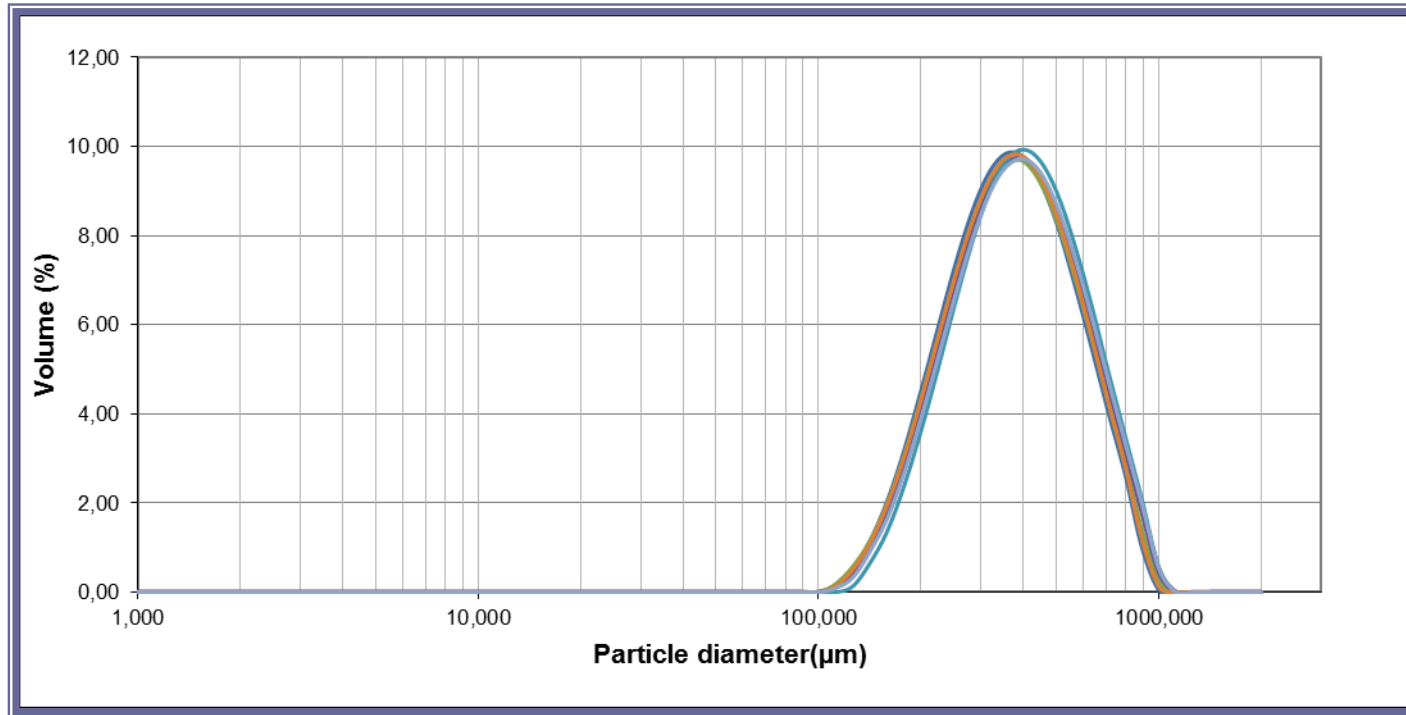
- 
- **Successful transfer of the crystallization conditions from lab to pilot scale**
 - **Very reproducible product quality from one batch to another**

- 
- Characterizations compared with**
- ✓ **Other RDX grades**
 - ✓ **VI-RDX from lab scale**



**VI-RDX AT PILOT SCALE
Characterizations**

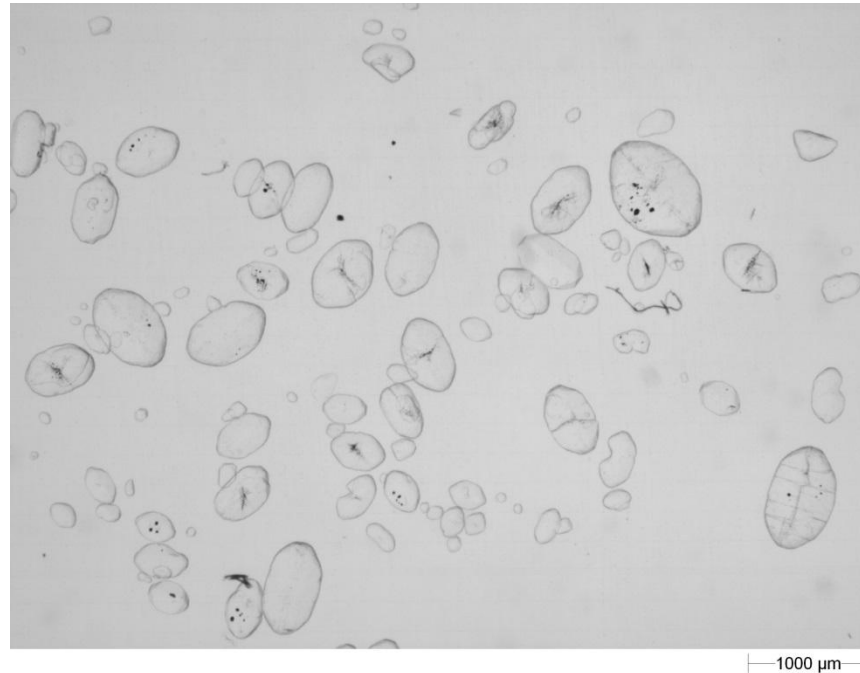
PARTICLE SIZE



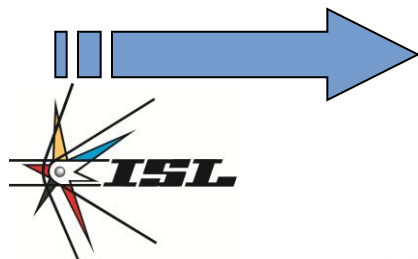
- **Narrow distribution reproducible from one batch to another**
- **Mean diameter $\approx 400 \mu\text{m}$**

VI-RDX AT PILOT SCALE Characterizations

MICROSCOPY



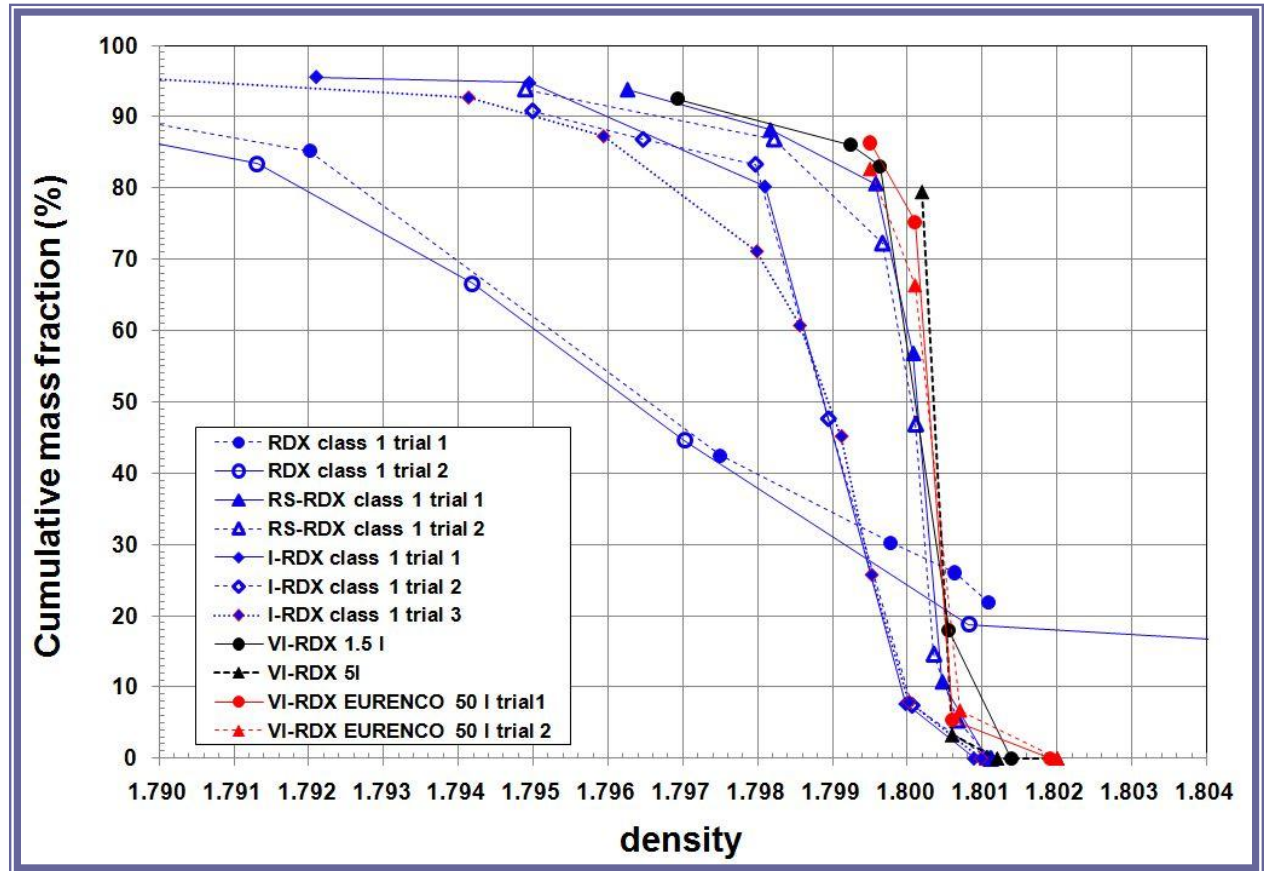
- **Rounded shape single crystals**
- **Very few internal defects**
- **EURENCO pilot scale crystals as good as those obtained at ISL lab scale**



VI-RDX AT PILOT SCALE
 Characterizations

PARTICLE APPARENT DENSITY

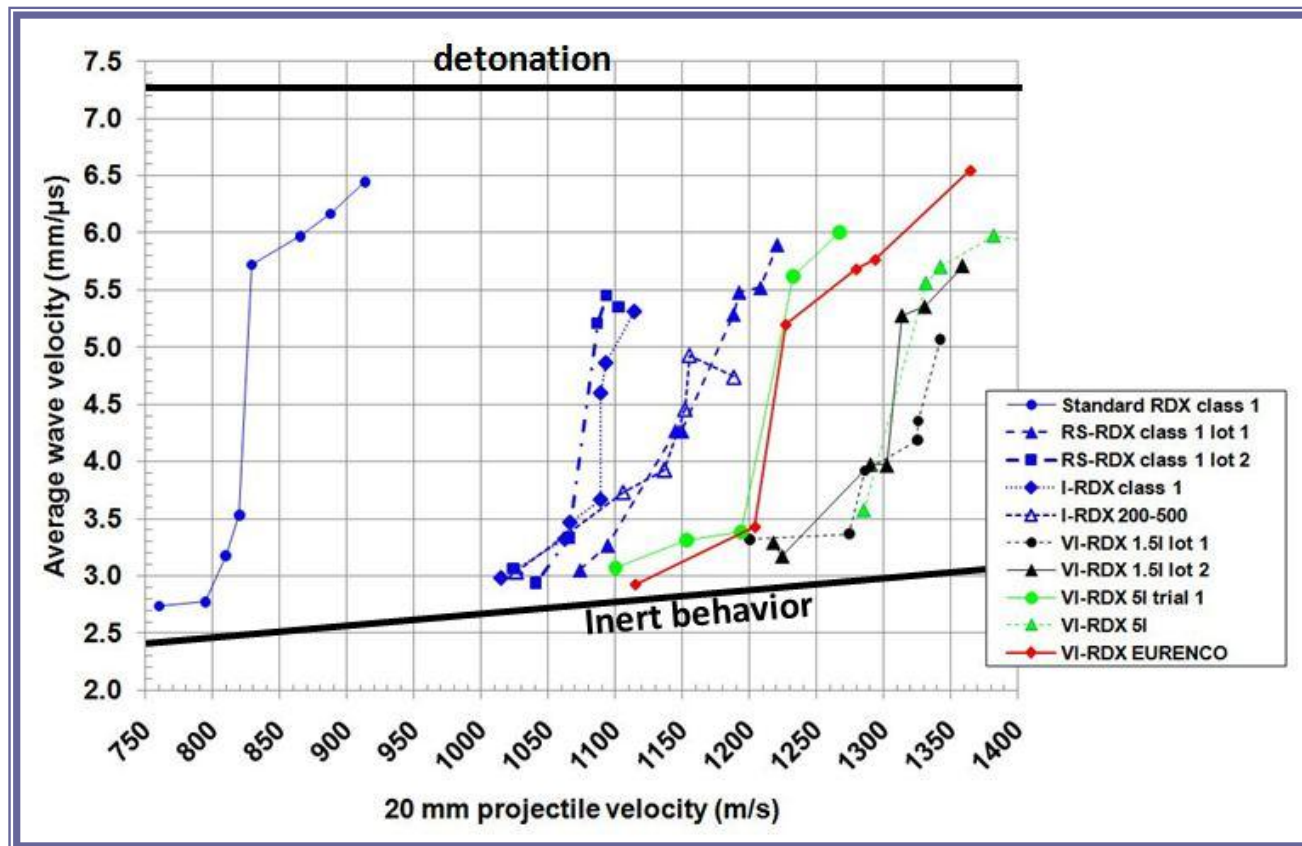
Apparent density distribution for pilot scale VI-RDX same as that for lab scale VI-RDX



**VI-RDX AT PILOT SCALE
 Characterizations**

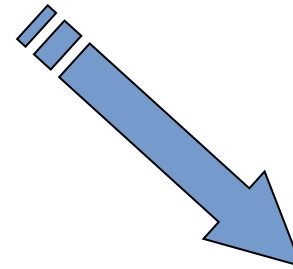
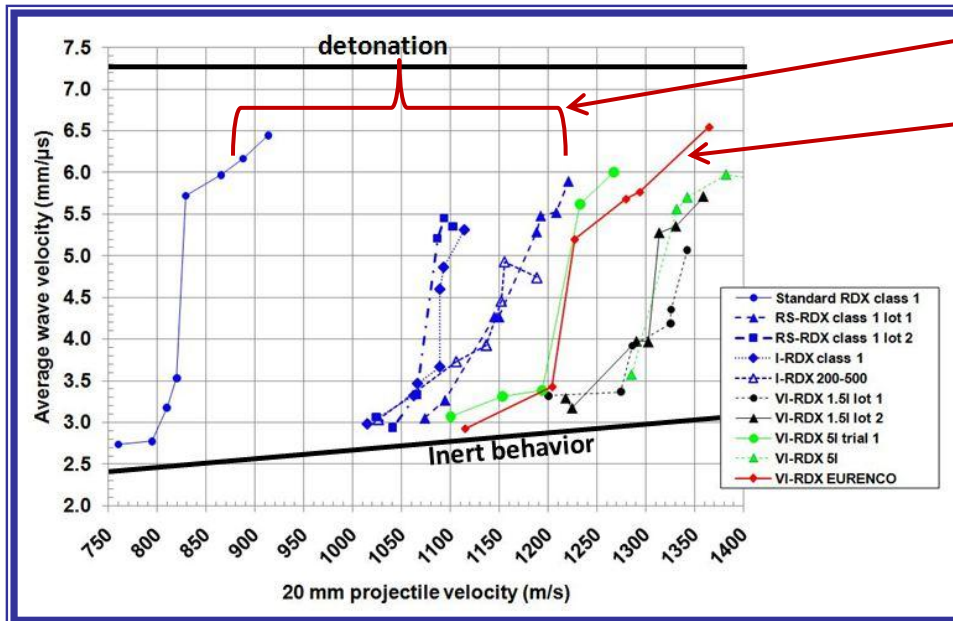
**ISL LAB SCALE SCHOCK
 SENSITIVITY TEST**

Performed on RDX/Wax 70/30



**VI-RDX AT PILOT SCALE
 Characterizations**

**ISL LAB SCALE SCHOCK
 SENSITIVITY TEST**

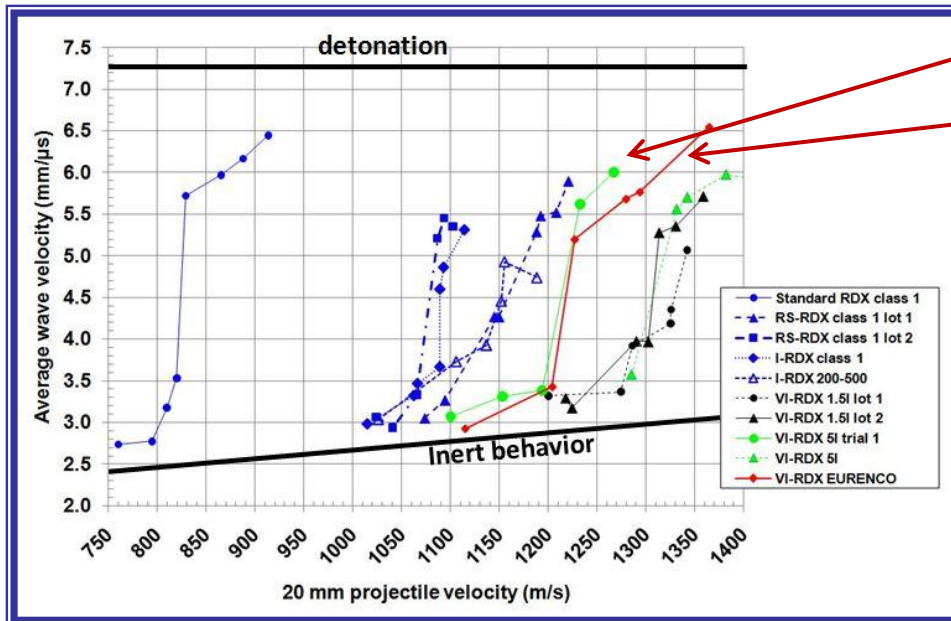


- Shock sensitivity of VI-RDX produced at pilot scale better than that for commercially available RS-RDX or I-RDX®



**VI-RDX AT PILOT SCALE
Characterizations**

**ISL LAB SCALE SCHOCK
SENSITIVITY TEST**



- **Shock sensitivity of VI-RDX produced at pilot scale quite similar to that obtained with the first ISL trial at 5 L. scale**



**VI-RDX AT PILOT SCALE
Characterizations**

**LSGT ON PBXN-109
COMPOSITION**

	Results for VI-RDX	Results for I-RDX®
Density (kg/m ³)	1696	1650 / 1700
Stress (Mpa)	0.54	0.33 / 0.76
Max Strain (%)	20.6	19 / 55
Shore hardness	61	44 / 64
LSGT (Cards)	In progress	140 ± 5



The mechanical properties are comparable



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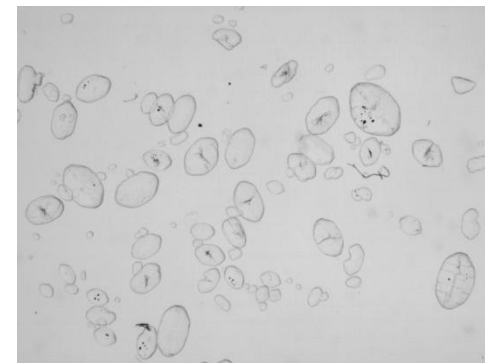
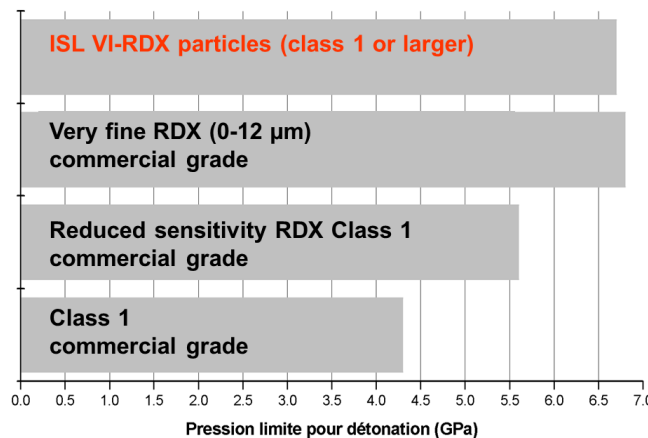
GENERAL CONCLUSION

VI-RDX



Possible to further reduce the sensitivity of RDX composition towards shock

- **Single round crystal with smooth surface and very few internal defects**
- **Sensitivity towards shock equivalent to a very fine RDX without processing problem due to high viscosity paste**



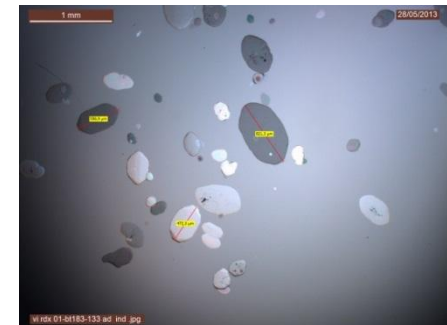
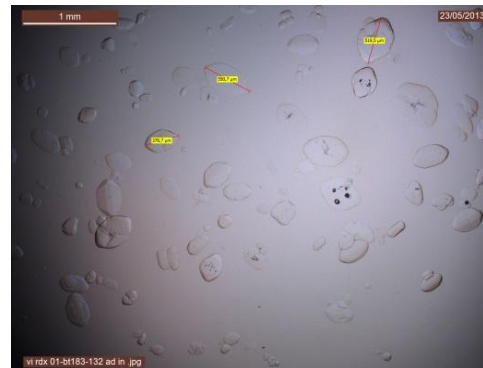
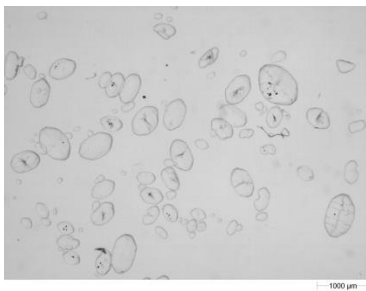
GENERAL CONCLUSION

VI-RDX



Possible to further reduce the sensitivity of RDX composition towards shock

- **Crystallization conditions transferred from lab to pilot scale**
- **First characterization results on EURENCO VI-RDX are very promising**
- **Work in progress to achieve the scale up process to pilot scale**



A special thank for their contribution to :

- **M. FOURDINIER (EURENCO), F. SCHLESSER and D. STEHLIN (ISL) who coauthored this work**
- **D. LEGEAY and his team for the pilot scale**
- **French DGA for its financial support**



A MEMBER OF

