Impact of REACh, ITAR and other regulations on Energetic Materials Sustainability

G. ECK, M. EL OTHMANI, J. PEROUEL, D. DRU, B. NOUGUEZ

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- Introduction
- Impact of REACh regulation
- Impact of ITAR / EAR regulation
- Conclusion

INTRODUCTION

EUROPE has to face to different regulations

REACh

ECHA
EUROPEAN CHEMICALS AGENCY

- **Registration, Evaluation, Authorization and Restriction of Chemicals**
- **Adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals**

ITAR
(US/DoD or US/DoC regulations)
EAR

- **International Traffic in Arms regulations / Export Administration Regulation**
- **Designed to help ensure that defense related technology does not get into the wrong hands**

INTRODUCTION

EUROPE has to face to different regulations

REACh

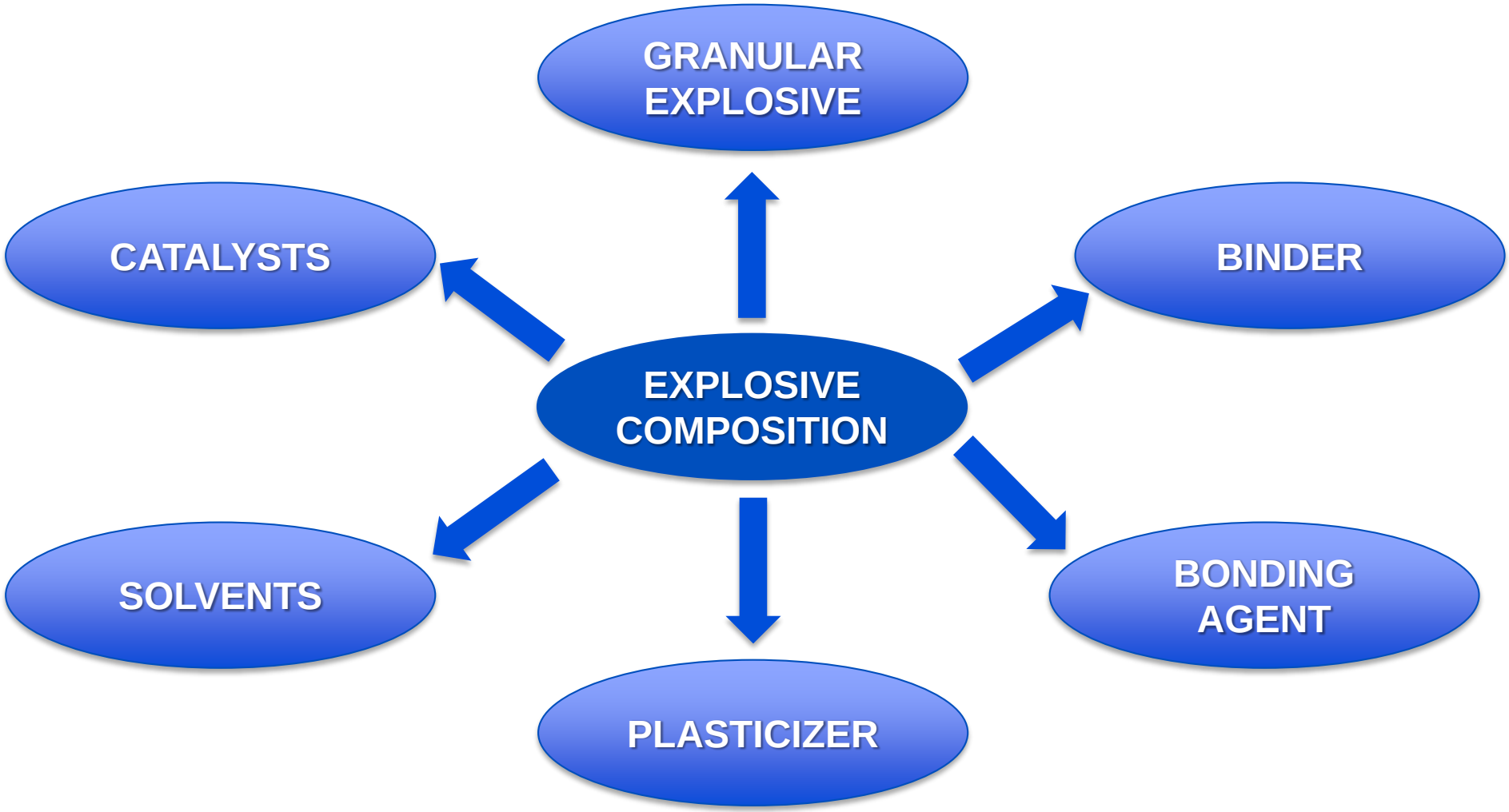
ECHA EUROPEAN CHEMICALS AGENCY

- **Replace the critical component by another one that is supposed to be chemically and/or functionally equivalent**

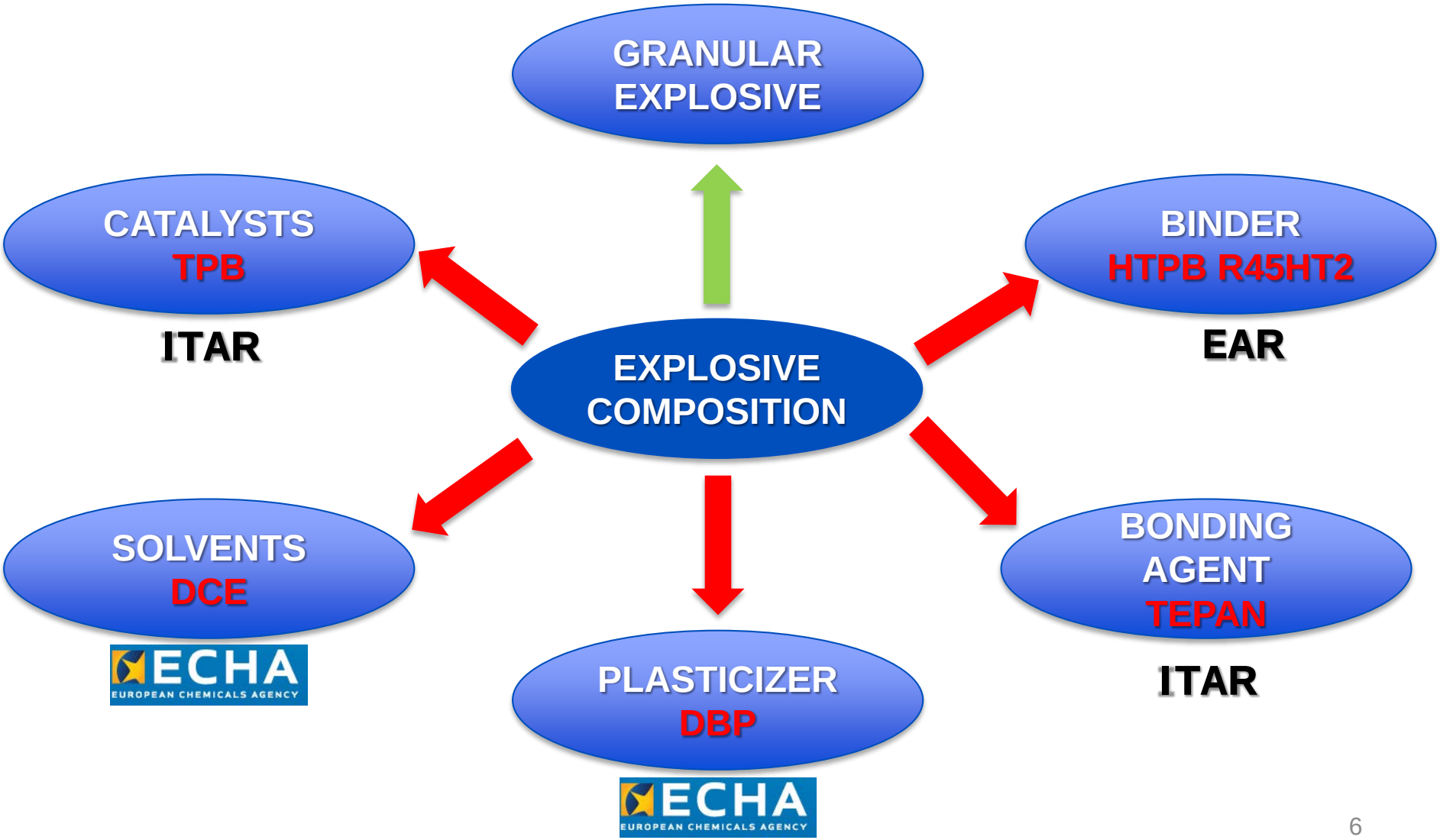
ITAR
(US/DoD or US/DoC regulations)
EAR

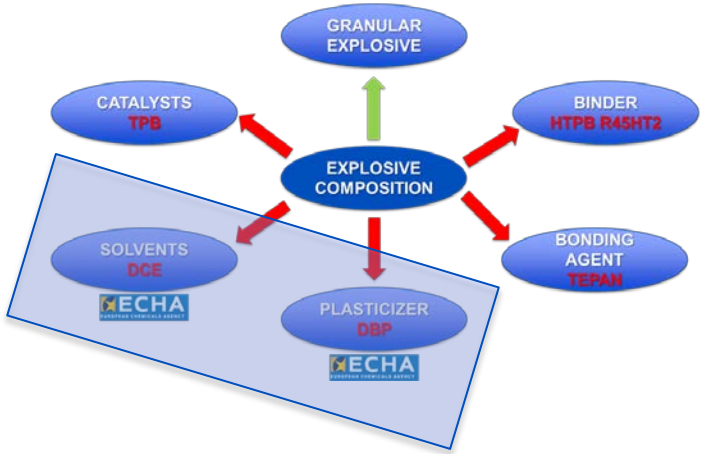
- **Find new suppliers of the same component**

INTRODUCTION



INTRODUCTION





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IMPACT OF REACh REGULATION

List of critical compounds

Impacted compounds	Use	Regulation impact	Strategy
DBP Dibutyl Phtalate	Plasticizer	Prohibited by REACh since **2015**	Replacement
DCE Dichloroethane	Polymerization solvent	Not to be in use after **2021**	Search for a new polymerization solvent
Tetrachloroethylene	Jellification solvent	Prohibited by REACh since **2016**	Search for a new solvent

IMPACT OF REACh REGULATION

DBP
Dibutyl Phtalate

PLASTICIZER
in the nitrocellulose varnish used for final coating of MACS and CCC

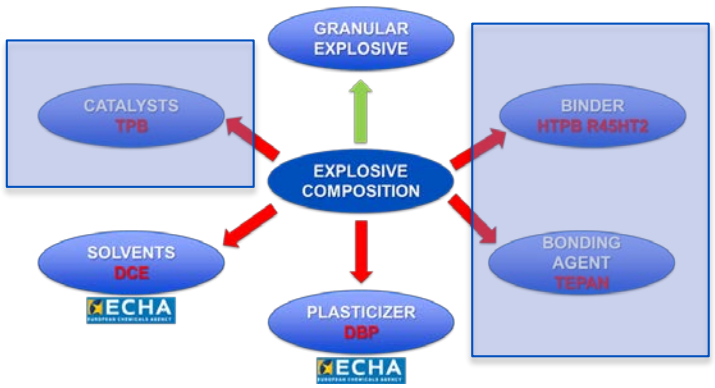
- **Replaced by a plasticizer widely used in the cosmetic industry**
- **Qualification of this new compound completed**
  - **Chemical compatibilities**
  - **Combustion quickness**
  - **Ash percent**
  - **Permeability**
  - **Overall qualification of MACS and CCC**

IMPACT OF REACh REGULATION

DCE
Dichloroethane

SOLVENT
Polymerization of ECH to get PECH, the intermediate polymer in GAP production

- **Middle term replacement by a standard organic solvent**
  - **Organic solvent not yet impacted by REACh**
  - **Process file ready for scale up to the industrial workshop**
- **Long term replacement: Research studies to find new ways to polymerize ECH**



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IMPACT OF ITAR / EAR REGULATION

List of critical compounds

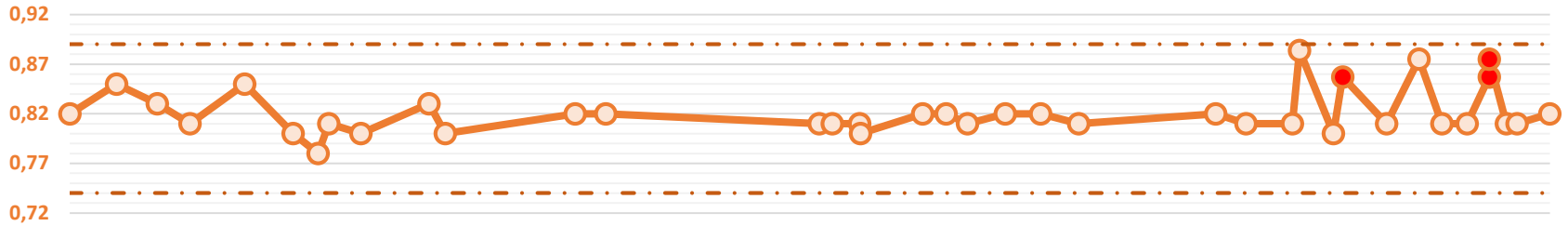
Impacted compounds	Use	Regulation impact	Strategy
HTPB R45HT2	Polymer	• Produced in the USA under EAR licence • Difficulties for renewing the end user statement	Find new suppliers
Copolymer SBS	Thermoplastic copolymer	• Long period supply • Difficulties due to final use	Find an European source
TEPAN **Tetraethylen pentamine acrylonitrile**	Bonding agent	• Impacted by ITAR regulation	Find new suppliers
$BiPhi_3$ or TPB **Triphenyl bismuth**	Polymerization catalyst	• Impacted by ITAR regulation	Find new suppliers

IMPACT OF ITAR / EAR REGULATION

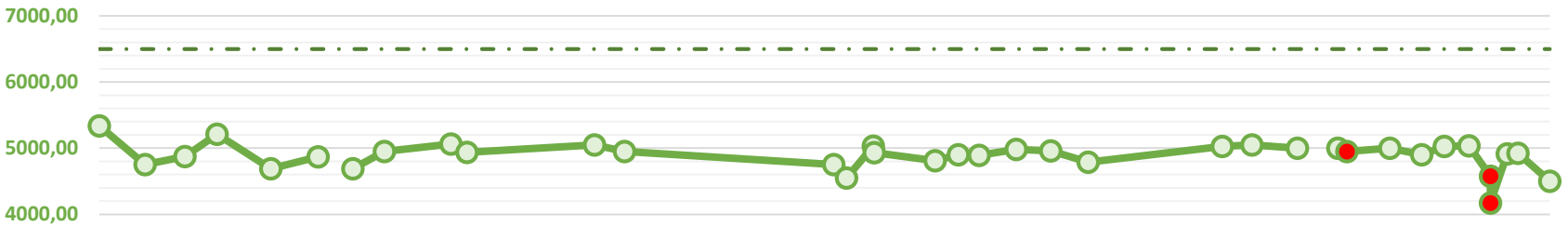
HTPB R45HT2

BINDER
Most used polymer in EURENCO cast PBX compositions

- **Supplying oh HTPB from a new source and comparison with the current one**



Hydroxyl content



Viscosity

IMPACT OF ITAR / EAR REGULATION

HTPB R45HT2

BINDER
Most used polymer in EURENCO cast PBX compositions

- **Qualification of this new source**
  - **Chemical compatibilities with most important granular products**
  - **Evaluation in cast PBX composition in 8 L. mixer ➔ implementation feasibility**
  - **Evaluation in cast PBX composition in 35 L. mixer ➔ implementation feasibility and composition characterization**
  - **Ageing studies at 60°C**
  - **Evaluation in 135 L. mixer**
  - **Evaluation in the proprietary bi-component process**

IMPACT OF ITAR / EAR REGULATION

HTPB R45HT2

BINDER
Most used polymer in EURENCO cast PBX compositions

- **Qualification of this new source**
  - **Chemical compatibilities with most important granular products**
  - **Evaluation in cast PBX composition in 8 L. mixer ➔ implementation feasibility**
  - **Evaluation in cast PBX composition in 35 L. mixer ➔ implementation feasibility and composition characterization**
  - **Ageing studies at 60°C ➔ In progress**
  - **Evaluation in 135 L. mixer ➔ In progress**
  - **Evaluation in the proprietary bi-component process ➔ In progress**

IMPACT OF ITAR / EAR REGULATION

HTPB R45HT2

- **Qualification at 8 L. scale on 6 cast cured compositions**

	B2238B	B2211B	PBXN-109	B2214B	B2263A
RDX	✓	✓	✓		✓
HMX				✓	
NTO				✓	
PA		✓			
Al		✓	✓		
HTPB	✓	✓	✓	✓	✓

IMPACT OF ITAR / EAR REGULATION

HTPB R45HT2

- **Qualification at 35 L. scale on 3 cast cured compositions**

	B2238B		PBXN-109		B2263A
RDX	✓		✓		✓
HMX					
NTO					
PA					
Al			✓		
HTPB	✓		✓		✓

IMPACT OF ITAR / EAR REGULATION

HTPB R45HT2

- **Qualification at 8 L. scale : Characterizations**
  - **Density**
  - **Hardness**
  - **Mechanical properties at +20°C, -45°C, +60°C**
  - **Sensitivity to friction (ISF) and impact (ISI)**

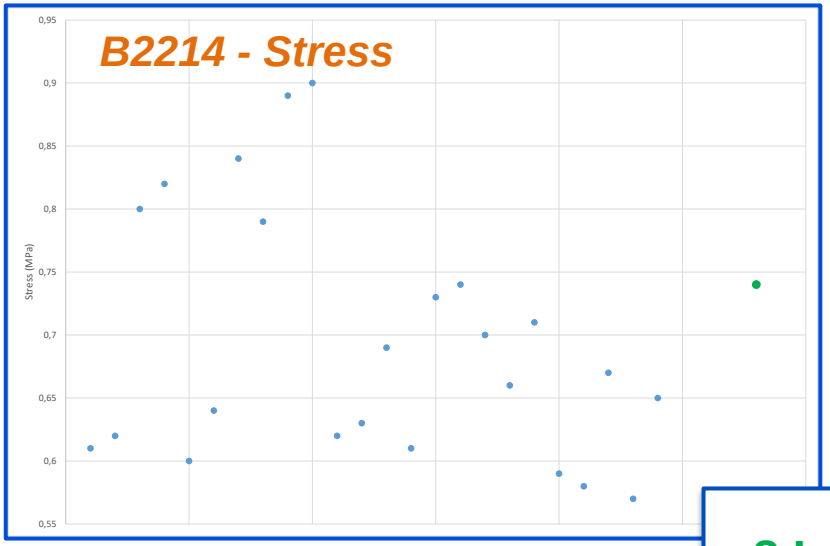
→

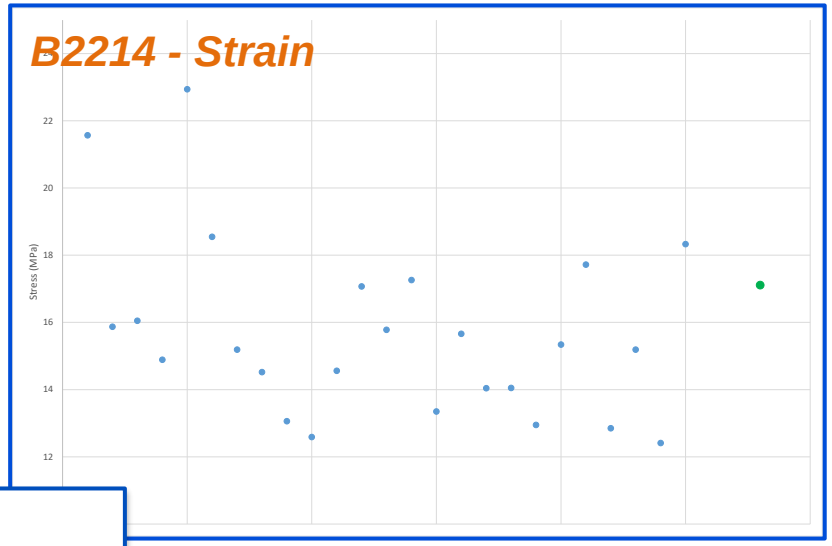
✓ **Conform to the specifications**
✓ **Results equivalent to those for standard industrial compositions**

- **Additive characterization at 35 L. scale**
  - **Friability**

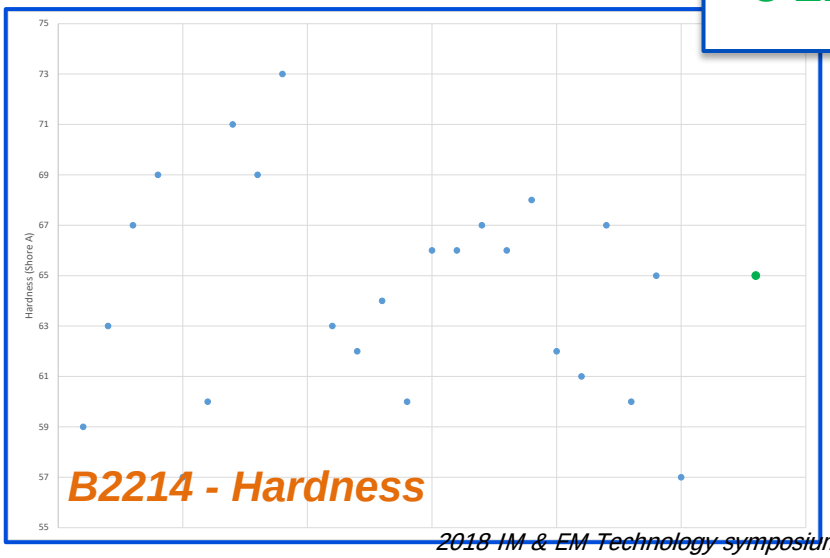
IMPACT OF ITAR / EAR REGULATION

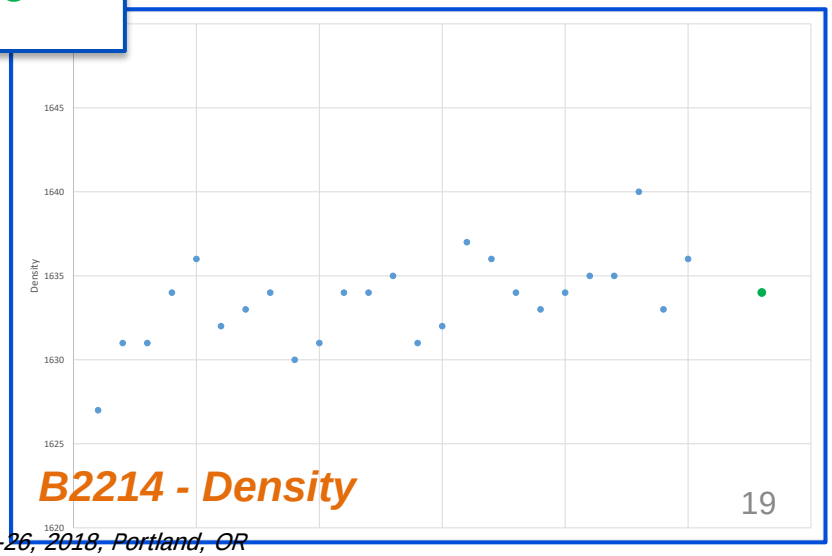
HTPB R45HT2





- 8 L. scale

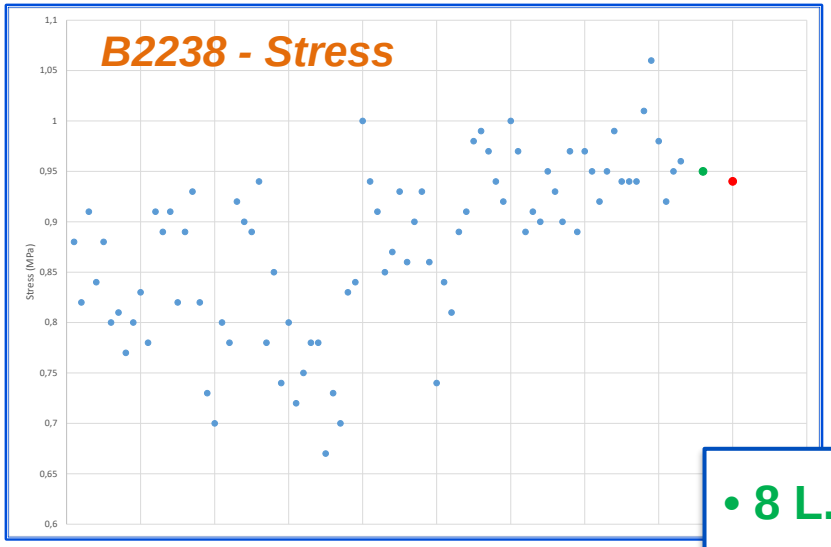


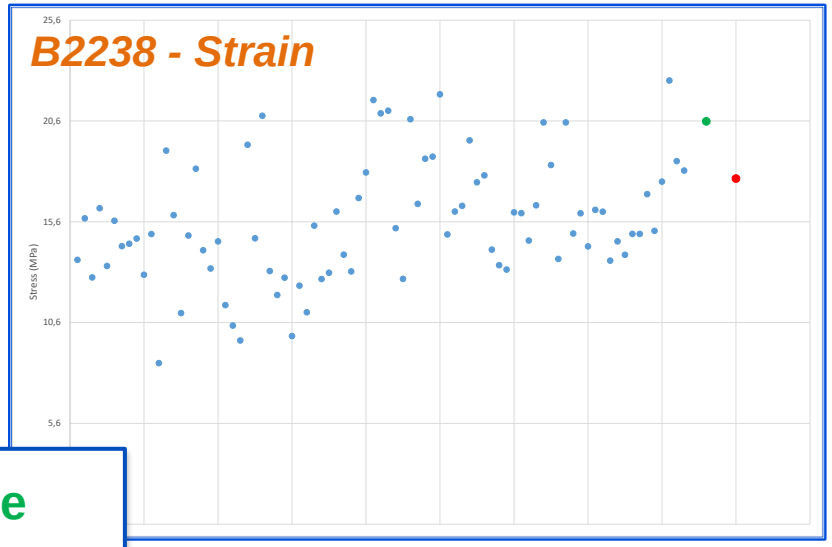


IMPACT OF ITAR / EAR REGULATION

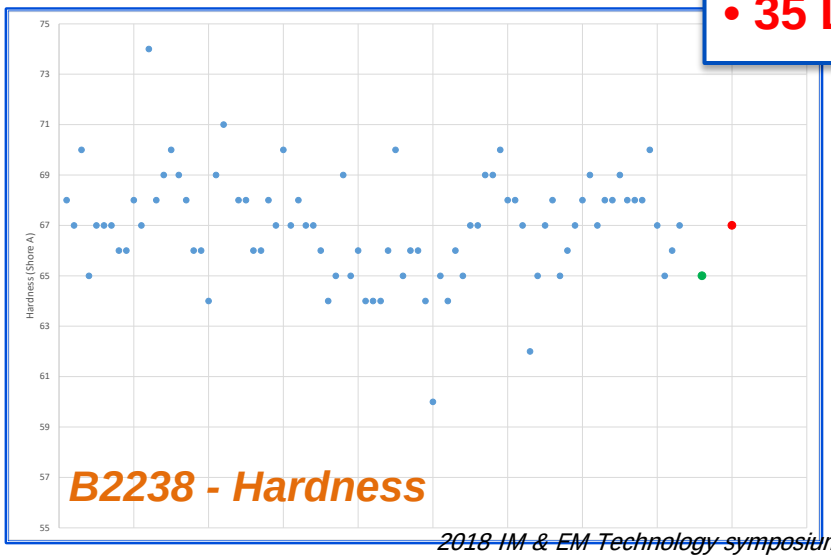
EUROPEAN ENERGETIC MATERIALS COMPANY

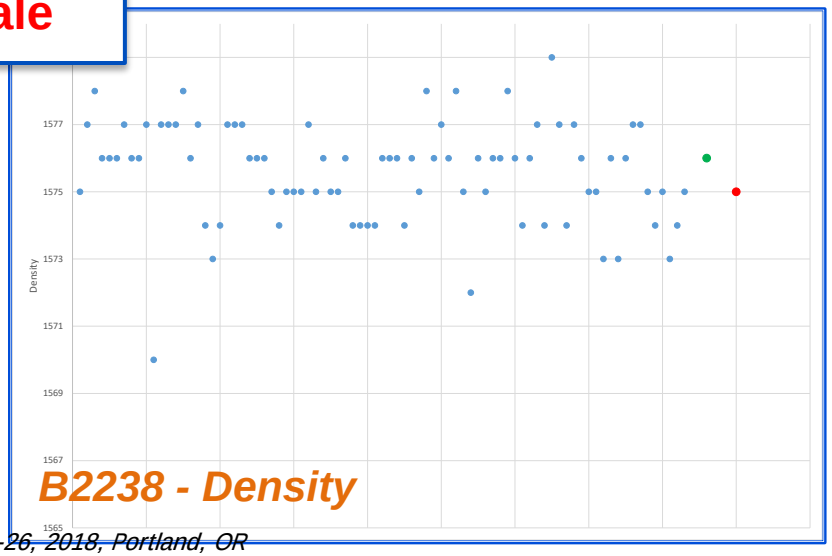
HTPB R45HT2





- 8 L. scale
- 35 L. scale





IMPACT OF ITAR / EAR REGULATION

TEPAN
Tetraethylen pentamine acrylonitrile

BONDING AGENT
In formulation of cast PBX or composite rocket propellants

- **Supplying of 2 French alternatives (TEPAN N°2 and TEPAN N°3) and comparison with the reference (TEPAN n°1)**

Characterization	Specification	TEPAN n°1 (Reference)	TEPAN n°2
Total amine content	11/15 eq/kg	13.7	13.7
Water content	≤ 0.50 %	0.28	0.28

IMPACT OF ITAR / EAR REGULATION

TEPAN
Tetraethylen pentamine acrylonitrile

BONDING AGENT
In formulation of cast PBX or composite rocket propellants

- **Validation in composition**

Formulation tested	B2238	B2214B
Viscosity	Compliant with industrial scale	Compliant with industrial scale
Density	1.572	1.636
Mechanical properties - Smt (MPa) - Emt (%)	 0.96 9.3	 0.60 10.6

IMPACT OF ITAR / EAR REGULATION

TPB
Triphenyl bismuth

CATALYST
For polymerization of cast cured formulations

- **Supplying of TPB N°2 (Non European supplier)**
- **Validation in composition PBXN-109**

Characteristics	PBXN-109 with US TPB[(a)]	PBXN-109 with TPB n°2[(b)]
Density	1669/1683	1669
Mechanical properties at 20°C - Sm (MPa) - Em (%)	 0.33/0.76 19/55	 0.61 19
Shore hardness	44/64	62

a) Industrial results (36 mixes)
b) Results at 8 L. scale

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CONCLUSION

Impacted compounds	Regulation impacts on the supply	Status
DBP / Dibutyl Phthalate	REACh	☑
DCE / Dichloroethane	REACh	Long term research studies needed
Tetrachloroethylene	REACh	☑
HTPB R45HT2	EAR	Long term program to be completed
TEPAN	ITAR	☑
Copolymer SBS	« Reluctant » supplier	☑
$BiPhi_3$ / TPB / Triphenyl bismuth	ITAR	☑

CONCLUSION

Most of the issues encountered by EURENCO

- ☺ **have been solved (DBP, TCE, TEPAN, SBS, TPB)**
- ☺ **or are about to be solved (HTPB)**

Of course these regulations cost money

But

- ➔ **They force us to find alternative solutions sometimes very innovative (DCE)**
- ➔ **They can significantly reduce the exposure of workers to dangerous substances**

Overall they are cost effective

ACKNOWLEDGEMENTS

- **J. PEROUEL, D. DRU, M. EL OTHMANI and B. NOUGUEZ who coauthored this work**
- **Process team and laboratory team who performed and characterized the compositions**
- **Bergerac team for MACS and CCC related inputs**

Thank you for your attention

Questions?

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