

**ROBATEL  
Industries**

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# HOTLAB2015

## Leuven, Belgium

### 27 Sept. - 01 Oct. 2015

## Use of FENOSOL™ foam in the design of new transportation packages



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- SUMMARY
- CONTEXT OVERVIEW
- DESCRIPTION OF FENOSOL™
- R&D PROGRAM
- CONCLUSION

1. Overview of the industrial context
  - Presentation of CEA: focus on securing the FENOSOL™ supply
  - Presentation of ROBATEL
2. Description of FENOSOL™ Foam
  - Mechanical properties
  - Thermal and fire resistance properties
3. Ongoing research and development program
4. Conclusion

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- CEA is the French Commission of Atomic Energy
- DSN is the Nuclear Services Departement in CEA
- STMR is the service dedicated to nuclear transports for all CEA's nuclear activities except arms elements
  
- The main STMR activities are :
  - Operational hold of the existing casks park
  - Capitalization of knowledge of nuclear transport fields
  - Contribution to transport competence pole of CEA
  - Duplication of existing packaging
  - Design of new packaging
  - Collection and analysis of needs expressions of CEA units
  - Planification, organisation and realization of transports
  - Provision casks to units
  - Maintenance tracking casks
  - Control and assistance in the field of transport

IR500 Cask  
(CEA)LR144 Cask  
(CEA)

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- **The FENOSOL™ process and formulation was developed in 2000 as a shock absorber and fire shield material for nuclear and military applications.**
- **It was used in over 10 transportation cask designs and implemented in over 1000 manufactured casks**
- **Risk of discontinuation of availability this product in 2012**



## ROBATEL Presentation

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- French company set up in 1830 (in continuous operation since)
- Involved in the nuclear field since 1953
- 130 employees
- 4 plants in France (Genas/ La Hague/ Marcoule/ Cadarache)
  - ROBATEL Industries (www.robatel.fr)
- 1 subsidiary in the USA
  - Robatel Technologies (www.robateltech.com)
- Main activities:
  - Studies, Design, Manufacturing, Technical support
  - On-site support and interventions
- Fields:
  - Hot cells
  - Custom gloveboxes
  - Various equipment and processing lines for the nuclear industry
  - Supply of thermal and neutron shield materials
  - Radioactive material Transportation Packages



# CEA & ROBATEL collaborations

ROBATEL and the CEA have a long collaboration history in radioactive transportation package projects.

- Starting in 1953 with the ZOE fresh fuel transportation package.
- Ongoing cask project R76-TIRADE (type B(M) Fissile) for the transportation of HLW and ILW drums from former research reactor facilities.

Now partnering for the continuation of the supply of the FENOSOL™ foam



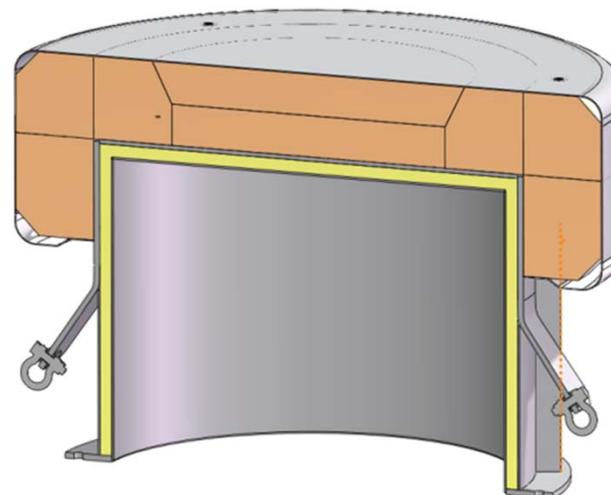
## Description of FENOSOL™ foam

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- Rigid Phenolic foam and lightweight
- Poured in a wide range of densities, from 30kg/m<sup>3</sup> up to 700kg/m<sup>3</sup>:
  - In standard molds and machined
  - Casted directly into the metallic shell to be filled
- Very efficient isotropic shock absorbing material



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- Temperature range of use from -180°C to +120°C
- High thermal insulation properties (variable with the material density)
- Classified M1 and F1 according to French standards (safety)
- Very good firewall as it doesn't melt and keeps its structure and geometry when submitted to flames
- Very low permeability to water vapor: moisture resistant



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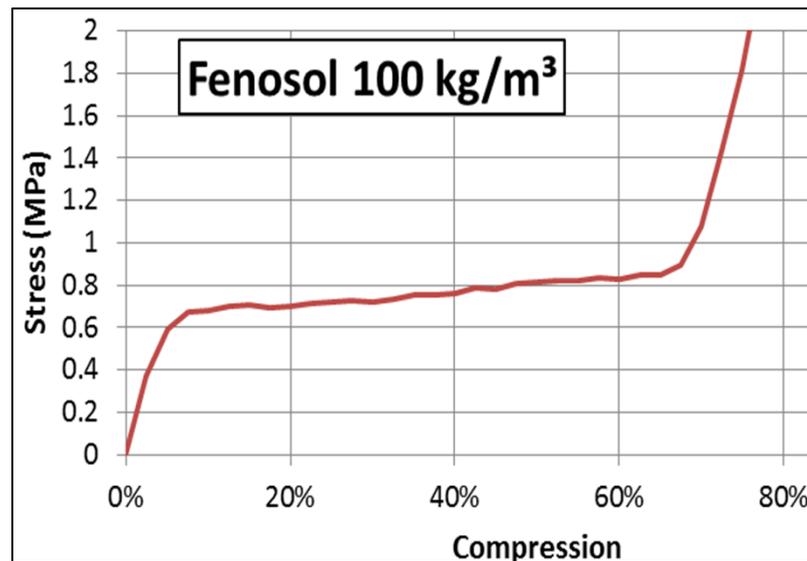
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- Focused mainly in implementation in transportation cask designs
- Launching confirmatory testing on the original FENOSOL™ formulation using the latest European standards, to allow faster qualification of the material through international safety authorities.
- Development of multivariable models to identify best variants for specific applications

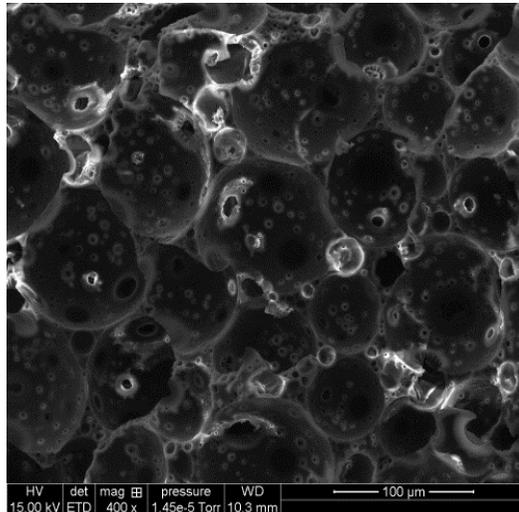
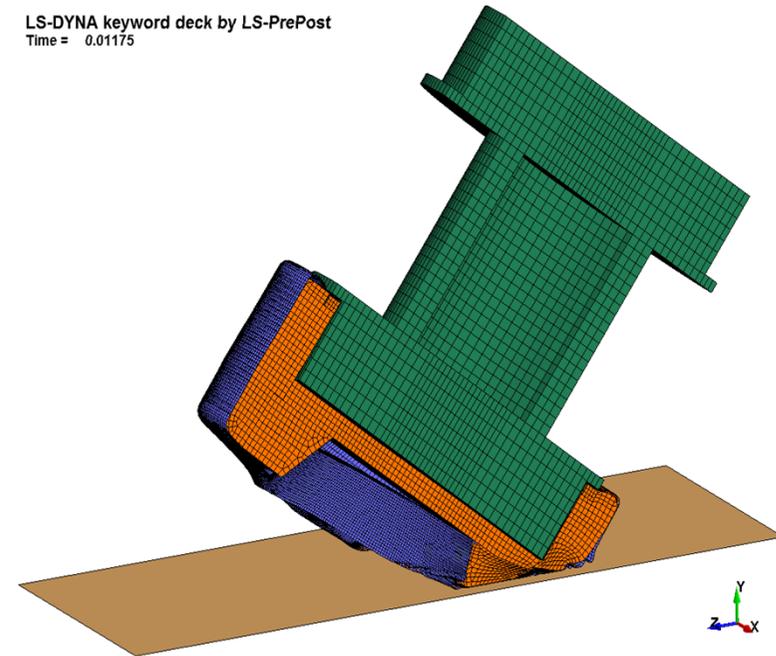


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- Evaluation of the dynamic effect by benchmarking our analytical models with actual cask scale model prototype drop tests.
- Analyses of chemical composition and microstructure variation effects to identify paths for improvement.


 LS-DYNA keyword deck by LS-PrePost  
 Time = 0.01175


# Conclusion

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- Fenosol™ is currently successfully implemented in type B cask designs.
- It is an advantageous alternative to wood in shock absorber designs:
  - For transportation casks
  - For static shock absorbers in nuclear plants
- Its fireproof behavior makes it a strong contender for fire shield door, can compete with aerated concrete thermal shields.
- The focus is on finalizing the qualification of the foam using all latest applicable European standards
- develop a comprehensive and broad density range for FENOSOL™ foam for the market.
- Create new formulations derived from the original to enhance characteristics for specific applications.

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## Thank you for your attention