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

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1. Overview of the industrial context
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   • Presentation of ROBATEL
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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
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.
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
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

- Rigid Phenolic foam and lightweight
- Poured in a wide range of densities, from 30kg/m3 up to 700kg/m3:
  - In standard molds and machined
  - Casted directly into the metallic shell to be filled
- Very efficient isotropic shock absorbing material
Description of FENOSOL™ foam

- 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
### Research and development program

- 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
- 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 = 0.0175
Conclusion

- 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.
Thank you for your attention