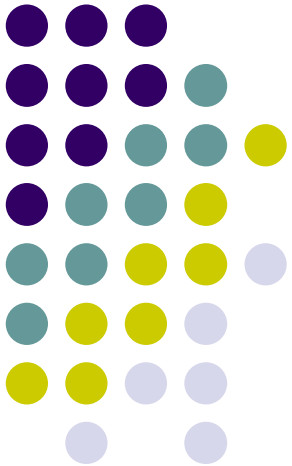
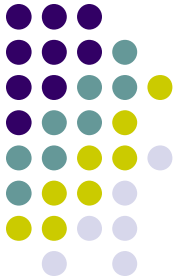
SAND2007-3784C

A Series of Unfortunate Events - General Discussion of Materials Issues

LeRoy Whinnery,
Linda Domeier
and Pat Keifer

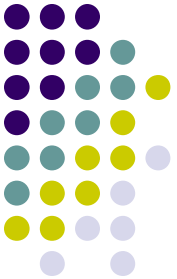


Conformal Coatings



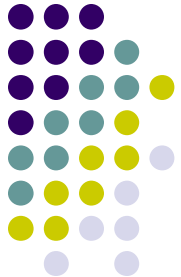
- Current choice at KCP is Laminar 500
  - Liked because of KCP and vendor experience
- Solvent based
  - CA regulations
- Longer set-up/evaporation
  - Overnight drip dry
- Suggest epoxy-based coatings
- Better control of viscosity with epoxy
- New precedence set with W88 telemetry efforts

GMB in Radiation Environment



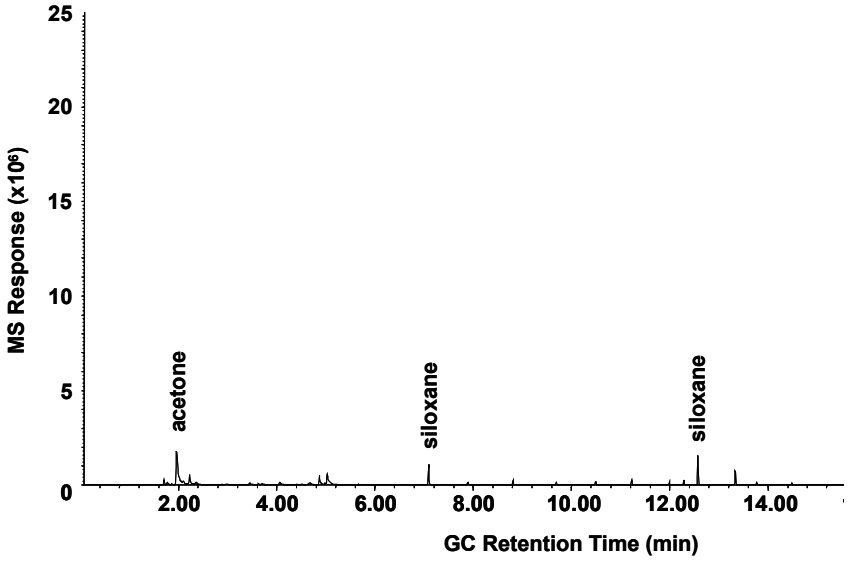
- Recent reports about GMB property changes in radiation environments
- Related to boron concentration

ILFC TEN-06

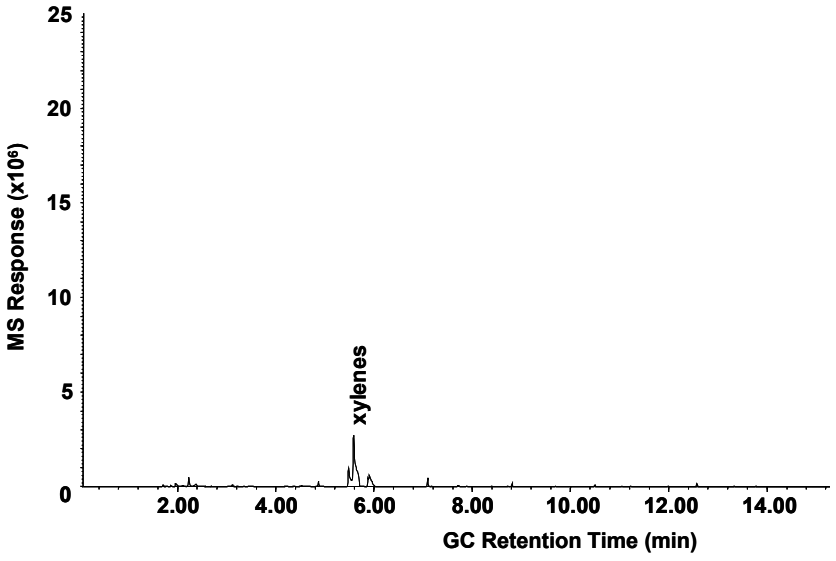


- water displacing corrosion inhibiting lubricant
  - Contents of a tightly sealed can evaporated to ~20% in the lab over the course of a year
  - The label of the same can turned a dark brown
  - The contents of the same can went from clear colorless to green/dark brown
  - Most importantly, the material appears to inhibit urethane potting cure

Results from MAC testing, other compatibility studies and common sense indicate that performing Solid Phase Micro-Extraction (SPME) analysis of all materials going into weapons should be a requirement



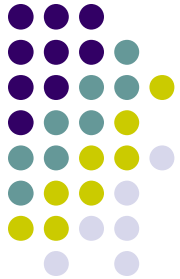
TufFoam™ at 70° C



TDI Foam at 70° C

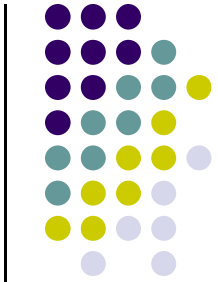
- Intended to provide an early indication of materials that need to be looked at closer before final incorporation into system

SPME of urethane elastomers



- Chris Harvey will be running samples soon (some are quite stinky, even after years)
  - Adiprene L100/Cyanacure
    - Old standard
  - PET 90A/Ethacure 300
    - KCP choice
  - EN7/8
    - High dielectric choice, high TDI
  - PET 90A/Cyanacure
    - Pat's choice
  - DK502
    - Linda's "new" replacement

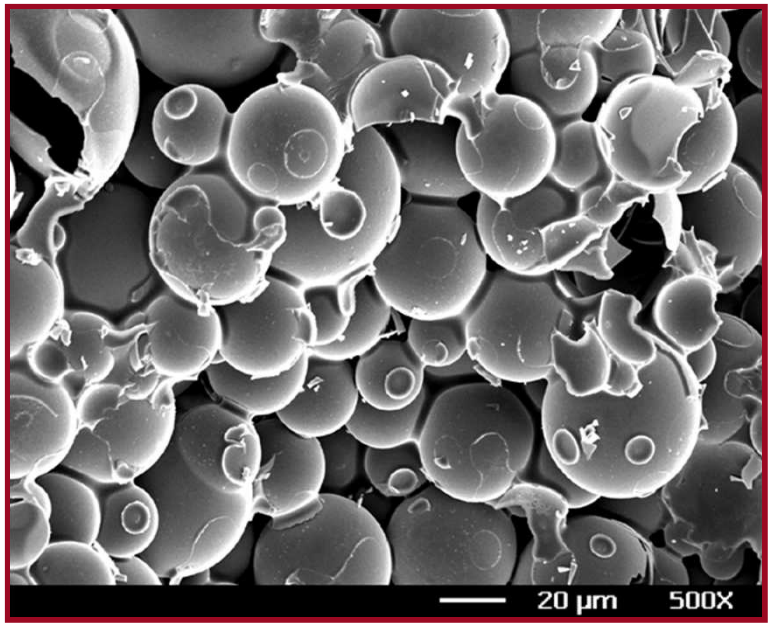
ULPA Filter



- Outside the sealed volume
- Aging report (UCRL-AR-134141) indicates a 10 year lifetime when dry, but only 5 years when wet
- Water causes plugging and decreased tensile strength
- Effect of salt water?
- Need 12-15 years

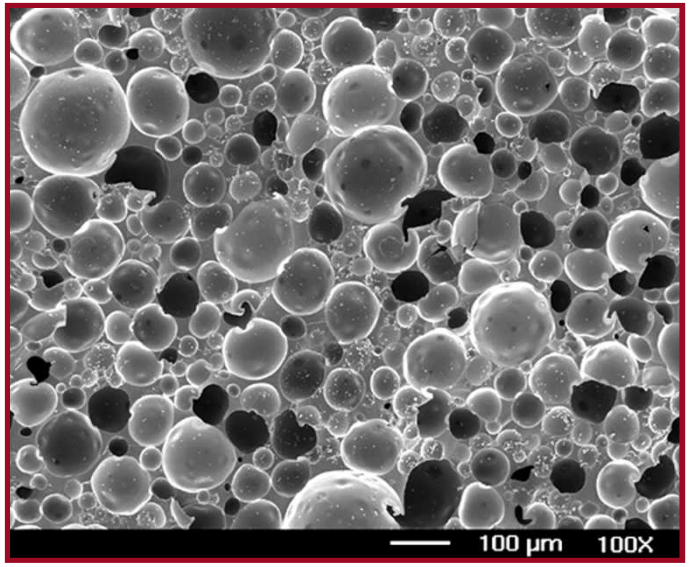
APO-BMI

- Contains Cyanacure
  - Limited supply, at least for now
- Very brittle
  - Cannot be machined to thin sections or knife edges
- Requires expensive high pressure heated molds
- Replacement material has been developed

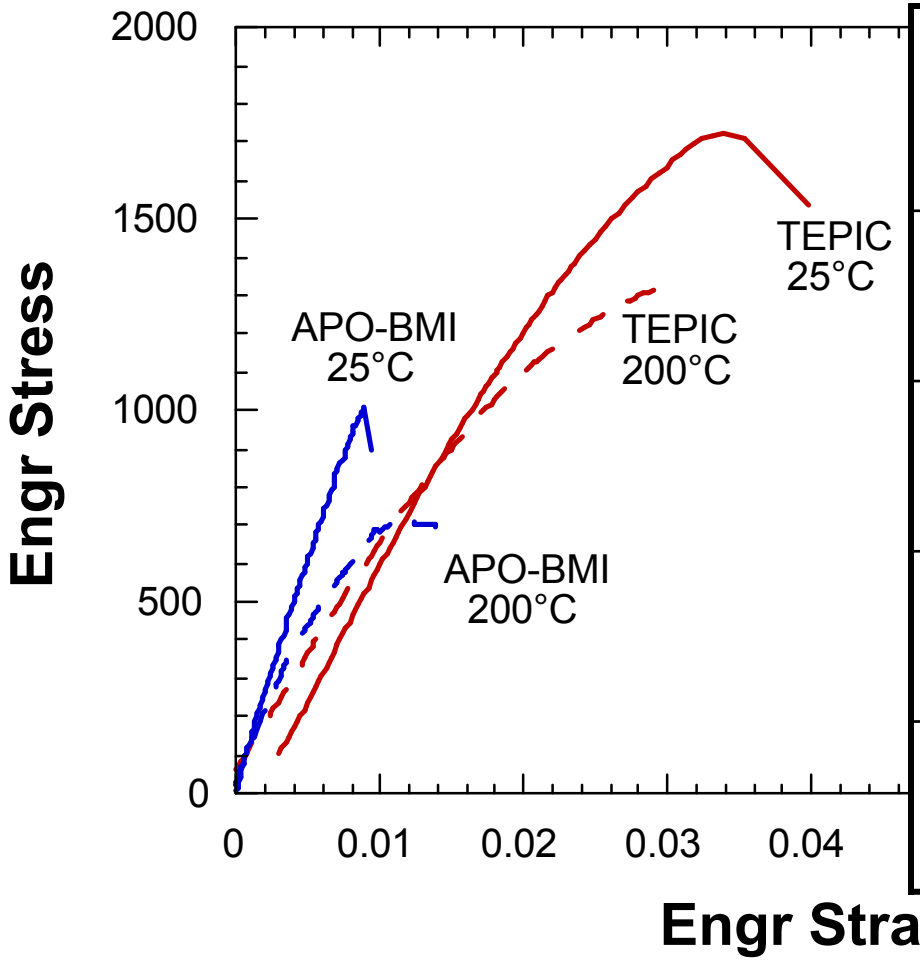


TEPIC™ is a high strength and high temperature syntactic foam initially developed for structural applications

- High-Temperature Stability
- Low Cost
- Low Density
  - Tailored density
- Thick Section Size
- Machinability
- Castability
- High Strength
- Easy of Processing
- Repairability
  - Very low TDI
  - KCP choice for cable potting
  - Apparently sensitive to ratio
  - Cracking and fissures have been observed
  - Strong odor even after cure

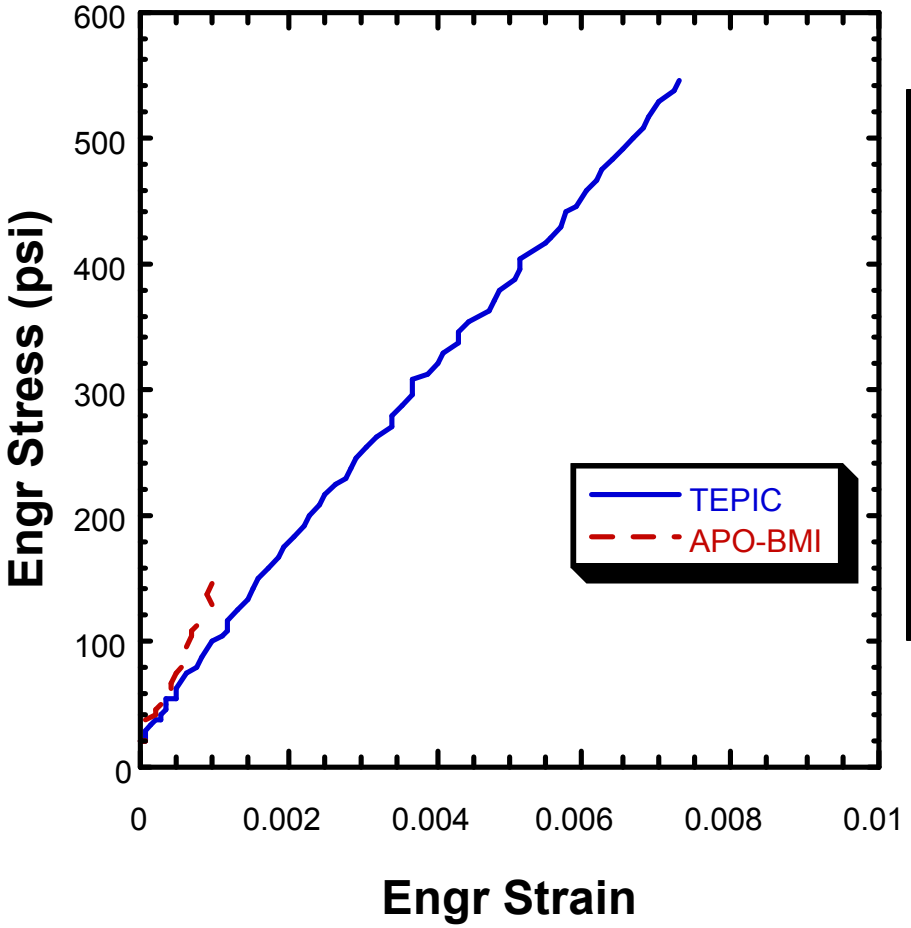


TEPIC™ has much better mechanical properties than APO-BMI



	Max. Stress, psi (MPa)	**Max Strain, %**	Modulus, ksi (MPa)
APO-BMI, 25C	1000	**0.8**	110
APO-BMI, 200C	700	**1.4**	59
TEPIC, 25C	1700	**4.0**	69
TEPIC, 200C	1300	**2.9**	56

Tensile data shows an even larger difference in properties



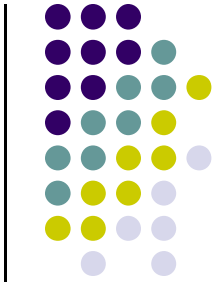
	Max. Stress, psi (MPa)	**Max Strain, %**	Modulus, ksi (MPa)
APO-BMI, 25C	150	**0.1**	110
TEPIC, 25C	550	**0.75**	71

- Area under cure is toughness
  - **~30 times more toughness**

Polystyrene Bead Foam

- Will it continue to be manufactured at KCP?
  - SNL/CA has been asked if we can make it.
- Should it be used as an encapsulant?
- If yes, when and where should it be used?
- What should we use instead?

Other Topics???



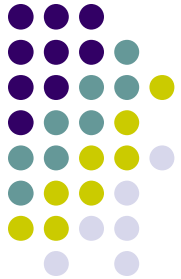
Urethane elastomers- cable potting & mechanical parts: bumpers, compression pads

- Adiprene L100/Cyanacure
  - Old standard
  - Adiprene has some TDI (0.12%)
    - Moisture sensitive
  - Short potlife (production issue)
  - Thought Cyanacure commercially unavailable
    - KCP implemented plans for in-house production
    - Recently KCP has made ½ batch (~75 gals.)
    - Air Products recently expresses an interest in making another large batch
- PET 90A/Ethacure 300
  - Very low TDI (0.05%)
  - KCP choice for cable potting
  - Apparently sensitive to ratio
  - Cracking and fissures have been observed
  - Strong odor even after cure

Urethane elastomers-cont.

- EN7/8
  - Significant TDI exposure level (~10%)
    - Toxic and sensitizer
  - $Fe(acac)_3$ catalyst precipitates out over time
    - Affects cure-impacts critical properties
    - May be responsible for “reversion”
  - High volume resistivity for high voltage connectors
- PET 90A/Cyanacure
  - Pat Keifer’s recommendation
  - Very low TDI (0.05%)
  - Less sensitive to ratio
  - Longer potlife than Adiprene L100/Cyanacure
  - PET 90A solidifies at room temperature
    - Must be melted (~1 hour) prior to use

Urethane elastomers-cont.



- Linda Domeier developed a replacement (DK502NC) a few years ago that seems to solve all of the property, toxicity and processing concerns
  - Was shelved for perceived chemical availability issues
- Need (we have much of this data, but not all on all materials for comparison):
  - Temperature dependant properties
    - Electrical
    - Mechanical (CTE, tensile, tear, elongation, etc.)
    - Adhesion
  - Ratio sensitivity
  - Aging
  - Outgassing (SPME)