



DEVELOPMENT AND OPTIMIZATION OF INNOVATIVE FOAM MATERIALS

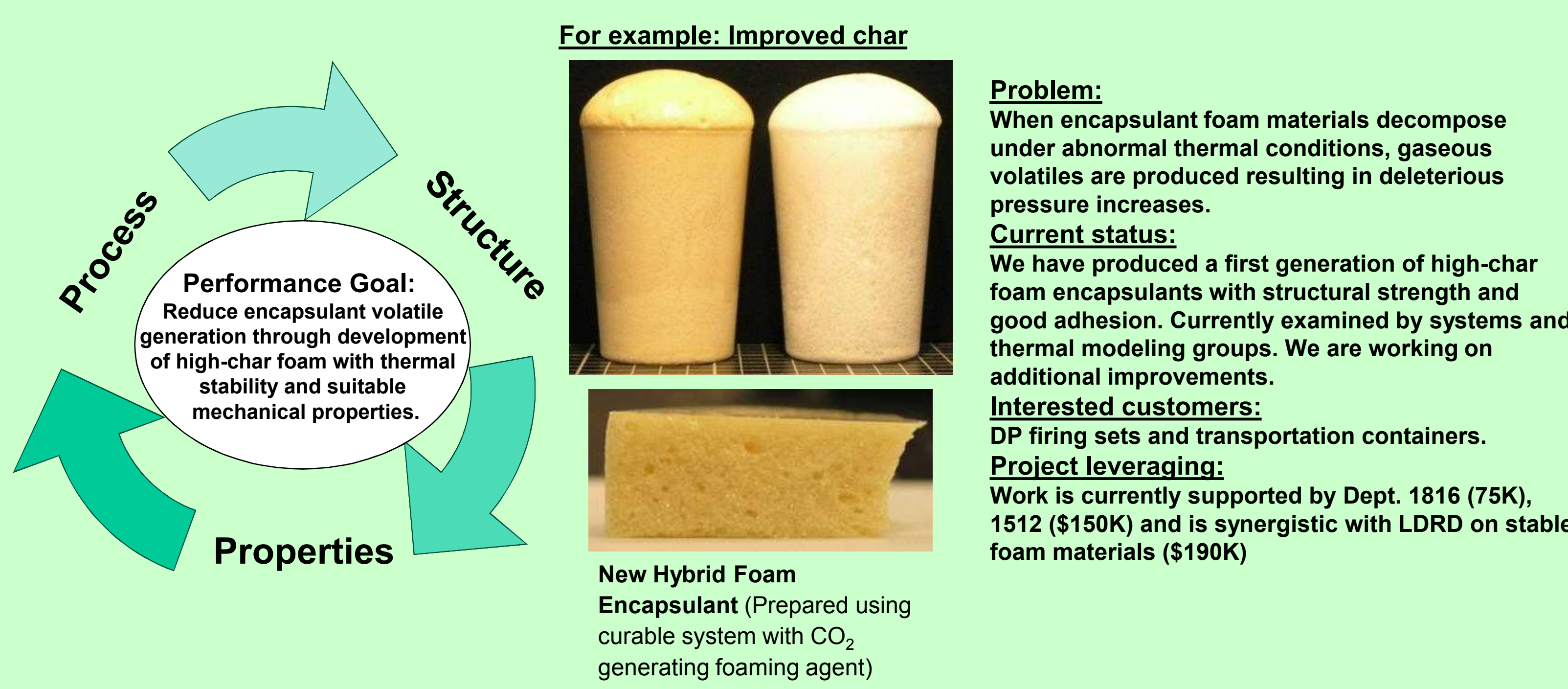
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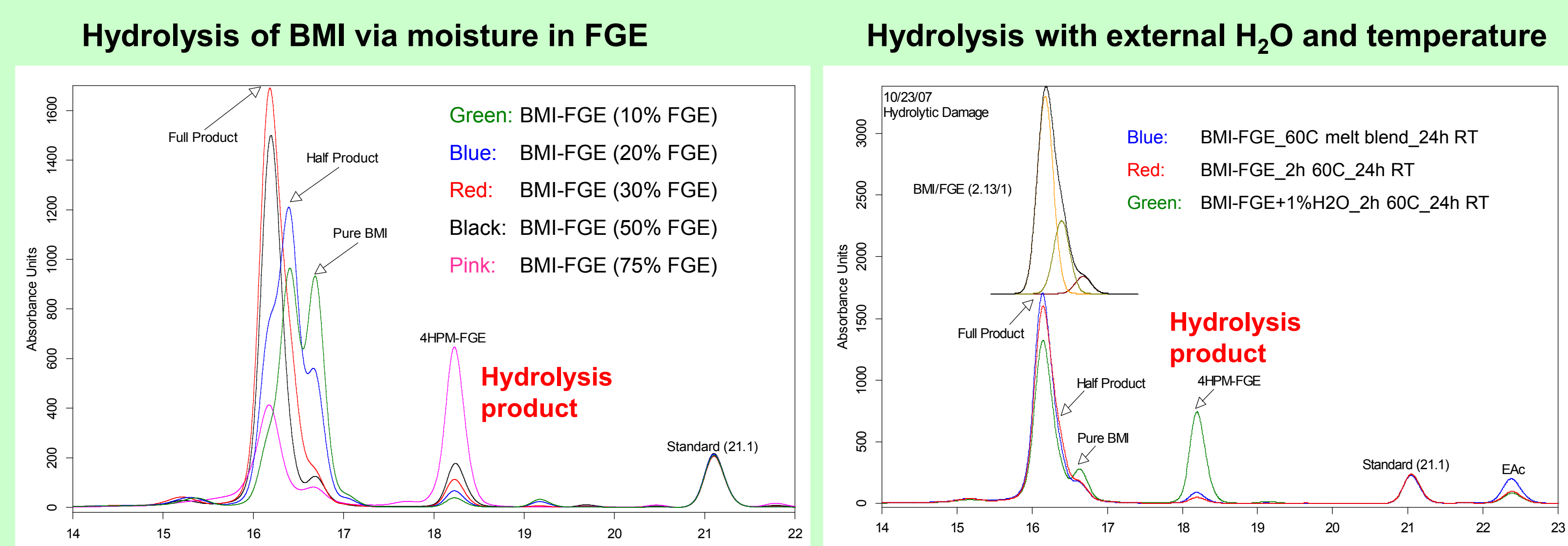
INTRODUCTION: Foams are Critical Materials

SNL is involved in developing removable foams, high char foam encapsulants, and novel curable resins chemistry resulting in improved foam processing

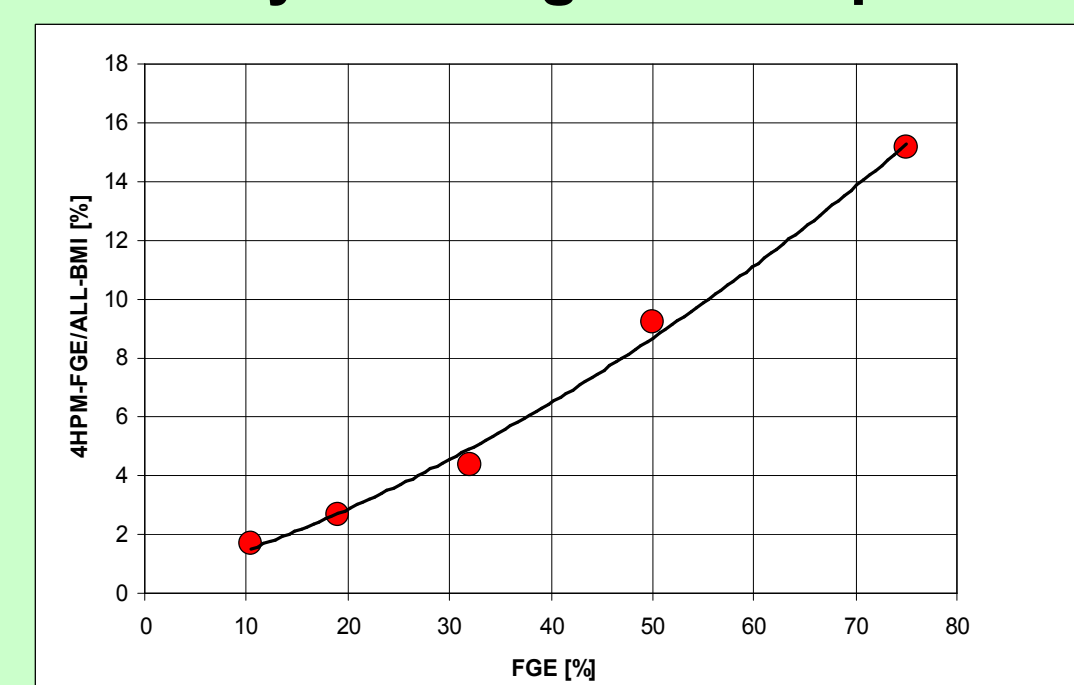


AIM: Better Performing and Customized Foam Materials

Example: Optimization of precursors for removable foams



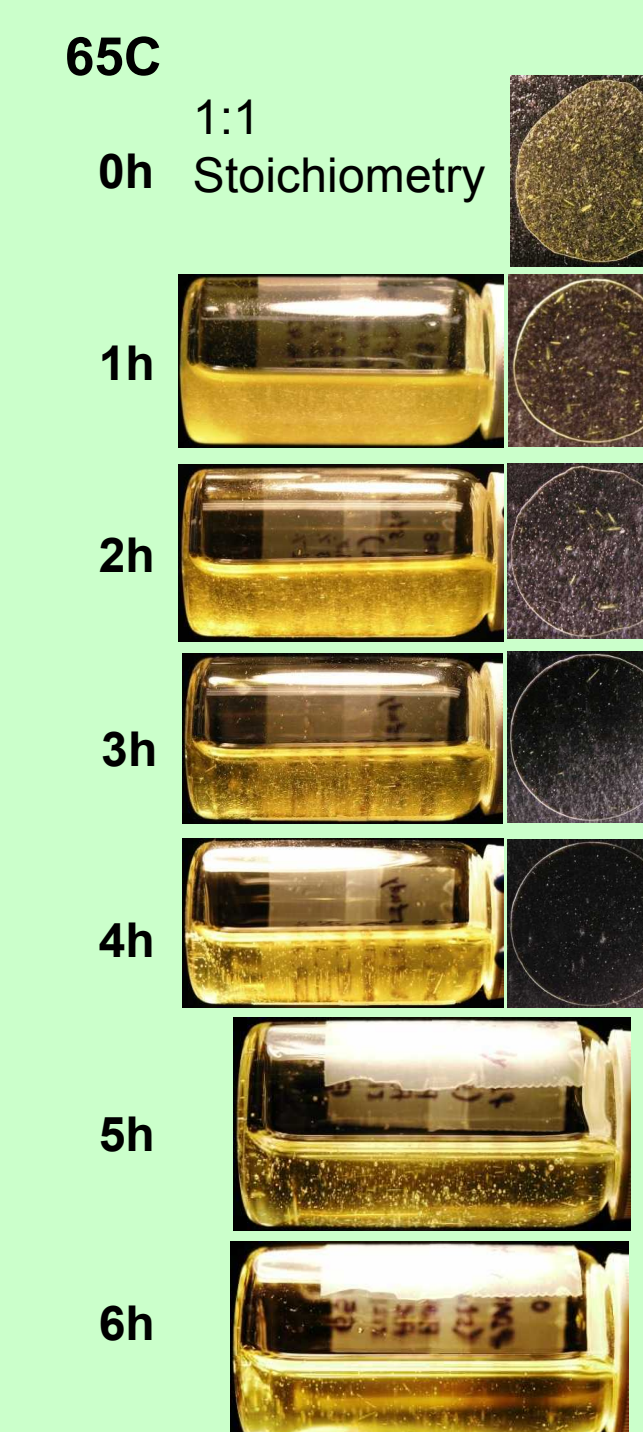
Moisture yields degradation product



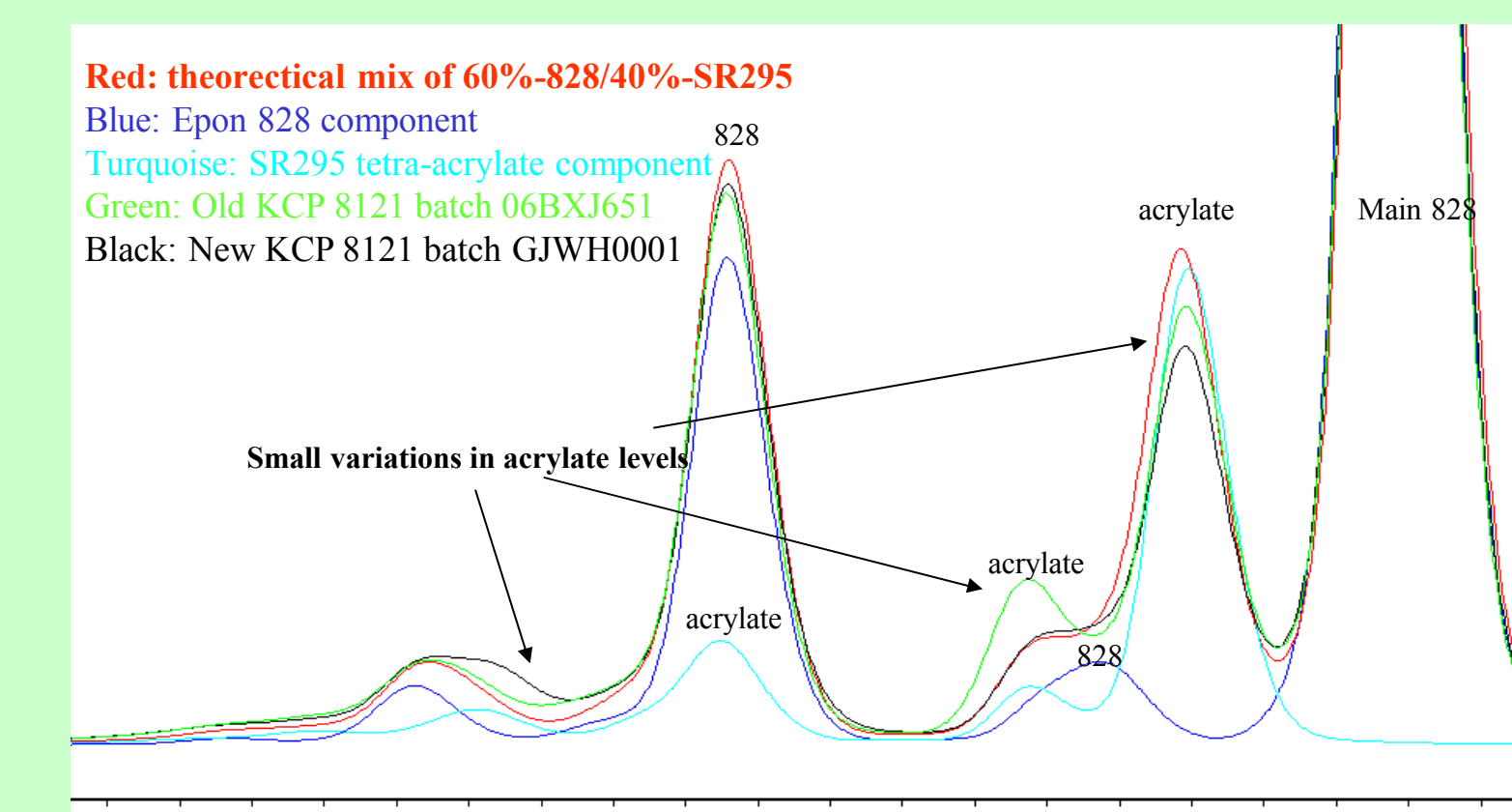
- H₂O contamination in epoxy and supporting resins has been identified as negatively affecting foam processing
- HPLC of resin constituents shows evidence of hydrolytic degradation
- Currently considering pre-drying of resins and manufacturing adjustments to further increase foam quality

Superior foams depend on many variables:

Diels/Alder reaction for removability

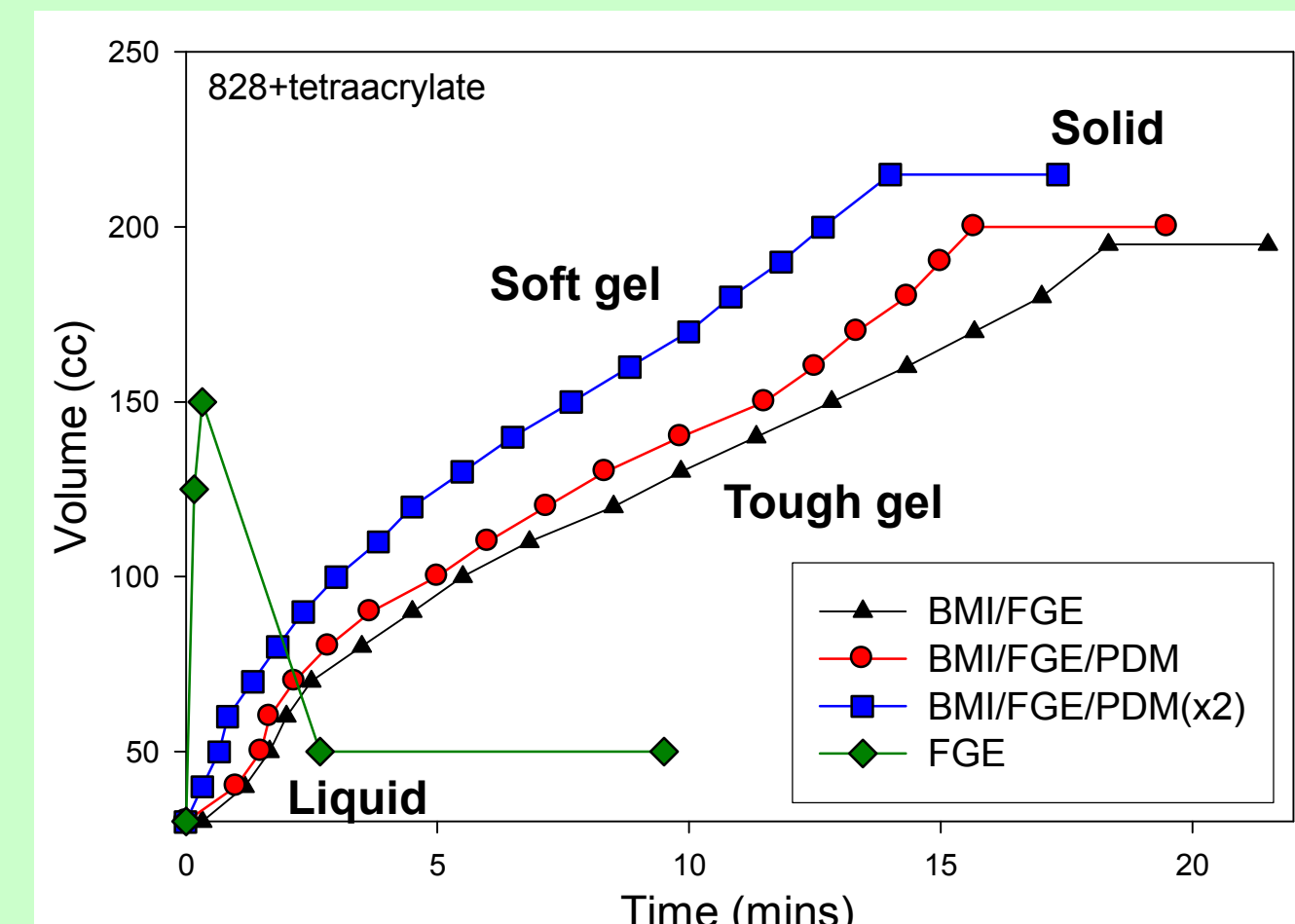


Constituent synthesis and variability



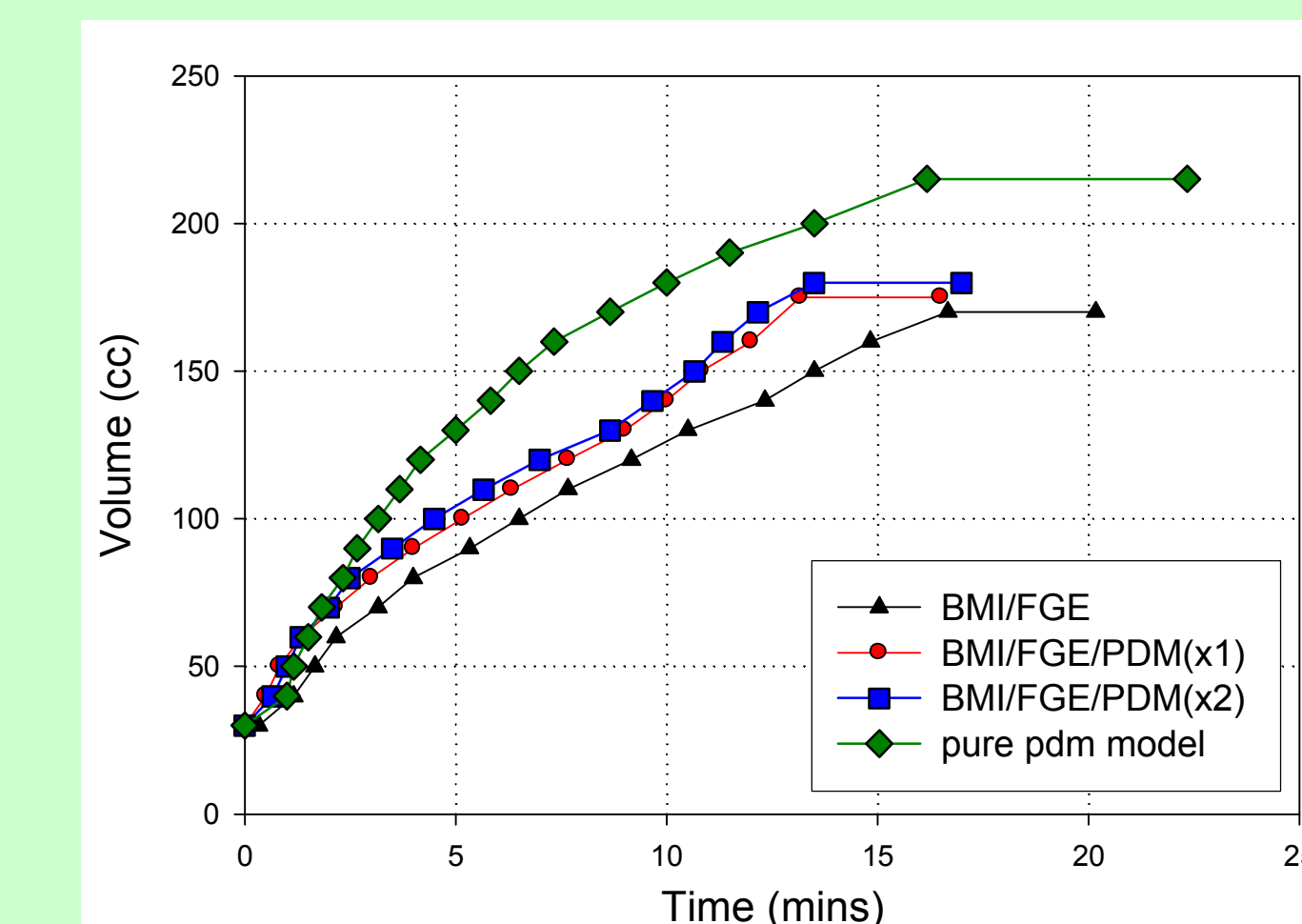
Variations in commercial epoxy resins
Molecular weight and reactivity per molecule
HPLC analysis: Chemistry-property correlation

Foam processing and foaming



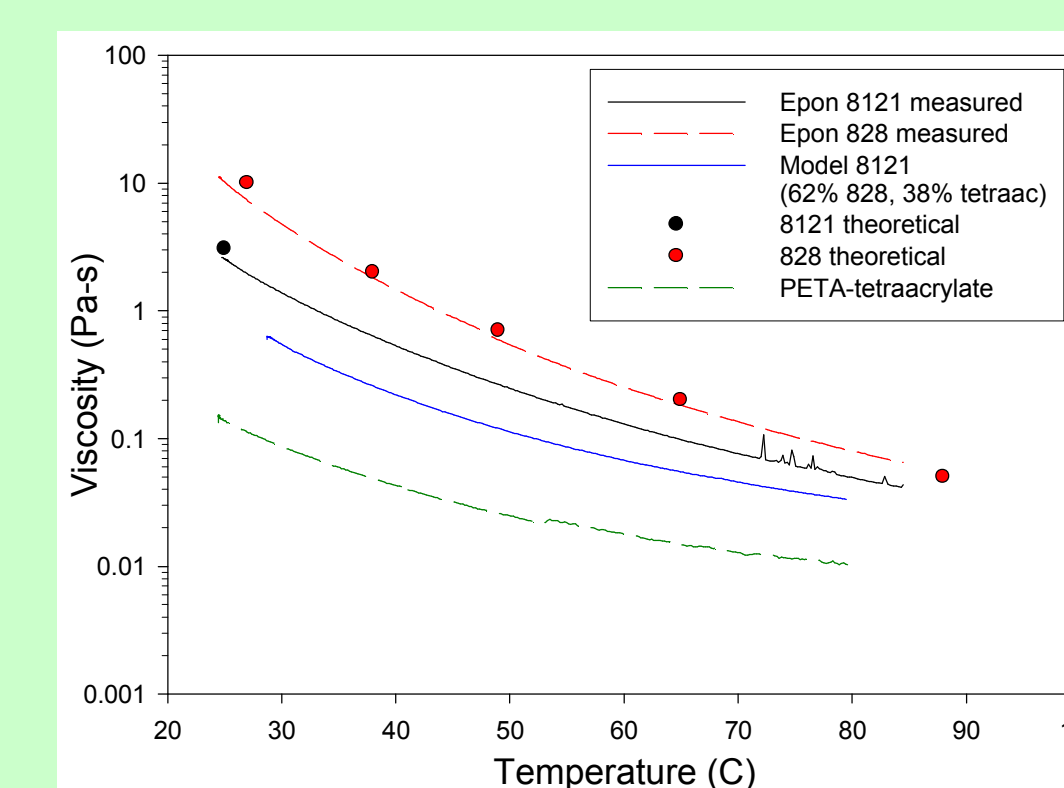
Transition from liquid to solid cured material
Correlation of foam volume with time
Depends on constituents, pre-warm and history of pre-cursors

Influence of individual constituents



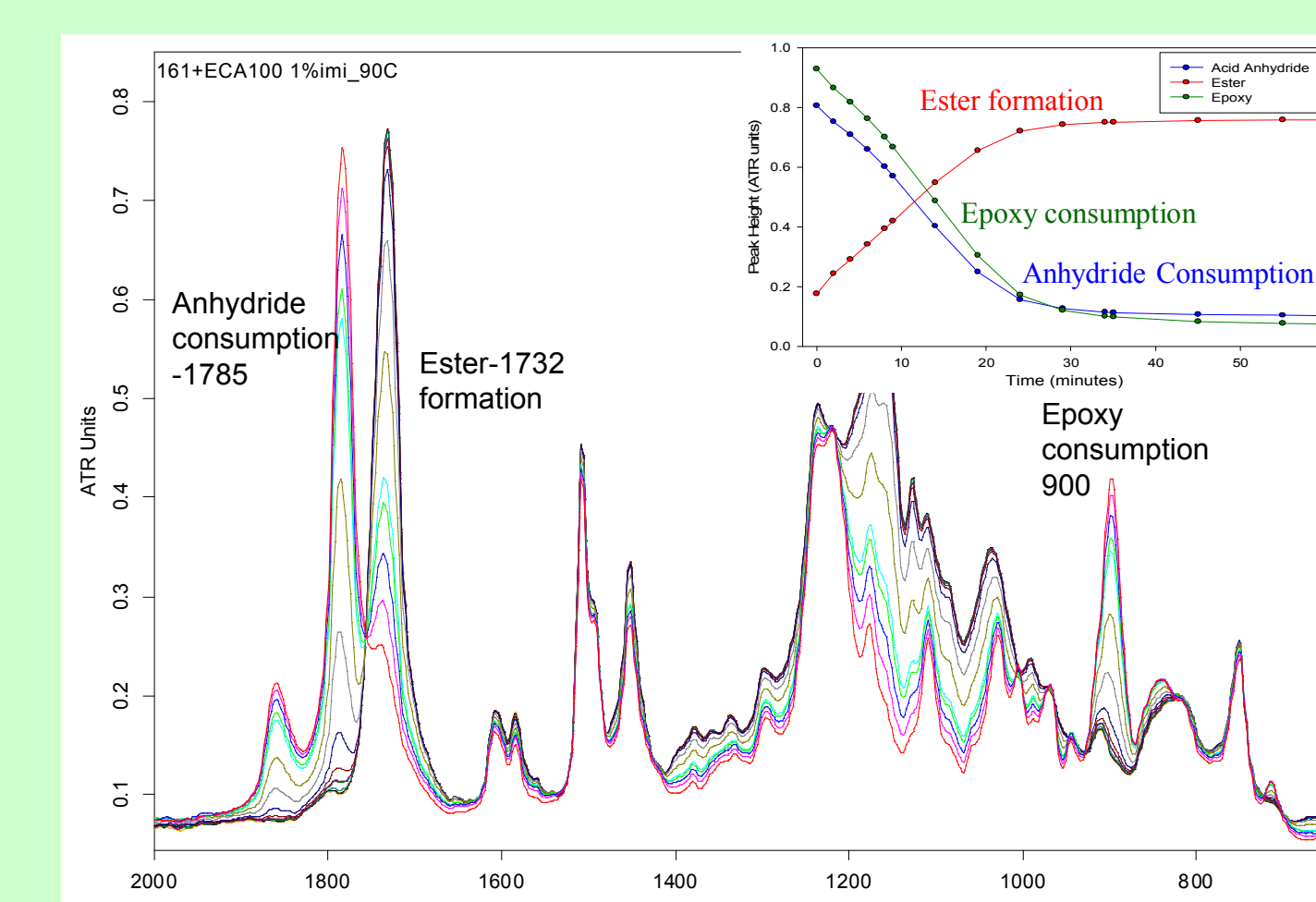
Example: Influence of phenylene-dimaleimide

Resin viscosity



Important viscosity variations affecting foam development

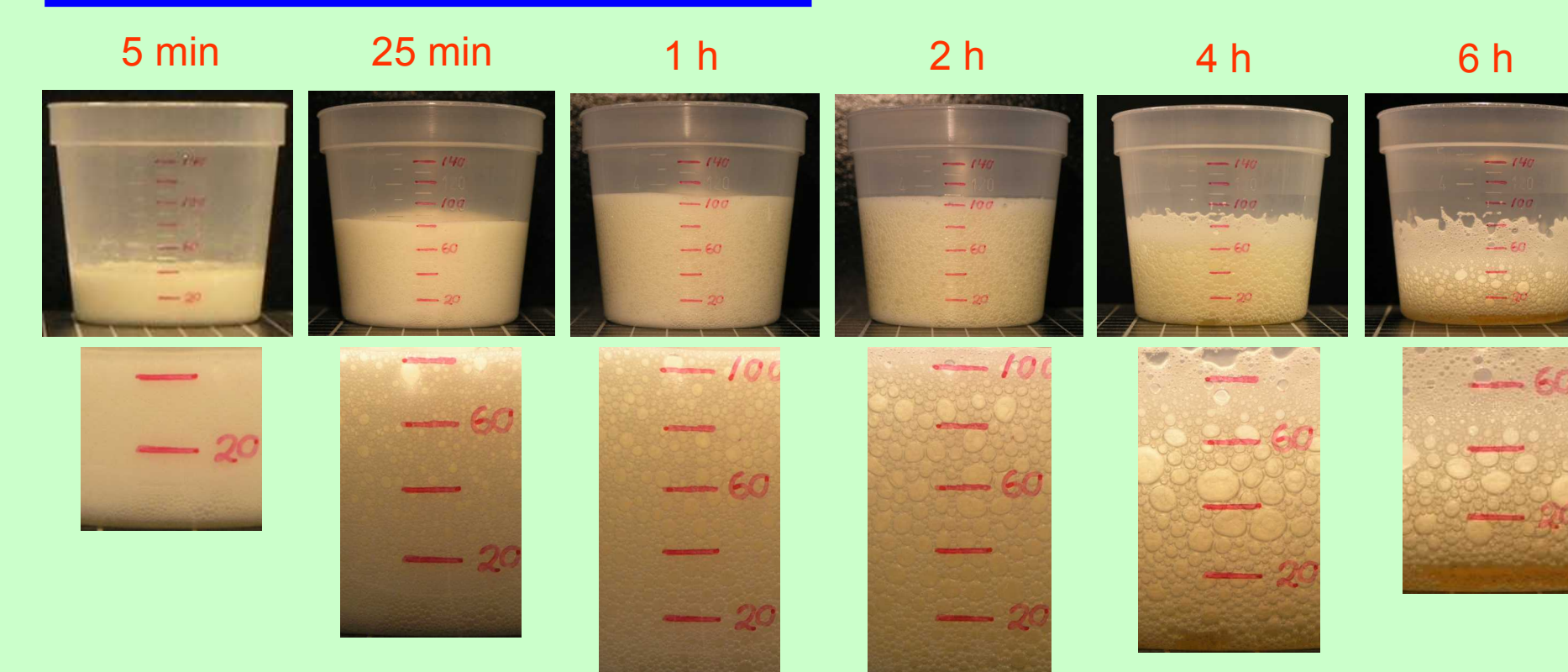
Cure kinetics



Epoxy and anhydride conversion with t,T

FUTURE WORK: Foam Stability and Alternative Application (Foam Injection)

Systematic foam stability assessment on non-curable resins



Foam Volume and Cell Structure as a Function of Time

Conclusions

- Optimized IR and HPLC analytic techniques to support foam performance studies
- Developed a better understanding of Diels/Alder kinetics, viscosity and influences of foam constituent and their history
- Identified hydrolytic damage from moisture contamination as a contributing factor to foam processing variability
- Developed foams with higher char under pyrolytic degradation
- Evaluated new gas generating reactions and alternative cure processes
- Org 1800 will continue to be instrumental for comprehensive foam optimization and innovative materials development at SNL

Related References:

Removing processing variability in removable foam systems: Establishing the fundamental physical and chemical principles for improved foam processing, Mat Celina, Jim Aubert, Sarah Leming, Nick Giron, Organic Materials Dept.1821, JOWOG meeting (2008).