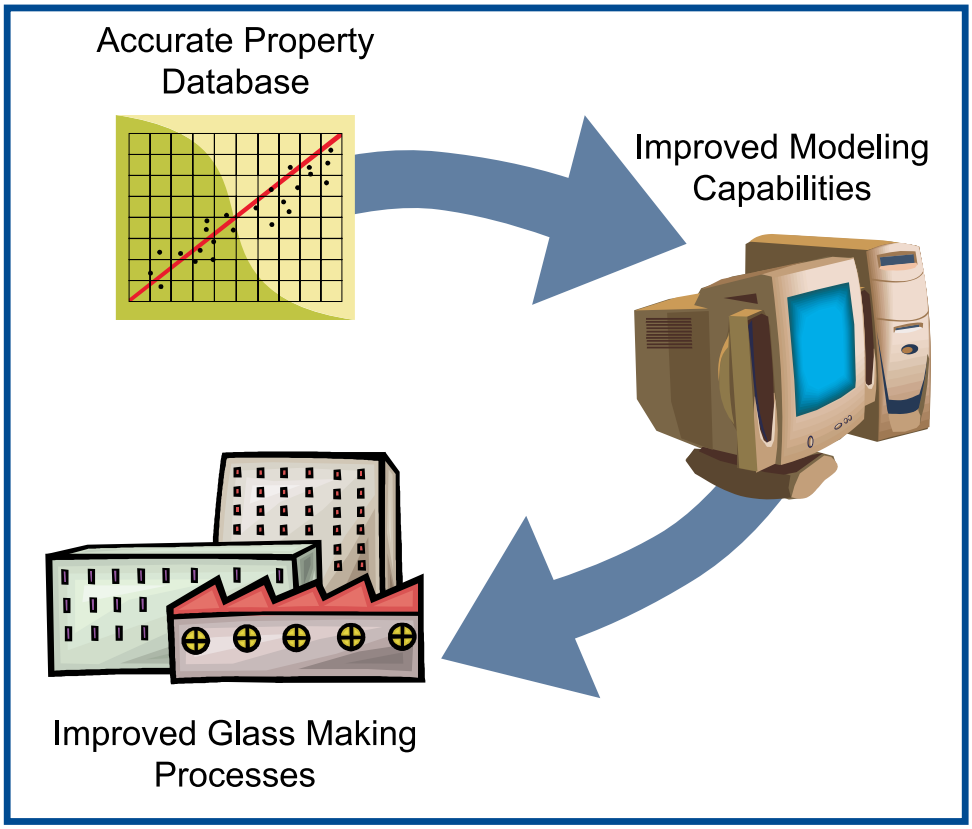
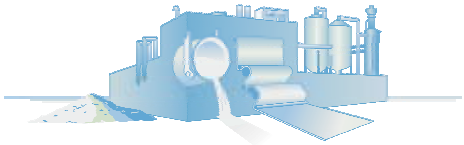
Modeling of Glass Making Process

High-temperature glass property database will improve modeling

Modeling has increasingly become an economical way to test changes designed to increase energy efficiency and product quality in glass making processes. However, modeling is often hindered by the lack of necessary, reliable compositon-properties data in specific temperature ranges. The Center for Glass Research developed a database of all important, high-temperature melt properties, which will provide the glass industry with accurate data for improved modeling capabilities. Because of their important commercial value, six different types/families of glass were studied: container, float, fiberglass (E- and wool-types), low-expansion borosilicate and color TV panel glasses.



The propery database will contribute to more efficient glass making processes for the entire industry.



Benefits for Our Industry and Our Nation

- Improved production efficiency through improved process control
- Reduced production costs
- Increased energy efficiency of furnaces through improved modeling
- Reduced emissions and waste
- Increased yield of high-quality product

Applications in Our Nation's Industry

The resulting glass composition database can be used by the entire glass industry to improve modeling capabilities, which will ultimtely improve glass making processes. Accurate, improved modeling will also eliminate the need for costly experimental melts to test proposed process changes.

Product Description

Goal: Develop a comprehensive, reliable databse of high-temperature melt properties for commercial glass compositions in order to improve modeling and understanding of glass melting and forming processes.

Researchers will measure the following glass melt properties for six families of commercial glass compositions:

1. Viscosity
2. Gas solubility and diffusion
3. Density
4. Surface tension
5. Electrical conductivity
6. Elasticity/viscoelasticity
7. Radiative conductivity.

Progress and Milestones:

Measurements were completed in 2003 for approximately 140 glass compositions and were published in book form in 2005: High Temperature Glass Melt Property Database for Process Modeling, Edited by Thomas P. Seward III and Terese Vascott, The American Ceramic Society, Westerville, Ohio (2005), 291 pages.

In addition to the composition and property data, the book contains:

- discussions of the importance of the studied properties for process modeling
- experimental techniques and methodologies used
- statistical analysis of some of the properties

The composition and property data are also available on-line at http:www.ceramics.org/glassmelt as is software for calculating viscosity, electrical resistivity, and water solubility for melt compositions within the composition range studied.

Table I. DOE Glassmelt Properties Project: Composition Ranges

Composition (wt%)						
Component	Container	E-glass	Float	Low expansion borosilicate	TV panel	Wool
SiO_2	65–75	52–60	70–74	70–81	58–64	56–66
B_2O_3		0–9		10–15		3–9
Al_2O_3	1–3	12–16	0.1–1.6	2.7	1.3–3.5	0–6
MgO	0–3	0.5–4.5	3–4		0–1.5	1–5
CaO	7–12	16–24	7–9	0-2	0–3.5	5–11
SrO					1–10	
BaO				0–2	2–13	
Li_2O	0–1				0–0.5	
Na_2O	11–15	0–2	12–15	4–8	6–9	13–17
K_2O	0–2	0–0.5	0.05–0.8	0–3	6–9	0–2
Fe_2O_3	0–0.4	0–0.8	0.1–1.5			0–0.6
Cr_2O_3	0–0.3					
TiO_2	0–0.5	0–1			0.1–0.5	
CeO_2					0–0.7	
ZrO_2					0–3	
PbO					0–3	
ZnO					0–1.5	
As_2O_3					0–0.3	
Sb_2O_3					0.2–0.6	
SO_3	0–0.3					0–0.2
F		0–0.6			0–0.7	0–0.6

Project Partners

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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