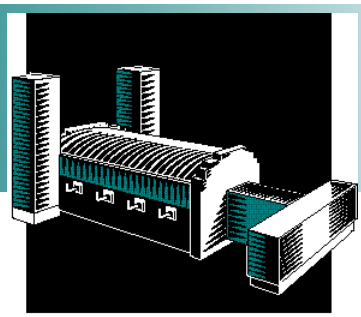
GLASS

Project Fact Sheet



Development of Advanced Refractories for the Glass Manufacturing Industry

Benefits

With the conversion to oxy-fuel firing:

- 61% anticipated conversion of existing furnaces by 2005 with an estimated energy savings of 40 trillion Btu
- 100% anticipated conversion of existing furnaces by 2020 with an estimated energy savings of 90 trillion Btu
- The results from this project will be used by glass manufacturers and furnace designers to further accelerate the conversion process to oxy-fuel firing and achieve these energy realizations

Applications

Engineering creep data of refractories can be used by furnace engineers as input in finite element analysis to model or optimize the long-term mechanical performance of glass-melting furnace superstructures. Such data for refractories in air-fuel fired furnaces will ultimately help these furnaces achieve more economic operation. Data for candidate refractories for oxy-fuel fired furnaces will optimize furnace superstructure designs with these materials, and also help more glass manufacturers to confidently consider conversion to oxy-fuel firing.

The design of glass-melting furnace superstructures can be optimized, and their mechanical performance can be predicted with the availability of appropriate refractory creep data

Because of the higher operating temperatures and different environmental conditions of oxy-fuel firing over conventional air firing, new or modified refractory materials will be necessary. The improved refractory materials will accelerate the conversion of oxy-fuel firing in the glass industry. Oxy-fuel firing is from 20 to 40% more energy efficient than air firing. Environmental benefits occur through lower NOx emissions. Oxy-fuel firing provides additional advantages in that furnace regenerator structures are not necessary as in air fired systems, thus also improving capital effectiveness. The purpose of this effort is to develop refractories for use in oxy-fuel furnaces used in glass production. Various types of current and new refractories are being tested and developed. High temperature properties of refractories are critical to the design, structural and chemical stability, and service life of various components of glass furnaces, including the glass melting furnace crowns. Furnace designers can ensure that glass melting furnace superstructure structural integrity is maintained by utilizing information and refractories identified through this project.

High temperature mechanical properties enable energy efficient processes

The testing of eight refractory categories is planned:

1. Fusion-cast alumina
2. Conventional silica
3. Fusion-cast AZS
4. Fused-grain mullite
5. Bonded AZS
6. Andalusite
7. Fused silica
8. Bonded zircon

Project Description

- **Goal:** Generate thermomechanical and thermophysical properties of several different commercial refractory categories that are candidate materials for glass-melting furnace superstructures.

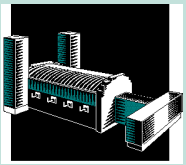
- **Issue:** There are literally several dozen candidate commercially-available refractories for use in glass furnace superstructures. Refractory suppliers supply technical data for specific brands; however, it is difficult for glass manufacturers to equitably judge and compare them because the data is almost always generated or reported differently among the suppliers.

- **Approach:** The present project surveyed domestic glass manufacturers (container, fiber, flat, and specialty) to determine and identify the classes of refractories for which they needed mechanical engineering data. The project then generates such data so these glass manufacturing companies are able to (1) compare performances and choose among various brands and (2) provide data that furnace engineers can use for optimizing the design or predicting the mechanical integrity of furnace superstructures.

- **Potential payoff:** More efficient and economical designs of glass-melting furnace superstructures will result. Furnace engineers will know which refractories will perform better than others, and how to model their high-temperature mechanical performance.

Progress and Milestones

- Construction of two very high-temperature creep test frames
- Committee formed (consisting of engineers from glass manufacturers, refractory suppliers, and academia) to provide guidance to the project
- Survey of refractories conducted with glass manufacturers to identify materials for creep testing
- Creep testing and microstructural analysis of conventional silica refractories completed, and ORNL Technical Report written describing the results
- Testing of alumina-based refractories commenced



Project Partners

Oak Ridge National Laboratory
Oak Ridge, TN

Glass Companies	Refractory Suppliers
Corning Corning, NY	Corhart Louisville, KY
Owens-Brockway Toledo, OH	Harbison-Walker Pittsburgh, PA
Owens-Corning Granville, OH	Monofrax Niagara Falls, NY
PPG Pittsburgh, PA	NARCO State College, PA

Techneglas
Columbus, OH

For Additional information, Please contact

Charles A. Sorrell
Office of Industrial Technologies
Phone: (202) 586-1514
Fax: (202) 586-7114
Charles.Sorrell@ee.doe.gov
http://www.oit.doe/IOF/AIM

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

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Office of Industrial Technologies
Energy Efficiency
And Renewable Energy
U.S. Department of Energy
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