Magnesia-Alumina Spinel Glass Tank Refractories (ID-14)

Primary Investigators

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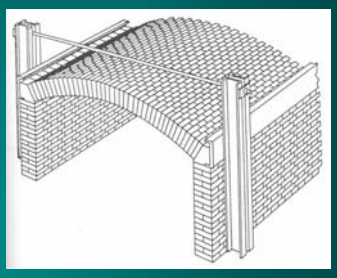
Industrial Participants

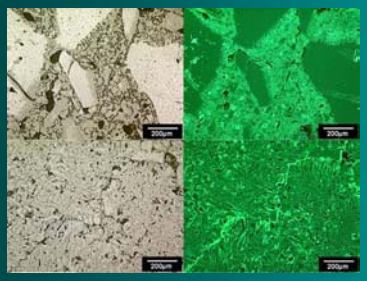
Monofrax Inc., Saint-Gobain SEFPRO Refractories
Glass Industry Advisory Committee
composed of representatives from glass and refractory industries
AFG Industries Inc., PPG Industries Inc., Kimball, Saint-Gobain Containers,
Thomson Multimedia Inc., Saint-Gobain SEFPRO, North American Refractories Co.

Goals and Objectives

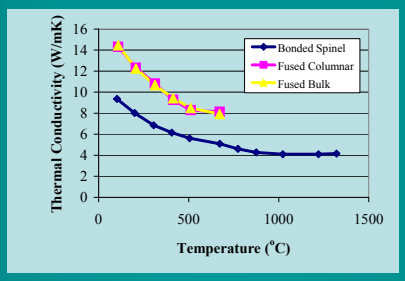
There is a need for characterization of key properties concerning refractory materials for improved thermal efficiency and management in industrial combustion environments. Specifically, the glass industry desires thermomechanical property data on alternative refractory materials (to traditionally used silica) such as Magnesia-Alumina Spinel.



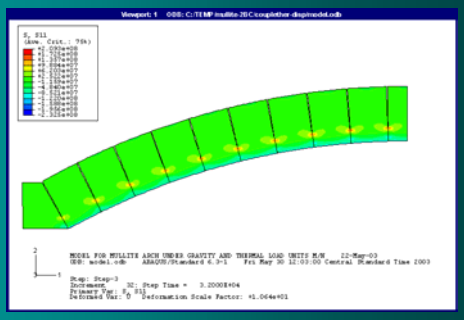
Significant Results



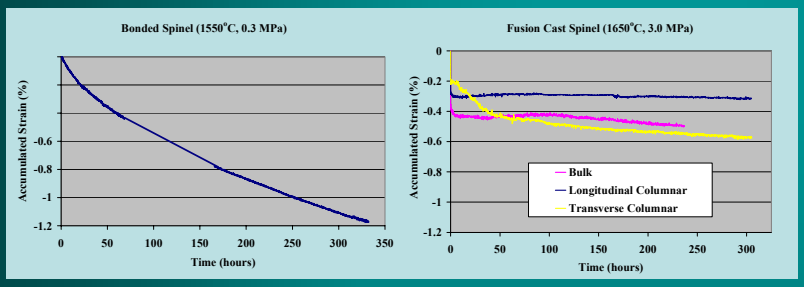
Optical Microscopy and Cathodoluminescence Microscopy of Bonded (Top) and Fusion-Cast (Bottom) Spinel Showing Difference in Grain Size and Microstructure



Thermal Conductivity of Bonded and Fusion-Cast Spinel Showing Higher Thermal Conductivity of Fusion-Cast Material



Sample FEA Crown Stress Model Showing Stress Accumulation



Accumulated Strain for Bonded and Fusion-Cast Spinel Showing Accelerated Creep in the Bonded Material

Important Finding

The fusion-cast spinel material would appear to be favorable to the bonded material based on the microstructure and creep behavior, although the high thermal conductivity may be of concern.

Benefits

The resulting database information will be made available to the glass manufacturers for assisting in the selection of appropriate refractories for glass melting furnaces. Additionally, data will be used to refine existing models describing the stress, temperature and microstructural dependencies of the creep rate and data will be used in conjunction with finite element analysis (FEA) to predict the time-dependent deformation of glass-tank crowns. This will allow glass companies to estimate the current life of their glass tanks and to better plan future glass tank construction for more economical and energy efficient furnaces. If implemented, an energy savings opportunity of 90 trillion Btu/year could be addressed primarily through the enabling of oxy-fuel firing in reverberatory glass melting furnaces.

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