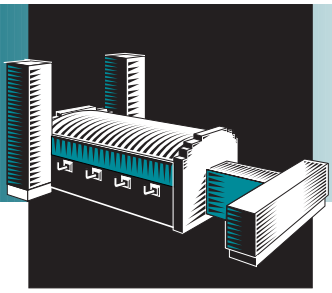
GLASS

Project Fact Sheet



Low-Energy Alternative to Commercial Silica-Based Glass Fibers

Benefits

- Potential to save 6.5 million Btu per ton of glass produced
- Costs of raw materials comparable to costs of silica-based fibers
- Potential to lower energy use 40 to 60 percent compared to silica-based fibers
- Extends furnace lifetime through reduced process temperature and melting time
- Reduces size of furnaces required for processing
- Increases production of existing furnaces and tanks
- Addresses health concerns associated with silica-based fiber particulates

Applications

The low-energy alternative to commercial silica-based glass fibers is positioned to be a key component of advanced composites and other materials used in the ground transportation, aircraft, and marine industries. Phosphate glasses provide lower cost raw material for composites that are used in a variety of commercial applications, including polymer-matrix composites used in boats, vehicles, and spacecraft; temperature-resistant building materials; and in corrosion-resistant vessels for the chemical industry.

Breakthrough in Glass-Fiber Research Yields New High-Strength Fibers That Require Less Energy to Produce

Fibers made from silica-based glasses have been used by industry for over 50 years to produce the polymer-matrix composites used in numerous products, including insulation, vehicle tires, and corrosion-resistant vessels for the chemicals industry. While silica-based glasses are chemically strong and durable, they require relatively long melting times at high temperatures.

A new low-energy alternative to commercial silica-based glass fibers uses a unique formula of high-strength, iron-phosphate glass fibers. Phosphate glasses are not new to industry, but their commercial use has been limited due to their inherently weaker chemical durability and mechanical properties. Recently, however, fibers of 20 to 100 microns in diameter have been produced from a family of iron-phosphate glass compositions whose tensile strength of roughly 1 million pounds-per-square-inch is incredibly high not only for phosphate glasses, but also for silica-based glasses.

This new alternative offers cost and energy savings, as well as health and environmental benefits. These high-strength, iron-phosphate glass fibers can be manufactured using essentially the same equipment now being used for silica-based fibers, but can be melted at lower temperatures and 3 to 20 times more quickly.

Potential Uses for Iron-Phosphate Glass Fibers

Iron-phosphate glass fibers offer a low-energy alternative to commercial silica-based glass fibers and can be applied in polymer-matrix composites used in boats, vehicles, and aircraft.

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Project Description

Goal: Investigate the selected properties and manufacturing characteristics of selected iron-phosphate glasses to assess and promote their commercial use as a low-energy alternative to existing silica-based fibers.

Typically, the chemical durability and mechanical properties of phosphate glasses are inferior to those of silica-based glasses. However, the iron-phosphate glasses under investigation are unusually strong compared to other phosphate glasses, as well as many commercial silicate glasses. The major technical manufacturing advantage of these glasses is that they melt in 1 to 2 hours, rather than the 6 to 24 hours needed for silicate glasses. The rapid melting results from the much lower viscosity of the iron-phosphate melts.

Rapid melting greatly reduces temperatures, translating into energy and cost savings for the manufacturer. In addition, smaller furnaces can be used for the same level of output. And, preliminary tests of iron-phosphate fibers show no adverse health effects in laboratory animals.

MO-SCI Corporation is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Evaluate raw materials and identify phosphate glasses with superior tensile strength.
- Determine optimum glass composition for commercial production based on its properties and processing (fiberizing) parameters.
- Evaluate the performance of phosphate glass fibers in glass reinforced polymers.
- Prepare final report on testing and performance, proposing future concept development.

Economics and Commercial Potential

The potential for energy savings associated with this alternative to commercial silica-based glass fibers is substantial. If only 10 percent of the current fiberglass market was captured, the estimated total energy savings would be approximately 1.1 trillion Btu per year.

Silica-based glasses require temperatures of 2700 to 2900°F for melting, while the iron-phosphate glass fibers can be melted at 2200°F. This significant reduction is expected to save producers up to 30 percent in energy costs. In addition, because the same equipment can be used, furnace life will be extended.

Producers of glass fibers may also benefit from raw-material costs if waste iron phosphate, currently sent to landfills by sheet-metal producers, can be reused. By using waste iron phosphate, raw-material costs could be reduced to half the typical costs for silica-based glass fibers. Producers can also achieve production efficiencies by increasing throughput due to shorter processing times for melting, fining, and homogenization.

Commercialization of this concept should be straightforward, with no major technical hurdles anticipated. The overall objective of the immediate work is to identify the optimum properties and manufacturing characteristics of these unusual iron-phosphate glasses. Recent efforts encouraging brownfield reuse may help bring this technology to market.

Industry of the Future—Glass

In April 1996, several organizations representing the glass industry signed a compact with the Department of Energy (DOE) in an effort to encourage technological innovations that will reduce energy consumption, pollution, and production costs in the industry. The glass industry published a report entitled ***Glass: A Clear Vision for a Bright Future,*** *which articulated the industry's vision of its future. This compact set the foundation for collaborative efforts between the industry and the Federal government. Signed by both key industry players and Department of Energy officials, it was a formal commitment to align DOE'S limited resources to meet the challenges identified in the vision.*

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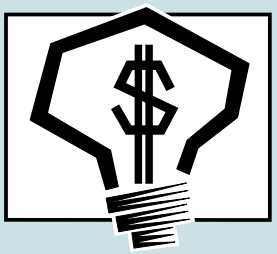

The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project Partners

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