HIGH-STRENGTH / ALKALINE RESISTANT IRON-PHOSPHATE GLASS FIBERS AS CONCRETE REINFORCEMENT

OIT/DOE Award No. GO14046

Budget Period from 4/1/2004 to 4/1/2007

Objectives:
Investigate use of alkaline-resistant iron-phosphate glass fibers as concrete reinforcement, replacing silica-based AR glass fibers

Simulated nuclear-waste glass cylinder (~8000 cm3) melted at 1200 C

Molten ARP-86 iron phosphate glass being bottom drained

TASKS

- Optimize composition of iron-phosphate glasses for concrete applications
- Measure critical properties of iron-phosphate glasses: chemical durability, tensile strength viscosity, Tg, density, and sizing parameters
- Determine industrial manufacturing parameters: bushing materials, melt conditions, and refractory materials
- Test GFRC (glass fiber reinforced concrete) mixes
- Pilot scale production in industry
- Test GFRP (glass fiber reinforced polymer) composites

University of Missouri-Rolla
Ceramic Engineering Dept.,
and
Center for Infrastructure Engineering Studies
Rolla, Missouri

MO-Sci Corporation
Rolla, Missouri

Advanced Glassfiber Yarns
Aiken, South Carolina

Industrial Insulation Group
Fruita, Colorado

U.S. Department of Energy
Energy Efficiency and Renewable Energy

MATERIALS, GLASS, AND SENSORS
PROJECT AND PORTFOLIO REVIEW MEETING

June 21-24, 2004 • Crystal Gateway Marriott • Arlington, Virginia

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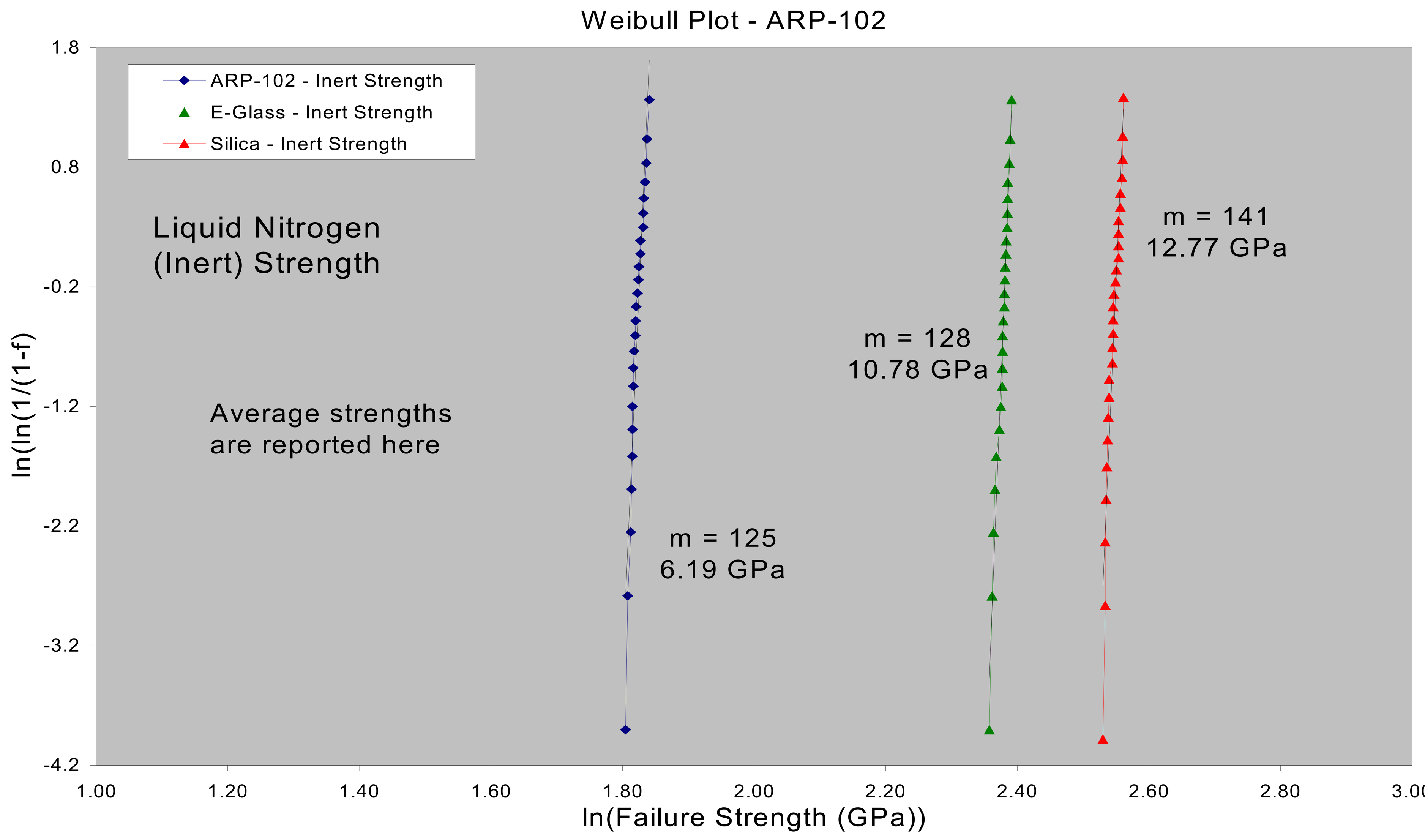
Benefits

- Lower cost raw materials
- 40-60% lower energy usage compared to silica-based fibers
- Silica-free fibers



Bending strength of ~100 micron diameter iron phosphate fiber at liquid nitrogen temperature (77 K)

Longitudinal cross-section of a commercially available alumino-silicate crucible after melting ~100 lbs of iron phosphate glass.

Crucible conditions:
Temperature: 1400º C
Time:>300 hours

ARP-102 iron phosphate 15-micron glass fiber pulled continuously from one-hole stainless steel bushing at 900 C for 2.5 h

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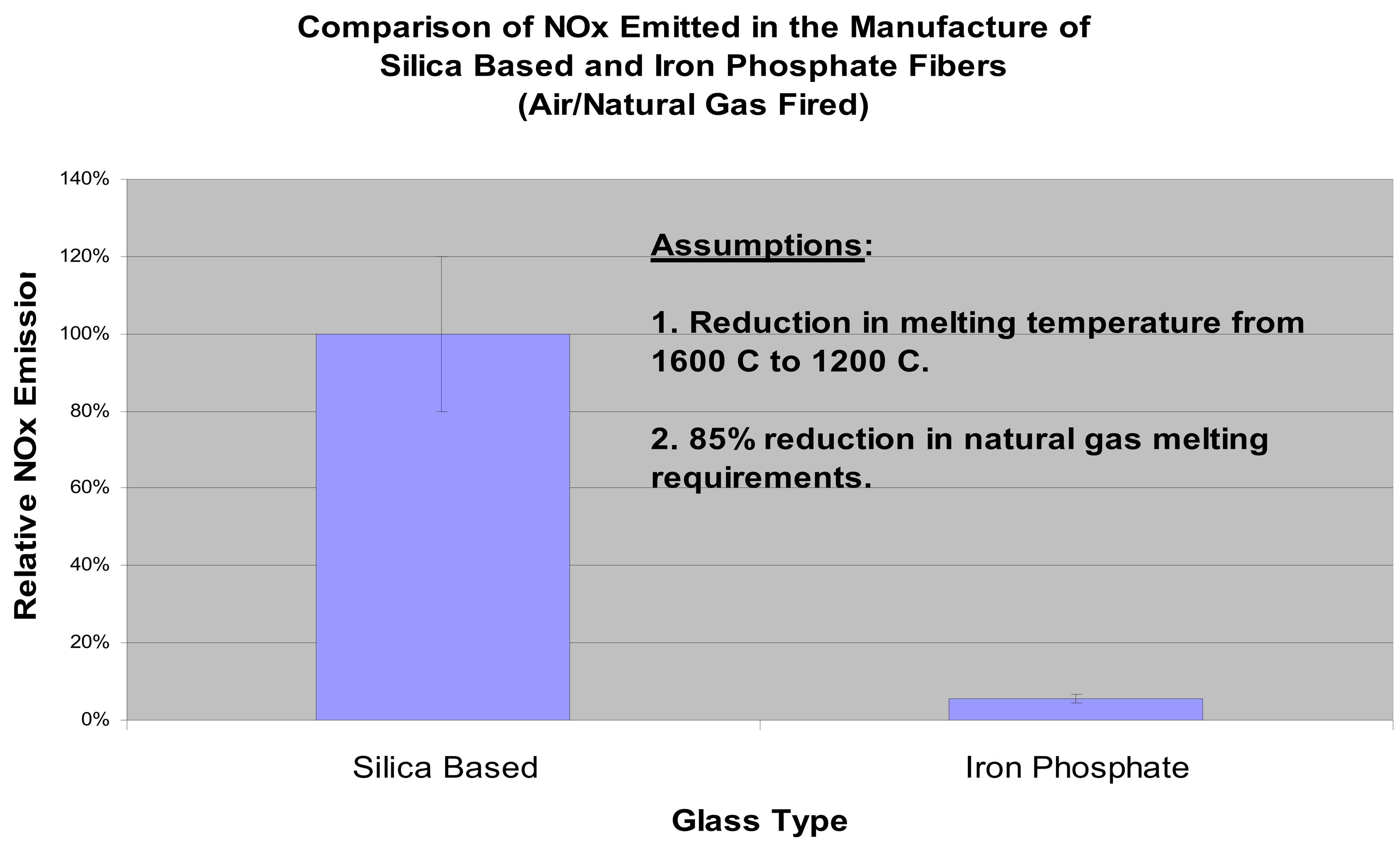
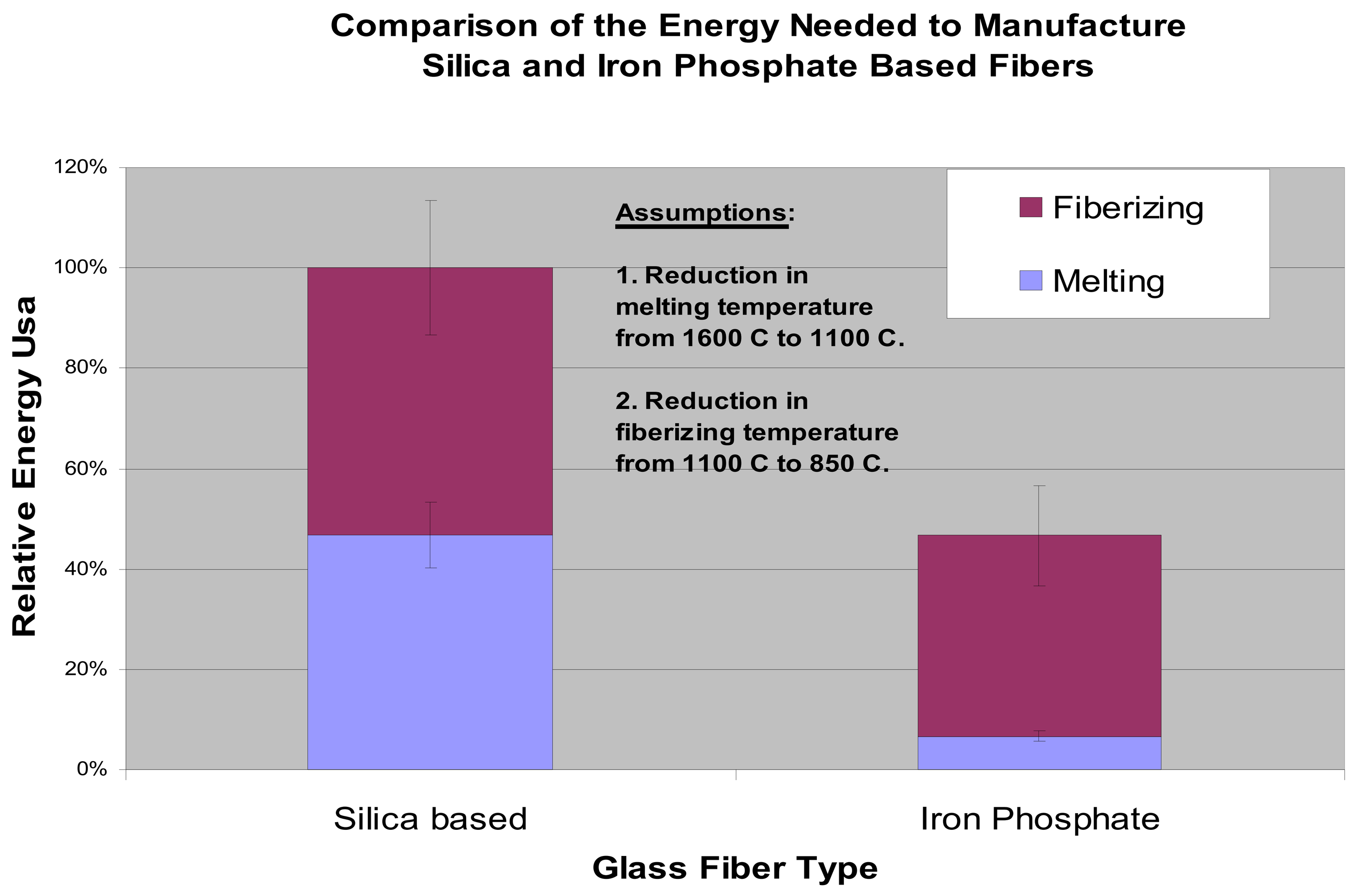
Technical Results:

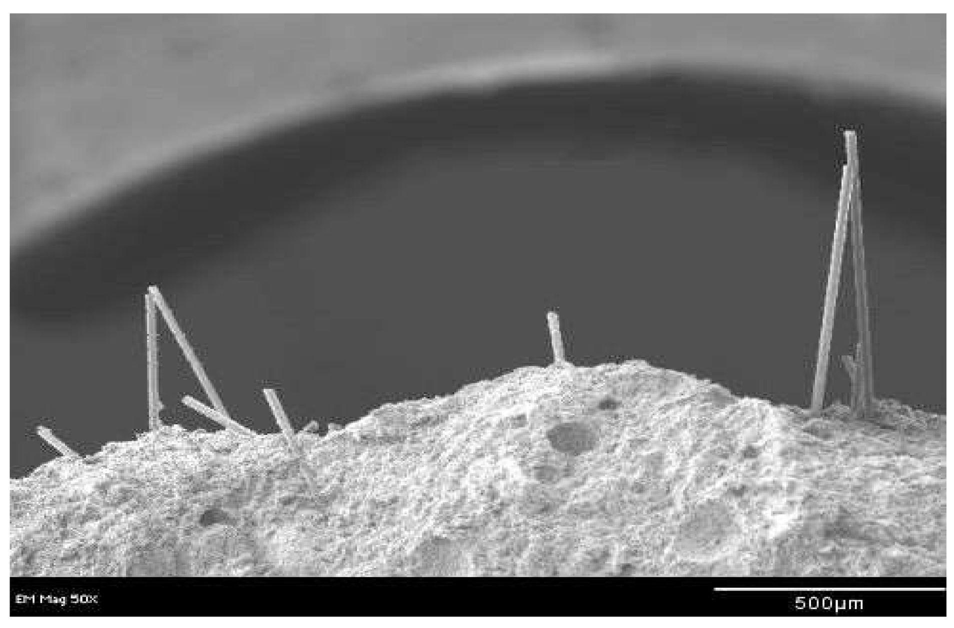
Fe-phosphate glass fibers have been manufactured using industrial phosphate waste as raw materials under a DOE SBIR Phase I contract. Glass compositions were produced with high chemical durability in acidic and alkaline solutions. Additional applications include vitrification of nuclear and hazardous wastes, fiber reinforced polymers and biodegradable composites, asbestos replacement, high temperature grease additives, and chemical resistant enamels.





Funding

FY	ITP/DOE	Industry
04-05	$315,000	$536,000
05-06	$326,000	$563,000
06-07	$319,000	$555,000



Fracture surface Glass Fiber Reinforced Concrete (GFRC) sample produced by mixing chopped alkali-resistant iron phosphate glass (ARP-102) in ordinary Portland cement.

UMR
UNIVERSITY OF MISSOURI-ROLLA
University of Missouri-Rolla
Ceramic Engineering Dept.,
and
Center for Infrastructure Engineering Studies
Rolla, Missouri

mo-sci CORPORATION
MO-Sci Corporation
Rolla, Missouri

agy
Advanced Glassfiber Yarns
Aiken, South Carolina

IIG
Johns Manville
Industrial Insulation Group
Fruita, Colorado