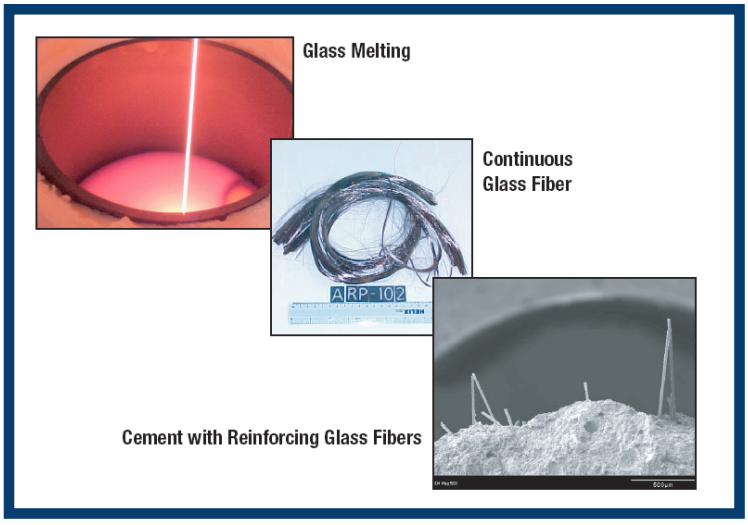
Use of High-Strength, High Alkaline-Resistant Iron-Phosphate Glass Fibers as Concrete Reinforcement

New Glass-Fiber Reinforcement Materials Will Improve Durability of Concrete

Alkali resistance is one of the important issues in concrete that is reinforced with steel or glass. The extended exposure of existing steelreinforced and glass-fiber-reinforced concrete (GFRC) to natural weather conditions results in degradation of its tensile strength, flexure strength, and ductility. In addition, exposure of GFRC to normal weathering cycles of moisture and temperature results in cyclical volumetric changes which need to be accounted for in the design. There have also been many attempts to modify the surface of the silica fibers used in GFRC with special coatings in order to improve its alkali resistance, but these have had limited success.

When compared to silica fibers, iron-phosphate glass fibers have been shown to possess improved chemical durability, mechanical strength, resistance to acid and alkali environments, and resistance to dissolution under high pH. In this project, new compositions of iron-phosphate glass fibers with superior alkali-resistance will be developed and evaluated for reinforcing concrete.



Iron-phosphate glass fibers can be produced using conventional processing techniques.

Benefits for Our Industry and Our Nation

The development of new alkali-resistant iron-phosphate reinforcement materials will result in energy benefits through lower energy usage in processing when compared to silica glass fibers, and extended furnace life through reduced process temperatures and melting times required for the processing of phosphate glasses. Economic benefits include lower raw material costs and indirect benefits due to the use of better alkali-resistant materials.

Applications in Our Nation's Industry

The development of new alkali resistant glass fiber for the reinforcement of concrete will result in the application of a new class of concretes across all industries through its use in infrastructure.

Project Description

The goal of this project is to develop and evaluate selected iron-phosphate glass fiber compositions for the reinforcement of concrete.

Barriers

Major barriers to be overcome include:

- Lack of knowledge of the effect of fiber composition, the degree of fiber loading, and resultant properties on reinforced materials;
- Lack of information on the processing of the iron-phosphate glass fiber-reinforced materials; and
- Insufficient information available on both the short-term and the long-term stability of these types of composites.

Pathways

The objectives of the project will be achieved through (1) modifying the composition of the phosphate fibers by incorporating other constituents, including Al2O3; (2) evaluating the long-term durability of existing and new composite systems using both natural aging and accelerated aging techniques; (3) evaluating the stability of the proportional elastic limit of fully aged composites under cyclic environmental conditions including wetting, drying, and changes in temperature; and (4) identifying composites having improved properties when compared to those of existing composites.

Milestones

- Evaluate the chemical durability of currently existing iron-phosphate glass fibers in high pH
- Identify new and optimized compositions of glass fibers
- Prepare glass fibers of the new compositions using conventional melting procedures
- Evaluate the mechanical and chemical resistance of fibers and composites

Commercialization

Mo-Sci Corporation has expertise in the manufacture and testing of glass fibers. The new compositions developed in this project can be produced with existing facilities and can be made available for reinforcement of commercially available concrete.

Project Partners

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Advanced Glass Yarns
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