UVM Innovations

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Environmentally Responsive Fibers for Reinforced Concrete Composites

Case #586

Environmentally responsive (ER) fibers provide a method of efficiently prestressing a reinforced concrete composite.

Inventors:

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Description:

Fiber-reinforced concrete composites have become popular in the construction industry due to their robust nature with regard to both compression and tension. These composites consist of concrete with randomly oriented steel or polymer fibers. The concrete strongly opposes compression and the fibers strongly oppose tension. These fibers, however, cannot be prestressed or post-tensioned in any practical way with the current standard of technology.

Professors Lee, Huston and Tan have invented a method of efficiently prestressing a reinforced concrete composite through the use of environmentally responsive (ER) fibers. Having the fibers prestressed upon the curing of the concrete allows them to apply a restoring compressive force before the structure experiences any tension, allowing the structure to apply even stronger forces in opposition to any tension it experiences.

The inventors' method takes advantage of environmental changes that occur during the cement curing process. In particular, the pH and temperature of the concrete medium tend to increase during curing, while moisture decreases. One type of ER fibers consists of a multi-base polymer with a geometry whose size is inversely related to the pH of the environment. The other type of ER fibers can be constructed in the form of a coaxial cable where both the outside layer and inside core shrink as a result of the curing, but the core shrinks more rapidly. The outside layer then dissolves due to the increased moisture, revealing a shrunken fiber. A functioning example of this process is a polypropylene core encased in polyethylene.

The fibers are constructed by a melt electrospinning process. The nanofiber is drawn from a pump onto a collecting plate by electrostatic forces or a melt extrusion process, where the nanofiber is extruded by

pressure. These processes allow the ER fibers to be oriented randomly, such that the structure can resist tension and torsion forces from many directions.

Applications:

- Load-bearing concrete structures such as garages
- Porous pavements, which currently suffer from low durability
- Asphalt pavement structures

Advantages:

- The randomness of the orientation of the ER fibers allows the concrete structure to handle a much more diverse array of stresses than the current standard of reinforced concrete.
- Can be applied as a replacement for steel bar reinforcement or in addition to it.

Patent Information:

US Provisional application filed. Worldwide rights available.