1-1-2007

Bone-shaped Short Fiber Composite

Purdue ECT Team

Purdue University, ectinfo@ecn.purdue.edu

DOI: 10.5703/1288284315722

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The Need

Civil engineers use steel, fiberglass and other similar materials to increase concrete's strength and toughness, but using those materials often requires costly construction techniques. Short-wire reinforced concrete should become a favorite technology since the process is compatible with standard construction processes and the steel used for the bone-shaped fibers is relatively cheap. Researchers at Department of Energy's Los Alamos National Laboratory have discovered that enlarging the ends of small fibers mixed into concrete substantially increases the material's overall strength and toughness.

The Technology

The Los Alamos researchers, led by Yuntian T. Zhu, found that adding 1 % bone-shaped fibers to concrete can increase its maximum strength up to 84 percent, and its toughness up to 93 times. The finding has solved a problem of getting effective load transfer between fibers and the surrounding matrix without making the composite more brittle, as happens when the fibers are tightly bonded to the matrix.
The bone-shaped fibers can help concrete to carry the load. This special fibers anchor into the matrix at each end because of their shape but bond only weakly with the matrix along their length. The researchers also optimized the shape and size of the enlarged fiber ends, so they don't experience the stresses that usually snap fibers and limit a short-fiber composite's performance.

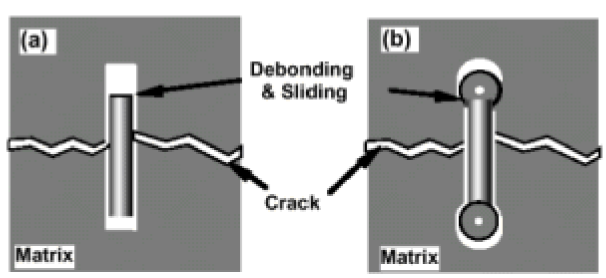

Figure 1 Comparison between Straight and Bone-Shaped Fiber

Straight fibers can pull free of the matrix material if the fibers bond weakly with the surrounding matrix. On the other hand, if the fibers bond strongly with the matrix, they

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can snap under the high stresses generated by a crack in the matrix. The bone-shaped fibers connect mechanically with the matrix predominantly at their ends. They have a weak interface, and so don't experience extreme stress, but remain anchored at their ends and so still help carry the load felt by the composite.

The bone-shaped fibers promote significant plastic deformation in bridging ligaments and the formation of multiple cracks. Multiple cracking is another effective mechanism for improving the composite toughness. Distributed multiple cracking allows more bridging bone-shaped fibers to plastically deform.

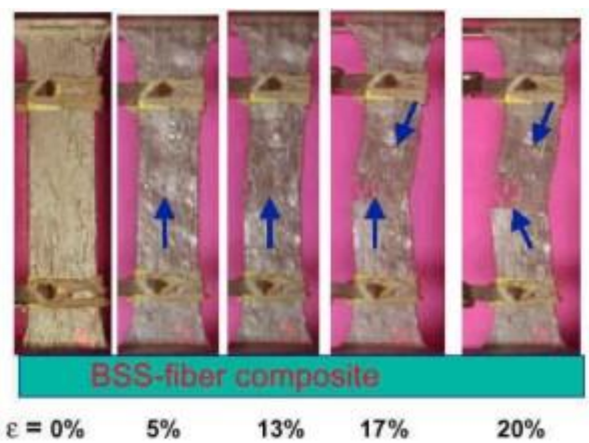

FIGURE 2GOOD BRIDGING AND MULTIPLE CRACKING OF BONE-SHAPED FIBERS COMPOSITE

THE BENEFITS

Compare to the straight-fiber concrete, the one containing the bone-shaped fibers is significantly much better in both toughness and strength. The bone-shaped fibers concrete resisted the propagation of cracks better. The fibers bridge the crack and refuse to let go. Close inspection showed that even though a crack in the concrete matrix had snaked through the sample, the sample remained intact. The bone-shaped fibers also promote significant plastic deformation in bridging ligaments and the formation of multiple cracks.

STATUS

Charles G Nutter of Silacon CorporatioÅn invented the processes and technology that produce bone-shaped fibers in high volume at low cost. verified by independent university testing that confirms the superiority of the Silacon/LANL fibers. Nutter, in addition invented Intelligent sensors for concrete and other purposes based on bone-shape derived extension of the Los Alamos National Laboratory/Silacon technology applied as multi-dimensional sensors with 'intelligence' based on magnetostriction of small linear ferrite toroidal transformer nodules and electronics that sense concurrently cracking, strain, temperature, and dielectric chemistry in concrete or plastics. The fiber and sensing technology underwent university testing at South Dakota School of Mines and Technology and University of Minnesota physics department. A patent recently

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issued (2011) in Nutter's name as primary inventor and James Wahlstrand as co-inventor, Lino Lakes MN. find data at http://www.silacon.com.

The rest of the status can be deleted. Please correct this as several years passed without corrections after several notices. Please delete the fax number as well. I will call to follow up on the corrections. Also, your link http://rebar.ecn.purdue.edu/ect/links/tools/contact.aspx was not working. we are trying to be helpful. What is written by your staff makes no sense.

Barriers

Although this technology has been through extensive laboratory testing, no full scale test or project implementing this technology to the real structures reported yet.

Points of Contact

Charles G. Nutter, Silacon Valley Corporation
Tel: (651) 738-1965, Fax: (651) 738-1636. E-mail: sales@silacon.com
Yuntian T. Zhu, Los Alamos National Laboratory
Tel: (505) 667-4029, Fax: (505) 667-8021. E-mail: yzhu@lanl.gov

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1. Innovative Fiber Composites, Los Alamos National Laboratory, http://www.lanl.gov/news/releases/archive/99-004.shtml.
2. Silacon Valley Corporation Home Page, http://www.silacon.com

Reviewers

Peer reviewed as an emerging construction technology

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Publisher

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana

http://dx.doi.org/10.5703/1288284315722