Innegra™ S in Concrete

Structural fibers have been used to replace welded wire fabrics, steel fibers and light rebar and other secondary reinforcement in thin wall precast concrete and slab on grade. When designing for these applications, Innegra™ S has three features for consideration when thinking of its use as a reinforcement fiber in concrete.

1. Surface roughness: Surface roughness and porosity give it high mechanical adhesion to concrete matrix, resulting in high pull out strength and high Average Residual Strength (ASTM C-1399).
2. Fiber modulus of elasticity: The fiber has 80% higher modulus of elasticity than most fibers used in concrete reinforcement, more closely matching the fiber modulus to the concrete modulus.
3. Fiber count: compared to other structural fibers used to reinforce concrete, the fiber count is higher (29 million vs. 200 thousand fibers/kg), allowing the fiber to serve the dual purpose of reinforcing the concrete (giving high ARS) and also reducing concrete cracking.

Comparison to Grace Strux 90/40

Property	Grace Strux 90/40	Innegra S
Density	0.92 g/cm3	0.84 g/cm3
Tensile Strength	620 MPa	600 MPa
Modulus of Elasticity	9.5 GPa	**15 GPa**
Melting Point	160 C	160 C
Fiber length	40 mm	25 mm
Fiber diameter	450 micron	50 micron
Fiber denier	1000 denier	12.5 denier
Fiber count	200,000/kg	**29,000,000/kg**

Fiber Surface Roughness and Porosity

By using Innegrity's ultra-drawing technology, the fiber is imparted with high modulus of elasticity and also a surface roughness and porosity that allows for a mechanical interlock between the concrete matrix and the fiber surface, increasing the force required to pull the fiber out and thus increasing the ARS of the fiber. The surface roughness is shown below in Figure 1.

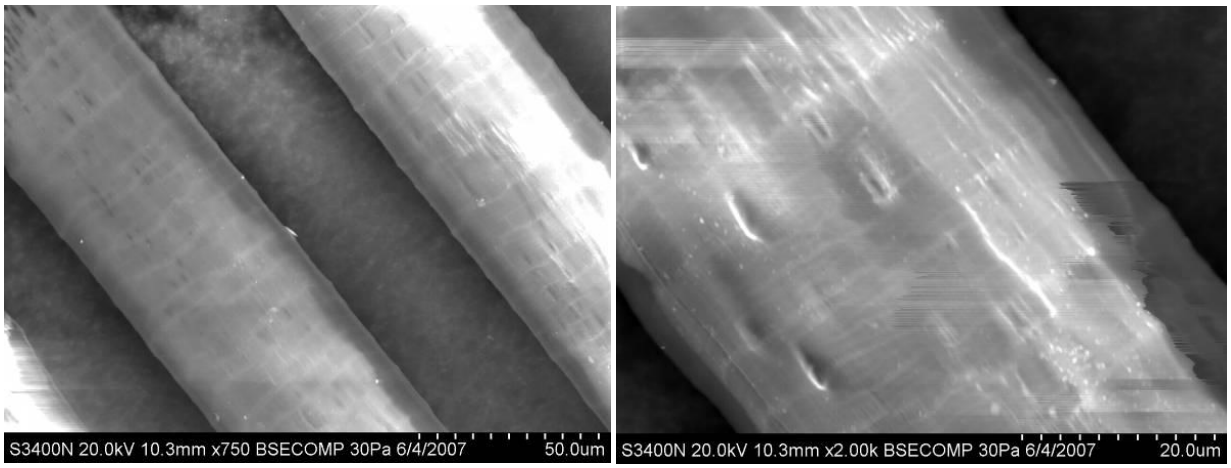
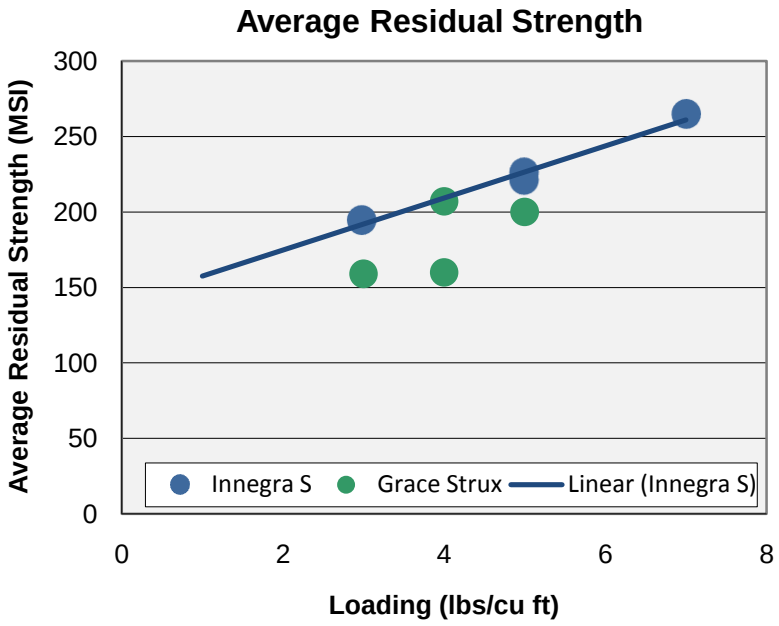


Figure 1: Scanning Electron Micrographs showing fiber surface roughness and porosity.

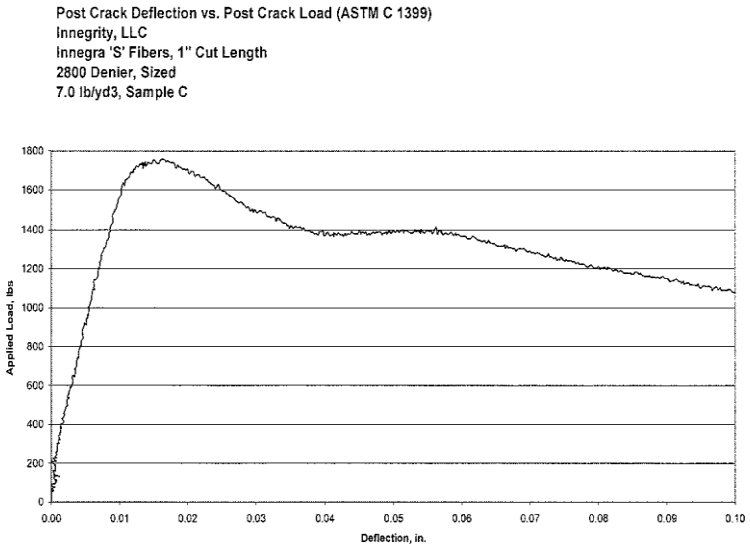
Fiber Modulus of Elasticity

The modulus is also much higher than competitive fibers, as illustrated in the table comparing to Grace Strux 90/40. When combined with the surface roughness, this gives higher Average Residual Strength for the concrete, as measured by ASTM C-1399 and shown at right in comparison with Grace Strux 90/40 and 85/50 (reference Florida Approved Fibers for Concrete Receptacles)



The combination of high elastic modulus and fiber count leads to improved toughness in the modified concrete. The chart at lower right shows post crack load vs deflection and is indicative of high toughness after cracking. By providing very low filament size and short length, the number of fibers that can be included is greatly increased, to levels not normally seen except in low strength shrinkage control monofilament fibers. For Innegra S, this is 29 million/kg. When shrinkage control and reinforcement are both desired, Innegra S fibers can be used to give superior performance for both sets of requirements.

Other properties of concrete with Innegra S, indicating good slump, low air content and high concrete strength



Stork TCT Client:	Innegrity, LLC	Fiber Dosage Rate:	3.0 lbs/yd^3
Stork TCT Project No.:	308059.4	Concrete Strength:	5435 psi
Date Cast:	4/23/2008	Concrete Slump:	2-1/2 inches
Date Tested:	5/21/2008	Concrete Air Content:	2.5%
Fiber Type:	Innegra 'S' Fiber, 1" Cut Length 2800 Denier, Washed	Concrete Unit Weight:	146.8 lbs/ft^3

US Patents 7074483, 7445843 and 7445842.
Additional patents pending
Materials Safety Data Sheet : See www.innegrity.com
Hazard Statement: Innegra S is not considered to be or contain hazardous chemicals based on evaluations made by Innegrity LLC under the OSHA Hazard Communication Standard 29 CFR 1910.1200

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