SAFETY DATA SHEET

Issue Date 14-Jul-2015 **Revision Date** 14-Jul-2015 **Version** 2

UF-500 **UltraFiber 500**

1. IDENTIFICATION

Product identifier

Product Name UltraFiber 500

Other means of identification

Product Code UF-500

Recommended use of the chemical and restrictions on use

Recommended Use Restricted to professional users.

Uses advised against Consumer use

Details of the supplier of the safety data sheet

Supplier Address
Solomon Colors, Inc.
4050 Color Plant Road
Springfield, IL 62702

Manufacturer Address
Solomon Colors, Inc.
4050 Color Plant Road
Springfield, IL 62702

Company Phone Number 800-624-0261 (US & Canada); 217-522-3112 (Outside North America)

24 Hour Emergency Phone Number 800-373-7542

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.122)

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Acute toxicity - Oral	No evidence of adverse effects from available data.
Acute toxicity - Dermal	May cause mechanical irritation, soiling and skin drying. No cases of sensitization in humans have been reported.
Acute toxicity - Inhalation (Dusts/Mists)	Cellulose dust might be generated during handling. Temporary discomfort to upper respiratory tract may occur due to mechanical irritation when exposures are well above the occupational exposure limit.

Label elements

Emergency Overview

Hazard statements

Cellulose dust might be generated during handling. Cellulose dust may form explosive dust-air mixtures.

The product contains no substances which at their given concentration, are considered to be hazardous to health

Appearance White rectangular squares **Physical state** Solid **Odor** Odorless

Precautionary Statements - Prevention

Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Keep away from heat/sparks/open flames/hot surfaces. - No smoking

Precautionary Statements - Response
Get medical advice/attention if you feel unwell
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
If skin irritation occurs: Get medical advice/attention
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
No known significant effects or critical hazards.
In case of fire: Use Water spray, fog or regular foam for extinction
Collect spillage

Precautionary Statements - Storage
Store in accordance with local regulations

Precautionary Statements - Disposal
Dispose of contents/container to an approved landfill

Hazards not otherwise classified (HNOC)

Other Information

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Weight-%	Trade Secret
Cellulose Pulp	65996-61-4	90-100	*
Trade Secret	Proprietary	0-5	*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

Description of first aid measures

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin Contact Wash skin with soap and water.

Inhalation Remove to fresh air.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media Caution: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical
Dusts or fumes may form explosive mixtures in air.

Explosion data
Sensitivity to Mechanical Impact None.
Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep container tightly closed in a dry and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity).

Incompatible materials Strong oxidizing agents. Strong acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines	This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering Controls	Showers Eyewash stations Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin and body protection	Wear protective gloves and protective clothing.
Respiratory protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
General Hygiene Considerations	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Solid		
Appearance	White rectangular squares	**Odor**	Odorless
Color	White	**Odor threshold**	No information available

Property	**Values**	**Remarks • Method**
pH	No information available	
Melting point/freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	See Remarks	UltraFiber 500® ignition temperature is expected to be about 400°C. Thisexpectation is based on the chemical similarity among cellulose, cotton fibers,and viscose rayon fibers. Reported ignition temperatures for cotton and rayonfibers are 390-400°C and 420°C, respectively (Polymer Handbook, Brandrupand Immergut (eds.), 2nd edition, page V-96, 1975).
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	1.5	
Water solubility	No information available	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition temperature	No information available	
Decomposition temperature	Thermal decomposition 200 - 270°C (392 - 518°F)	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	

Explosive properties	Cellulose minimum explosive concentration is 0.055 oz/ft3 (55 g/m³), andexplosivity indices for cellulose dusts range from weak (<0.1) for raw cottonlinters to severe (>10) for ground cotton flock. Variables that affect explosivity . include dust concentration, fiber length, heating rate, and moisture content.Data are from Explosivity Of Dusts Used In the Plastics Industry, report ofinvestigations 5971, U.S. Department Of Interior, Bureau Of Mines.
Oxidizing properties	No information available

Other Information

Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Density	No information available
Bulk density	No information available

10. STABILITY AND REACTIVITY

Reactivity
No data available

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Hazardous polymerization Hazardous polymerization does not occur.

Conditions to avoid
Heat, flames and sparks.

Incompatible materials
Strong oxidizing agents. Strong acids.

Hazardous Decomposition Products
Carbon oxides.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information	No data available
Inhalation	No data available.
Eye contact	No data available.
Skin Contact	No data available.
Ingestion	No data available.

Information on toxicological effects

Symptoms	No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization	No information available.
Germ cell mutagenicity	No information available.
Carcinogenicity	No information available.
Reproductive toxicity	No information available.
STOT - single exposure	No information available.
STOT - repeated exposure	No information available.
Aspiration hazard	No information available.

Numerical measures of toxicity - Product Information

12. ECOLOGICAL INFORMATION

Ecotoxicity

Persistence and degradability
No information available.

Bioaccumulation
No information available.

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated packaging	Do not reuse container.

14. TRANSPORT INFORMATION

DOT Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute health hazard	No
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA	**Reactivity** 0	**Physical and Chemical Properties** -	**HMIS**	**Health hazards** 0
Flammability 0	**Physical hazards** 0	**Personal protection** X		

Issue Date 14-Jul-2015
Revision Date 14-Jul-2015
Revision Note
No information available

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

SECTION 03 24 00
FIBROUS REINFORCING

Display hidden notes to specifier. (Don't know how? Click Here)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Alkali-resistant, natural cellulose concrete reinforcing fiber. (UltraFiber 500).

B. Alkali-resistant, natural cellulose fiber blend with steel fibers. (UltraFiber 302 Blend).

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 03 41 16 - Precast Concrete Slabs.

1.3 REFERENCES

A. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.

B. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

C. ICC Evaluation Service (ICC-ES) AC217 - Acceptance Criteria for Concrete with Virgin Cellulose Fibers.

D. ICC Evaluation Service ESR-1032.

E. ACI 544 Fiber Reinforced Concrete.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Submit manufacturer's product data, including mixing instructions, dosage rate, and fiber dispersion assessment procedure.
4. Installation methods.

C. Manufacturer's Certification:
1. Submit manufacturer's certification that reinforcing fibers comply with specified requirements.
2. Submit manufacturer's ISO 9001:2000 certification.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.
   1. Manufacturer shall have ISO 9001:2000 certification.

B. Installer Qualifications: Minimum 2 year experience installing similar products.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver bagged reinforcing fibers in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, and weight of fibers.

B. Storage: Store reinforcing fibers in dry area in accordance with manufacturer's instructions.
   1. Bagged Reinforcing Fibers: Keep bags sealed until ready for use.
   2. Bulk Packaged Reinforcing Fibers: Install manufacturer's dispensing system in accordance with manufacturer's instructions to provide dry, watertight environment, when bulk packaged reinforcing fibers are loaded into dispensing system.

C. Handling: Protect reinforcing fibers during handling to prevent contamination.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Solomon Colors, which is located at: 4050 Color Plant Rd.; Springfield, IL 62702-1060; Toll Free Tel: 800-624-0261; Tel: 217-522-3112; Fax: 800-624-3147; Email:request info (sgs@solomoncolors.com); Web:www.solomoncolors.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 FIBROUS REINFORCING

A. Fibrous Reinforcing: "Solomon UltraFiber 500" concrete reinforcing fiber.
   1. Material: Alkali-resistant, natural cellulose fibers.
   2. Average Length: 2.1 mm (0.083 inch).
   3. Average Denier: 2.5 g/9,000 m.
   4. Average Diameter: 18 i (0.63 x 10-3 inch).
   5. Count: 1,590,000 fibers/g (720,000,000 fibers/pound).
   6. Density: 1.10 g/cm3.
   7. Surface Area: 25,000 cm2/g (12,200 ft2/pound).
   8. Average Tensile Strength: 750 N/mm2 (110 ksi).

9. Average Elastic Modulus: 8,500 N/mm2 (1,200 ksi).
10. Fiber Spacing: 550 im at 0.9 kg/m3 dosage rate (0.026 inch at 1.5 pounds/cubic yard dosage rate).

B. Fibrous Reinforcing: "Solomon UltraFiber 302 Blend" concrete reinforcing fiber.
1. Material: Alkali-resistant, natural cellulose fibers with CFS cold drawn steel fibers, ASTM A 820.
2. Average Length: 2.1 mm (0.083 inch).
3. Average Denier: 2.5 g/9,000 m.
4. Average Diameter: 18 i (0.63 x 10-3 inch).
5. Count: 1,590,000 fibers/g (720,000,000 fibers/pound).
6. Density: 1.10 g/cm3.
7. Surface Area: 25,000 cm2/g (12,200 ft2/pound).
8. Average Tensile Strength: 750 N/mm2 (110 ksi).
9. Average Elastic Modulus: 8,500 N/mm2 (1,200 ksi).

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 MIXING

A. Add reinforcing fibers into concrete mixture in accordance with manufacturer's instructions and ASTM C 94.

B. Add reinforcing fibers at a dosage rate of 1.5 pounds/cubic yard (0.6 kg/m3) of concrete directly into concrete mixer at beginning of batch cycle. Higher dosage rates of 2 -4 pounds can be used for replacement of welded wire or mild temperature steel. Please refer to manufacturer's recommendations.

C. Add reinforcing fibers at a dosage rate of 16.5 pounds (7.48 kg) per cubic yard of concrete directly into concrete mixer at beginning of batch cycle. Higher dosage rates of 2 -4 pounds can be used for replacement of welded wire or mild temperature steel. Please refer to manufacturer's recommendations.

D. Allow a minimum of 5 minutes at mixing speed in concrete mixer for full reinforcing fiber dispersion.

E. Concrete shall be as specified in Section 03 30 00 - Cast-in-Place Concrete.

3.4 FIELD QUALITY CONTROL

A. Confirm uniform fiber dispersion throughout concrete in accordance with manufacturer's instructions.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

Comparison of UltraFiber 500® Alkali Resistant Cellulose Fiber versus Synthetic Polypropylene Fiber for Secondary Reinforcement in Concrete

Mr. Robert I. Bell, Dr. Gerald H. Morton, and Mr. Michael J. Schultz, PE

OVERVIEW

The successful introduction of a new alkali resistant virgin cellulose fiber for secondary reinforcement in concrete has generated questions and some misconceptions in the marketplace. This technical report answers these questions and addresses the misconceptions.

The use of un-processed, cellulose based fibers for reinforcement in building materials dates back well over 2,000 years. In the modern era, engineered processed cellulose fibers are used extensively in cementitious building materials and in concrete applications. UltraFiber 500® was developed based on a virgin, purified form of cellulose manufactured from one of the longest, thickest cellulose fibers found in nature. These properties make it ideal for the harsh demands of today's modern concrete applications. Research and independent testing have verified the performance attributes provided by UltraFiber 500® for: plastic shrinkage crack control, temperature crack control, increased impact resistance, improved freeze/thaw resistance, control of explosive fire spalling, improved concrete hydration, improved strength properties, reduction in water permeability, reduction in water absorption, and improved concrete durability.

A thorough assessment of the attributes of cellulose fibers proves that they offer new performance dimensions to the fiber reinforced concrete (FRC) market. The distinct differences in the physical properties of cellulose fiber offer performance features that are superior to and cannot be matched by synthetic polypropylene fibers.

FIBER PROPERTIES

Cellulose fibers and synthetic polypropylene fibers vary tremendously in their fiber properties.

Polypropylene Fiber

Polypropylene (PP) fibers are one of many synthetic end products of the fossil fuels industry. They are either extruded as monofilament or produced as fibrillated tapes in many different shapes and sizes. The first PP fibers to enter the FRC market were side products from textile mills. These PP fibers were called "fibrillated" because of the interconnecting strands between the fibers (most commonly used as carpet backing fibers in the textile industry). Years later, polypropylene producers began offering individual monofilament fibers in various lengths and deniers. Over the years, the PP fibers have become shorter and thinner in an attempt to reduce the problems they present when placing and finishing concrete.

Polypropylene fibers are completely hydrophobic meaning that they will absorb no moisture. As a result, PP fibers do not assimilate well in the concrete paste, and petrography proves that they do not bond well within the cement paste and create additional voids.

FIGURE A: Synthetic Polypropylene in Concrete (Note: Micro-voids around fiber and lack of paste/fiber bonding)

Some producers coat their fibers with a surfactant to provide some short-term pseudo-hydrophilicity to reduce fiber balling in the concrete. This coating is soon washed off during the concrete mixing process and has been shown to increase air content.

To be anchored into the concrete, polypropylene fibers depend solely on frictional forces and aggregate gripping since there is no surface bonding between the fiber and the paste. This is why PP fibers must be long so that gripping and interlock can take place. Without that, performance benefits would be substantially reduced.

Cellulose Fiber

The term "cellulose fiber" represents a class of fibers that originate from wood and plant materials and they vary tremendously in size, denier, shape, purity, and fiber strength. One commonality of these fibers is that they all contain some

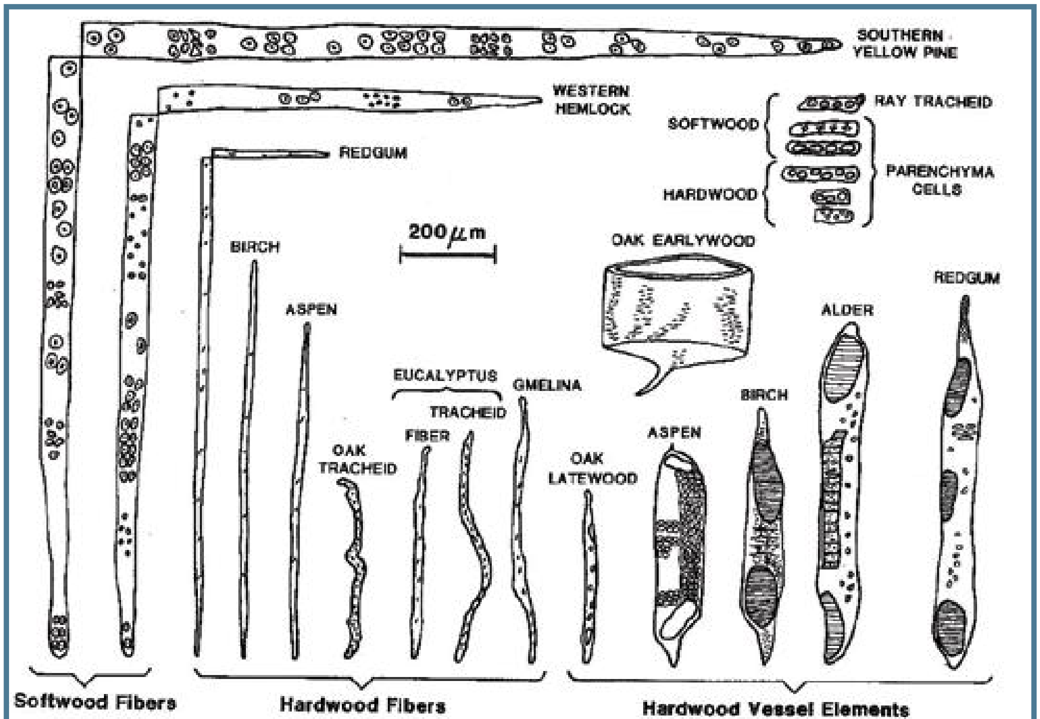


Figure B: Sketch of Wood Based Cellulose Fibers

cellulose which is an organic polymer of glucose. On a molecular level, cellulose can vary substantially in the degree of polymerization and in the crystalline structure. All cellulose fibers are not created equal. Figure B shows a class of cellulose fibers processed from trees. Note the tremendous variance in size, shape, and appearance. Cellulose fibers can be liberated from wood materials through numerous processing methodologies. In these processes, the less stable and weaker components of the wood can be completely removed leaving only purified cellulose fiber remaining. Some processing conditions purify the cellulose fibers to higher degrees of stability and chemical resistance than others.

Numerous and varied forms of cellulose fiber have been used as a reinforcing fiber in building materials dating back well over 2,000 years. Their crack control and reinforcing properties were recognized by pre-modern societies. In the last 50 years, numerous forms of engineered processed cellulose fibers are used as a major component in highly durable building materials used worldwide.

To meet the demands of today's modern concrete industry, UltraFiber 500® was developed based on a virgin, purified form of cellulose fiber made from one of the longest and thickest cellulose fibers found in nature. The select plantation trees used to manufacture UltraFiber 500® contain the longest and thickest cellulose fiber in North American and are similar to the Southern Yellow Pine fiber shown in Figure B.

Unlike polypropylene fibers, cellulose fibers are highly hydrophilic and will absorb moisture. UltraFiber 500® can absorb up to about 85% of its weight in moisture. This hydrophilic characteristic promotes outstanding bonding between cellulose fiber and the cement paste
(see Figures C and D).

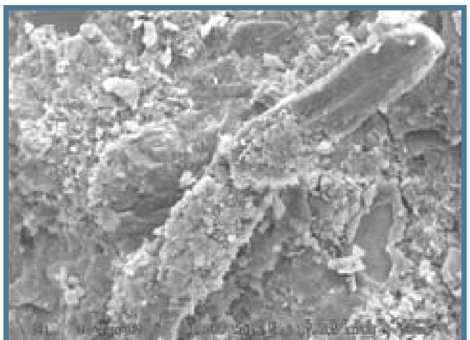


FIGURE C: Cellulose Fiber Bonded Into Concrete

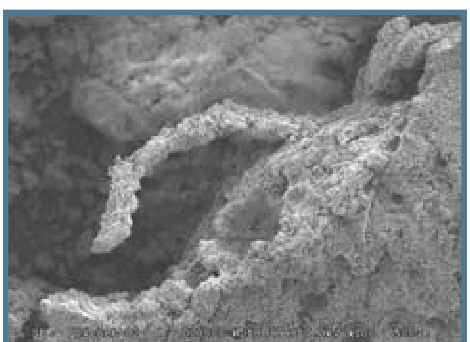


FIGURE D: Cellulose Fiber Bonded With Cement Paste

As it cures, this bonding intensifies, hardens, and becomes more fully hydrated from internal curing provided by the moisture that is given up by the fiber to unhydrated cement.

Since UltraFiber 500® is bonded and fully anchored within the concrete paste, it does not require a fiber length as long as polypropylene requires to provide excellent performance properties. Furthermore, the intense bonding reduces microscopic voids and openings within the concrete as observed from hydrophobic fibers like synthetic polypropylene.

Fiber Property Comparison

Compared to typical synthetic polypropylene fibers, UltraFiber 500® cellulose fiber has greater fiber tensile strength and higher elastic modulus than polypropylene fibers (ACI SP182-8). The fine diameter and short fiber length provide exponentially higher fiber counts, closer fiber spacing, and higher specific surface area versus polypropylene fibers (ACI 544.1R-96). Cellulose is slightly heavier than water (1.1 g/cm^3) while synthetic PP fibers are lighter than water (0.9 g/cm^3). Hydrophilic cellulose fibers acclimate much better within the paste than light, hydrophobic synthetic PP fibers. Because of their hydrophilic nature, cellulose fibers more easily disperse within the concrete in typical industry concrete mixing processes. Good fiber dispersion within the concrete is important for uniform performance throughout the concrete. The hydrophobic nature of PP presents a challenge to good mixing and good fiber distribution without the occurrence of fiber clumping and balling that reduces the in-place concrete performance and finishability. Table 1 below summarizes some of the key fiber property differences:

Table 1: Fiber Property Comparison

Fiber Attributes, units	UltraFiber 500®	Typical PP
Avg. Length, mm	2.1	16
Denier, g/9,000m	2.5	6
Projected Diameter	18	30
Max. Moisture Uptake, wt.%	85	0
Fiber Count, fibers/lb.	720 x 10^6	44 x 10^6
Apparent Density, g/cm^3	1.10	0.91
Surface area, cm^2/g	25,000	1,500
Avg. Fiber Tensile, KSI	90 - 130	30 - 70
*Fiber Spacing µm	640	950

* Dosage @ 1.5lbs/yd^3

FIBER PERFORMANCE

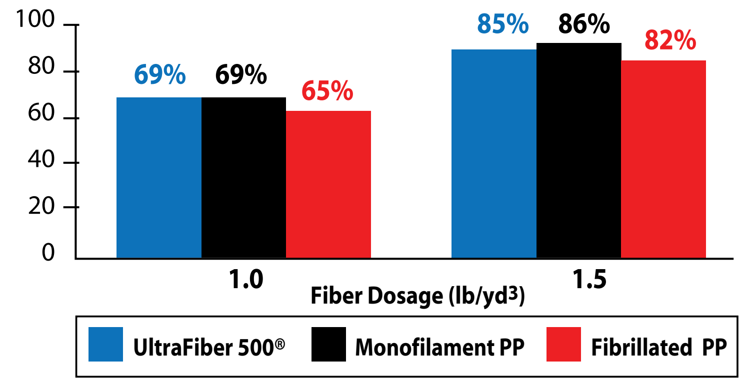
Crack Control

It is well documented that concrete commonly cracks due to intrinsic stresses that occur from shrinkage changes during curing. Temperature changes during the plastic state also contribute to early stage cracking. When fibers are introduced to the concrete they intersect micro-cracks, stop them from progressing, and disperse the energy. This substantially reduces the chance for development of visible macro-cracks. By controlling early age cracking, fibers contribute to the long-term durability of concrete.

The International Code Council (ICC) has established Acceptance Criteria (AC) for fibers used in the evaluation of concrete. ICC AC-32 was developed for evaluation of synthetic fibers and ICC AC-217 was developed for virgin cellulose fibers. Each criterion uses the same identical plastic shrinkage crack test method (Annex A in each criterion) to assess synthetic and cellulose fibers.

Figure E shows plastic shrinkage crack data from an ICC-ES certified test lab using the ICC standard plastic shrinkage crack method. In this finely controlled lab test, the concrete containing UltraFiber 500® performed essentially identical compared to the polypropylene fiber concrete samples. Also note that the fibers in each batch were dosed based on fiber weight per unit volume of concrete. This dosing methodology is standard in the concrete industry.

FIGURE E: ICC Certified Plastic Shrinkage Crack Testing



On a practical level, UltraFiber 500® has differentiated itself for crack control in the field. It is well known in the industry that the addition of PP fibers (monofilament or fibrillated) can substantially reduce the concrete slump. This creates the desire for additional water to be mixed in at the jobsite which lowers strength properties and increases the potential for cracking. The use of

UltraFiber 500® has a zero to negligible change on concrete slump and, therefore, the desire to add water at the jobsite is substantially reduced. This represents a significant advantage for UltraFiber 500® to control cracking in the field.

Alkali Resistance

Concrete is alkaline in nature due to the generation of predominantly calcium hydroxide and sodium hydroxide; therefore, it is important that fibers used in concrete are resistant to degradation in an alkaline environment. If the fibers were to degrade, it would increase the volume of voids and open channels within the concrete and could be detrimental to the long term durability of the concrete and to other performance benefits from FRC. There are some types of synthetic fibers that will degrade in an alkaline environment and there are other types that will not. The same is true for fibers derived from wood and plant raw materials. The source of cellulose, the type of processing, the degree of purity, etc., will all impact whether that particular type of cellulose fiber will deteriorate in an alkaline environment.

ICC requires that concrete reinforcing fibers demonstrate resistance to alkaline degradation. Acceptance Criteria 32 for synthetic fibers requires that cylinders be cast and then re-examined in 2 years to confirm that the fibers have not deteriorated. ICC also specifies an interim test for synthetic fibers where the fibers are soaked in calcium hydroxide for a set period of time and then tested for tensile strength before and after exposure to alkali (the procedure is provided in AC-32, Annex B). ICC requires that 90% of the synthetic fiber tensile strength be retained following alkaline exposure.

ICC Acceptance Criteria 217 specifies that cellulose fibers must be tested in accordance to ASTM D6942, "Standard Test Method for Stability of Cellulose Fibers in Alkaline Environments." The fibers must be soaked in saturated calcium hydroxide and 1.0 Normal sodium hydroxide for a set time period. Following alkali exposure, the fibers are tested for tensile strength and they must retain a minimum of 90% of their original strength. It should be mentioned that 1.0 Normal sodium hydroxide is significantly stronger than saturated calcium hydroxide and represents a severe condition not typical of concrete. UltraFiber 500® has been successfully tested for ASTM D6942 and it exceeded ICC's performance criteria. In saturated calcium hydroxide, UltraFiber 500 retained 100% fiber tensile strength and in 1.0 Normal sodium hydroxide it retained 96% fiber tensile strength. The following micrographs (FIGURES F and G) were taken from a driveway slab containing UF-500 that was poured in the summer of 2002. Notice the presence of healthy, non-deteriorated UltraFiber 500® cellulose fibers.

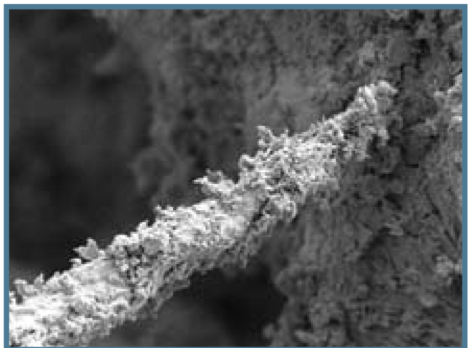


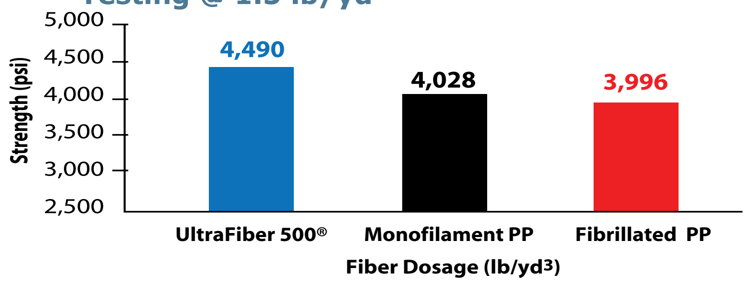
FIGURE F: UltraFiber 500® in concrete after 4.5 years

FIGURE G: UltraFiber 500® in concrete after 4.5 years

Compressive Strength

The hydrophilic nature of cellulose fibers provides an added benefit that hydrophobic synthetic fibers cannot provide. The moisture initially held by the fibers during mixing and initial placement is given up to enhance the hydration level in regions in and around the fiber. This phenomenon is commonly referred to as internal curing. This enhanced hydration can have a positive impact on strength properties. Identical mixes were tested for compressive strength; each mix contained 1.5 lbs/yd³ of fiber (see Figure H).

FIGURE H: Compressive Strength Testing @ 1.5 lb/yd³



The compressive strength of the concrete containing UltraFiber 500® exceeded the concrete containing synthetic polypropylene fibers.

Three residential grade slabs (6 yards each) were poured and placed side-by-side with identical mix designs on the same day, supplied by the same ready mix producer, and finished by the same contractor. Each slab contained 1.5 lbs/yd^3 of one fiber type (UltraFiber 500®, monofilament PP, and fibrillated PP). After approximately 8 months of curing in the field, the slabs were tested for strength using a rebound probe and a Windsor probe. The data are summarized in Figures I and J.

FIGURE I: In-Field Slab Testing with Rebound Probe @ 1.5 lb/yd^3

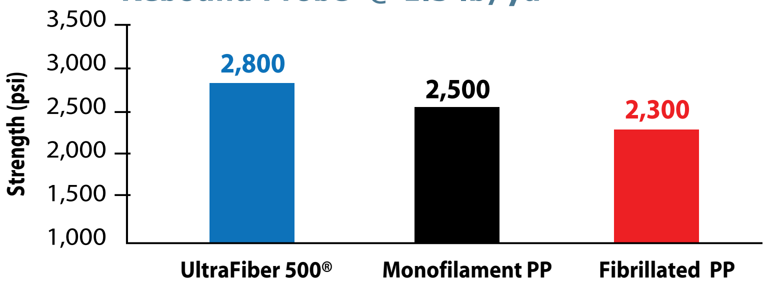
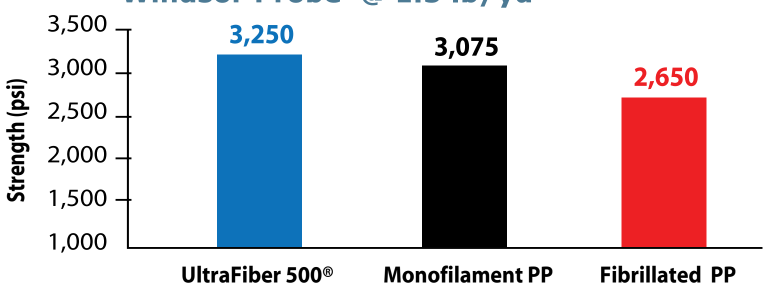


FIGURE J: In-Field Slab Testing with Windsor Probe @ 1.5 lb/yd^3



In both test methodologies, the slabs containing UltraFiber 500® achieved higher in-place strength values.

Concrete Absorbency

The long term durability of concrete can be negatively impacted by high levels of water absorbency. During curing, the hydrophilic nature of cellulose fibers allows the cement paste to adhere and bond tightly to the fiber so that voids and openings are not introduced within the paste. Hydrophobic PP fibers repel the paste and create micro voids around the fibers within the paste. ASTM C1585, "Measurement of Rate of Absorption of Water by Hydraulic-Cement Concrete," was conducted on identical FRC mixes (see Figures K and L).

At equal void volume, the concrete containing UltraFiber 500® had a slower rate of water absorption and a lower amount of water was absorbed

FIGURE K: Rate of Absorption Results

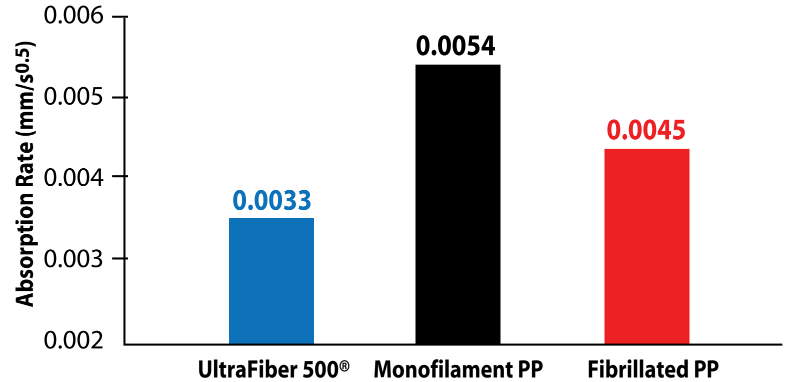
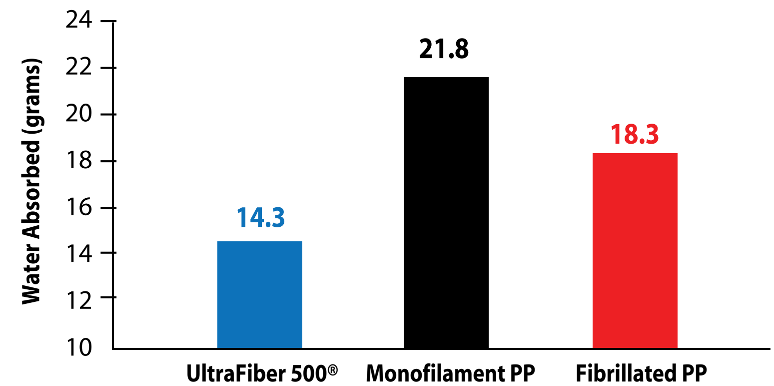


FIGURE L: Total Absorption Results

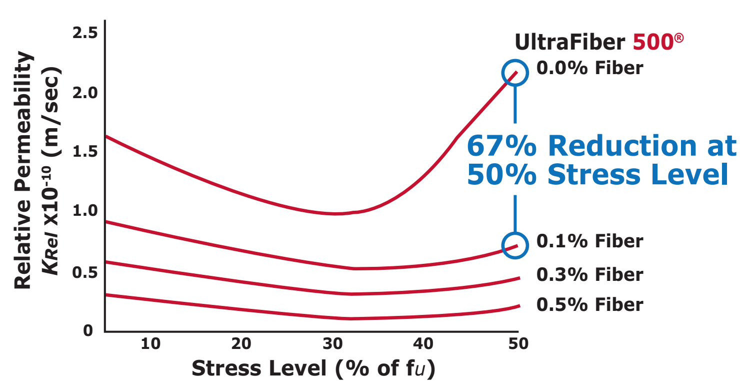


compared to the concrete containing PP fiber. According to Lucas-Washburne theory (Chatterjee, P. K., "Absorbency", Elsevier, NY, 1985, pp 36-40), these results indicate that the voids in cellulose FRC are more uniform, giving a lower effective capillary radius. The finer porosity also leads to a smaller amount of water being absorbed by capillary pressure.

Concrete Permeability

Recent novel research by Banthia (Banthia, N., "Do Fibers Reduce the Permeability of Stressed Concrete?", European Symposium on Service Life and Serviceability of Concrete Structures, June 2006) has shown that FRC containing UltraFiber 500® reduces the water permeability of unstressed and stressed concrete (see Figure M). The presence

FIGURE M: Water Permeability Results



of cellulose fibers in the concrete substantially reduces the increased water permeability that occurs from cracking under load. This behavior should have a substantial benefit for corrosion reduction in structural elements containing embedded rebar.

Freeze/Thaw Performance

The reduced concrete absorption and reduced concrete permeability benefits documented from the use of UltraFiber 500® have a favorable impact to freeze/thaw durability performance. The presence of UF-500 can improve the F/T resistance of concrete that would otherwise have poor performance. The data in Figures M and N show two different freeze/thaw test results using ASTM 666 and French Standard P 18-425 respectively. UltraFiber 500® was dosed at 1.5 lbs/yd^3 for both tests. More testing is underway.

FIGURE N: Freeze/Thaw Testing, ASTM C666

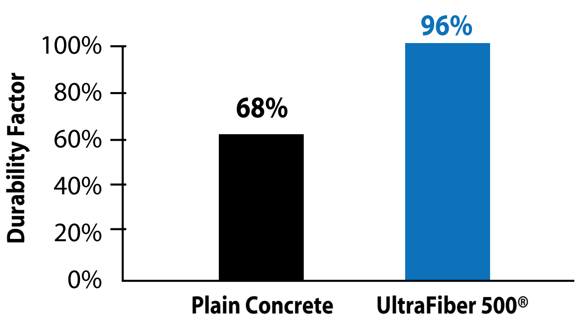
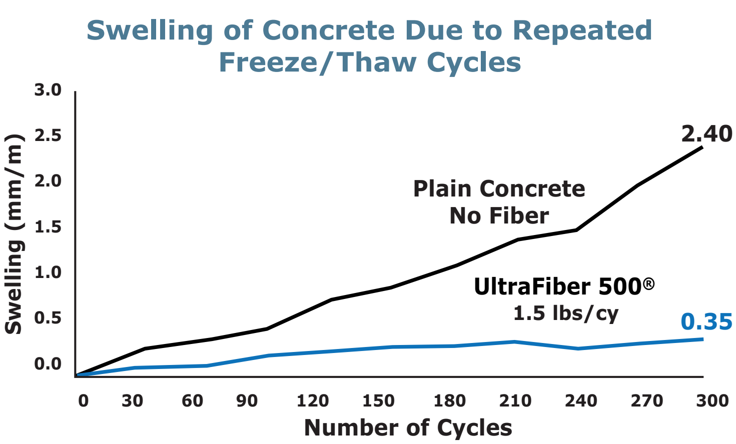


FIGURE O: Freeze/Thaw Testing, P 18-425



Compared to the poor results for the control in each of these tests, the presence of UltraFiber 500® had a substantial improvement on the freeze/thaw durability of the concrete.

Impact Resistance

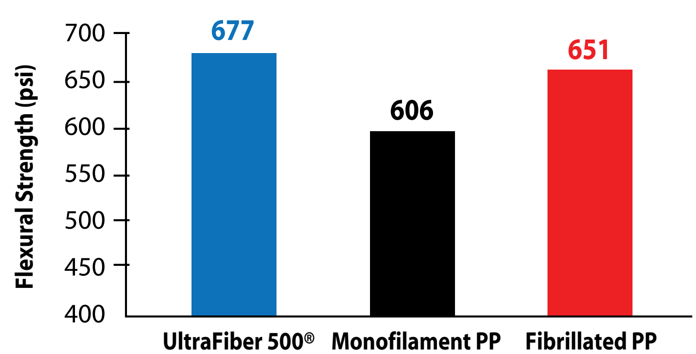
ICC specifies that concrete containing fiber (synthetic and cellulose) show a performance benefit to impact resistance. This test requires a small concrete specimen be impacted multiple times with a drop hammer ball until such time the specimen breaks apart and separates into individual pieces. Concrete containing fibers can increase the number of blows before the concrete breaks apart since the fibers can absorb some of the impact energy and disperse it throughout the concrete. UltraFiber 500® meets ICC acceptance criteria for impact resistance as do PP fibers.

Residual Strength/Toughness Testing

After the initial introduction of fibrillated PP fibers for concrete, monofilament PP fibers soon followed. In an effort to differentiate between these fibers, tests such as the average residual strength (ARS) test and toughness test have evolved. These tests have extremely high variability and are still being debated and modified in their respective ASTM committees. Problems in interpreting ARS and toughness of FRC are discussed by Banthia and Mindess (see ASTM Journal of Testing and Evaluation, March 2004, Vol. 32 (#2), pp 1-5). Synthetic PP fiber producers claim that these tests indicate the "crack holding power" of fibers. None of these tests are required by ICC in their evaluation criteria for the use of fibers (synthetic or cellulose) in concrete for secondary reinforcement. These values are used mostly as a marketing tool by PP fiber producers.

The mechanism of cracking in the field is different from what these tests measure. Cracks in concrete slabs are subject to movement due to shrinkage in the horizontal plane. The crack holding capacity of fibers during concrete shrinkage is directly proportional to the tensile capacity of the fibers. UltraFiber 500® obtains similar results in these test compared to monofilament synthetic fibers. But, more importantly, UltraFiber 500® performs at the micro level to combat crack formation and increase the stress carrying capacity of the concrete prior to reaching the first crack level (i.e. flexural strength). Flexural strength testing is required by ICC in their evaluation criteria for fibers in concrete (synthetic and cellulose). Flexural strength testing has shown that UltraFiber 500® fibers are equal to or better than synthetic fibers used for secondary reinforcement (see Figure P).

FIGURE P: Flexural Strength Testing @ 1.5 lb/yd^3



Fire Testing
Cellulose fibers also provide a benefit to reduce explosive spalling due to fire. Figure Q below shows photographs of concrete specimens taken after fire exposure in accordance with EN 1363-1 using the ISO 834 fire curve. The cellulose reinforced concrete and the monofilament polypropylene reinforced concrete (both dosed at 3.0 lbs/yd^3) stopped explosive spalling while the plain concrete specimen did not.

UltraFiber 500® fibers have also been tested by Underwriters Laboratories under ANSI/UL 263, thirteenth edition standards in a D900 series metal deck assembly. The fiber was used as an alternate for welded wire fabric for secondary reinforcement. The concrete containing UltraFiber 500® did not exceed the maximum temperature rise for over 2 hours. As a result, UltraFiber 500® has been successfully UL classified in D700, D800 & D900 series deck designs. More testing is underway at UL to expand this unique performance benefit for fire resistance.

Impacts to Finishing
Concrete has to be properly finished in order for it to provide maximum performance. It is well documented in the concrete industry that polypropylene fibers have a history of balling and finishing problems. As previously discussed, PP fibers do not always disperse well in the mixes. Their hydrophobic nature favors balling and clumping. Fibrillated PP fibers do not always open up into the "mesh" form that is required for proper performance. At the surface, PP fibers protrude out and are often observed in clumps or balls. Their presence at the surface makes it difficult to obtain a properly finished, densified surface. If the concrete is being used in a highly aesthetic decorative application, the finishing problems from synthetic fibers frequently eliminate the possibility for their use.

Hydrophilic cellulose fibers are able to uniformly disperse more easily in concrete so that performance can be maximized. Special finishing steps do not have to taken – concrete containing cellulose fibers at normal dosages finishes very similar to plain concrete. Cellulose fibers do not clump or ball up at the surface allowing proper finishing techniques to obtain a properly sealed, smooth surface. The hydrophilic nature also helps to maintain more paste at the surface allowing excellent surface finishing ability. In decorative applications, cellulose fibers are invisible to the eye making them highly desirable in these applications where other fibers cannot be used.

FIGURE Q: Pictures From Explosive Fire Spalling Test

UltraFiber 500®

Plain Concrete

Monofilament PP

SUMMARY

• The International Code Council has developed acceptance criteria for the use of synthetic fibers (AC-32) and cellulose fibers (AC-217) in concrete for providing secondary reinforcement. The key test used to assess plastic shrinkage crack control is identical for both fibers.
• UltraFiber 500® cellulose fiber, monofilament polypropylene fiber, and fibrillated polypropylene fiber performed similarly in certified plastic shrinkage crack testing in accordance to ICC acceptance criteria.
• UltraFiber 500® cellulose fiber is alkaline resistant in concrete as proven through testing with ASTM D6942 using saturated calcium hydroxide and 1.0 Normal sodium hydroxide.
• UltraFiber 500® has a performance advantage in the field over synthetic fibers for crack control since it has zero to negligible impact on slump and synthetic fibers can substantially reduce the slump which creates the desire for water to be added at the jobsite.
• UltraFiber 500® cellulose fibers and synthetic fibers perform similarly in control of explosive spalling (ISO 834).
• UltraFiber 500® is UL Classified with a two-hour fire rating for all D700, D800 and D900 composite metal deck assemblies.

• UltraFiber 500® cellulose fiber provides the following advantages over synthetic fibers for FRC:

- Higher surface area, higher fiber tensile strength, higher fiber count, and closer fiber spacing.
- Cellulose fiber properties promote better fiber dispersion throughout the FRC.
- Cellulose fibers assimilate and bond within the paste creating a tighter, denser paste.
- Minimal to no negative impact to plastic properties of FRC
- Provides enhanced curing by the gradual release of water to unhydrated cement.
- FRC strength properties are improved from internal curing.
- Reduced water absorbency and permeability
- Improved freeze/thaw durability performance
- Cellulose fibers do not create placement and finishing problems.
- Processed cellulose fibers come from renewable resources.

• ARS and toughness tests are highly variable, frequently debated in technical circles, and not required by ICC to evaluate fibers in concrete.

In summary, it is clear that UltraFiber 500® cellulose fiber provides numerous and substantial advantages over synthetic polypropylene fiber for use as a secondary reinforcement for concrete.

SOLOMON

UltraFiber 500®

Secondary Reinforcement Fiber for Concrete

Description:

UltraFiber ® 500 reinforcement fiber for concrete is 100% virgin specialty cellulose fiber with a patented alkaline resistant coating specifically engineered and manufactured in an ISO 9001 certified facility. UltraFiber 500® provides secondary reinforcement in concrete (temperature and shrinkage crack control) and meets ICC evaluation criteria for use in slab on grade. UltraFiber 500® is manufactured in the USA from renewable resources and complies with National Building Codes, ASTM C1116-08 and ASTM D7357-07. A dosage rate of 1.0 to 4.0 lb/yd^3 is recommended depending on the application. In areas where freeze/thaw performance is a significant factor, a 2.0 lb/cy dosage rate is strongly recommended with a 1.5 lb/cy dosage rate minimum

Applications:

- Commercial & Residential Slabs
- Composite Metal Decks
- Paving
- Pervious Paving
- Curb and Gutter
- Slip Form
- Architectural & Decorative
- Pre-Cast
- Shotcrete
- Walls
- White Topping

Advantages:

UltraFiber 500® provides excellent secondary reinforcement from high fiber surface area, close fiber spacing, excellent bonding within the cement matrix, high fiber tensile strength, and easy dispersion in concrete so it is always positioned correctly. It is safe, easy to use, and offers superior finish-ability. UltraFiber 500® provides significant benefits in numerous applications.

Benefits:

- Alternate system to traditional secondary reinforcement in concrete
- Reduces the formation of intrinsic cracking in concrete
- Reduces concrete permeability and absorption.
- Improves concrete freeze/thaw resistance
- Improves concrete durability
- Provides enhanced hydration which improves concrete strength properties
- Improves concrete impact resistance
- Improves concrete shatter resistance
- Improves bond strength between rebar and cement paste

Concrete Fire Resistance:

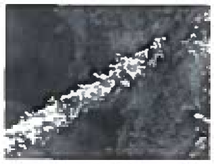
- UL Classified for use in all composite metal deck Designs No. D700, D800 & D900.
- UL Classified for use in composite metal deck Design No. D973 Reduced Thickness of NWC (normal weight concrete) while achieving a 2 Hour Fire Rating

Perfomance Characteristics:

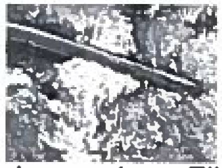
Water Absorption	Up to 80% of the fiber weight
Specific Gravity	1.10
Avg. Fiber Length	2.1 mm
Projected Fiber Diameter	18 um
Fiber Tensile Strength	90 -130 ksi
Alkali Resistance	High (ASTM D6942)

For additional information please contact us at 800-624-0261 or visit www.ultrafiber500.com. This publication should not be construed as engineering recommendations or advice. Users of this product should determine its suitability for their own particular application. UltraFiber 500® is sold with no express or implied warranty; seller's sole liability for claims is limited to replacement of defective or nonconforming product.

UltraFiber® 500



UltraFiber
Excellent Bond



Polypropylene Fiber
Minimal Bond

UltraFiber 500® vs. Synthetic Fibers

Attribute, units	UF-500	Synthetic Fiber
Avg. Length, mm	2.1	16
Denier, g/9,000m	2.5	6
Diameter, um	18	30
Count, fibers/lb.	720,000,000	44,000,000
Density, g/cm^3	1.10	0.91
Tensile, N/mm^2	600 - 900	200 - 500
Surface area, cm^2/g	25,000	1,500
Fiber Spacing, um	640	950

Application Rate
The minimum application rate for Buckeye UltraFiber 500® is 1.0 lb/yd^3. A dosage of 1.5 lb/yd^3 is recommended for most commercial slab on grade applications. Dosages of 2.0 to 4.0 lb/yd^3 may be used for applications requiring maximum impact and/or abrasion resistance and crack control.

Mix Design
The addition of UltraFiber 500® reinforcing fibers at normal dosage rates does not require any mix design changes. UltraFiber 500® is compatible with typical admixtures and other mix constituents.

Finish-ability
UltraFiber 500® reinforcing fiber provides superior finish-ability and has no restrictions or barriers to normal finishing techniques. These finishes include: trowel, swirl, broom, exposed, decorative, colored, and stained. All finishes exhibit excellent results, and the finisher can use normal timing.

Compatibility
UltraFiber 500® reinforcing fiber is compatible with all normal concrete constituents and admixtures and will not adversely affect their performance or concrete workability.

CLASSIFIED UL

Solomon Colors, Inc.
4050 Color Plant Road
Springfield, IL 62702
PH: 800-624-0261
Email: sgs@solomoncolors.com
www.ultrafiber500.com

Usage Guideline
UltraFiber 500® reinforcing fiber can be used as an alternate system to provide secondary reinforcement. It cannot be used as an alternative for structural reinforcement. UltraFiber 500® fiber should not be used to alter the concrete design for thickness or strength. ACI recommended curing practices, joint spacing and depth should be followed.

Mixing Procedure
UltraFiber 500® reinforcing fibers disperse best when added at the beginning of the batching sequence. Follow normal mixing, time and speed, as recommended by ASTM C94.

Packaging
UltraFiber 500® reinforcing fibers are available in 1.0 pound and 1.5 pound, water-soluble bags. Larger 20 pound non-soluble bags are also available. For automated dispensing, 500 pound bulk bags are recommended.

Engineering Specification
Use only 100% virgin alkali-resistant cellulose fibers manufactured for use in concrete for secondary reinforcement. Dosage rates are 1.0 lb/yd^3 (minimum), 1.5 lb/yd^3 (recommended), and up to 4.0 lb/yd^3 for special applications. Buckeye UltraFiber 500® fiber is for the control of cracking due to plastic shrinkage and thermal expansion/contraction, to reduce water migration, and for increased impact capacity and shatter resistance. Fiber manufacturer must provide compliance with applicable building codes, ISO 9001 certification of manufacturing facility and ASTM C1116-08 compliance. Fibrous concrete reinforcement shall be manufactured by Solomon Colors, Inc.
4050 Color Plant Road, Springfield, IL 62702
Phone: 800-624-0261, Fax: 217-522-3145

Website: www.ultrafiber500.com.

Spirit Bank Event Center
UltraFiber added @ 3.0 lbs/cyd

SOLOMON

UltraFiber 500 - An Alternative to WWF

Solomon Colors can recommend the use of UltraFiber 500 as an alternate for welded wire fabric (WWF) because it has met the standards of the leading nationally recognized construction testing organizations in North America. UltraFiber 500 increases the pre-crack load carrying capacity of concrete slabs through improved internal hydration of the concrete. UltraFiber 500 has a significantly higher fiber count than synthetic fibers to intercept more micro-cracks as they begin to form. As reported by Naaman et.al., (ACI Materials Journal, V. 102, Jan – Feb 2005) fiber <u>length</u> does not have a noticeable effect on plastic shrinkage cracking, whereas <u>smaller fiber diameters</u> have a significant positive effect on plastic shrinkage cracking.

Solomon Colors recommends the use of UltraFiber 500 at dosage rates from 1.5 lbs to 4.0 lbs per cubic yard for the replacement of WWF and mild temperature steel based on the design criteria set forth by the architect or structural engineer for each individual project. Solomon recommends following all ACI guidelines for joint spacing and concrete curing.

<u>International Code Council (ICC)</u>

UltraFiber 500 meets the highest standards of industry testing for replacing welded wire fabric in the construction industry {i.e., the International Code Council (ICC) and Underwriters Laboratories (UL)}. UltraFiber 500 currently holds ICC (formally, SBC, BOCA, IBC, UBC) code certification stating that UltraFiber 500 may be used as an <u>alternate to WWF</u> for plastic shrinkage and temperature cracking (see ICC ERS-1032).

ICC does not recognize post cracking average residual strength (ARS) as a code acceptance requirement for fiber reinforced concrete. ARS (i.e., ASTM 1399) is induced by an applied extrinsic force, not intrinsic stresses. ARS is only measuring the temporary strength of the fibers spanning a concrete crack. This strength will decline as plastic polypropylene fibers degrade due to exposure to ultraviolet light and ambient conditions. Under ASTM 1399 test methods the fiber is only loaded one time. The test method does not consider the affect of repeated loads on the same concrete. Under repeated loading, polypropylene fibers will pull out of the concrete or the fibers will stretch, therefore the benefit of the post crack performance is minimal at best. All of the fiber types (synthetic macro, synthetic micro, steel, glass, etc) sold under ICC evaluation has the same secondary reinforcement approval as UltraFiber 500, with no requirement for post cracking average residual strength as an acceptance criterion.

Use the chart below to determine the proper dosage rate for Ultrafiber500

New designation by wire number	Old designation by wire gauge	UltraFiber500 dosage
6 x 6 -w 1.4 x w 1.4	6 x 6 -10 x 10	1.5 pounds per yard
6 x 6 -w 2.0 x w 2.0	6 x 6 - 8 x 8	2.0 pounds per yard
6 x 6 -w 2.9 x w 2.9	6 x 6 - 6 x 6	3.0 pounds per yard
6 x 6 –w 4.0 x w 4.0	6 x 6 - 4 x 4	4.0 pounds per yard
Temperature steel	# 3 at 24" on center	3.0 pounds per yard
Temperature steel	# 4 at 24" on center	3.0 pounds per yard
Temperature steel	# 3 at 18" on center	4.0 pounds per yard
Temperature steel	# 4 at 18" on center	4.0 pounds per yard

Disclaimer:

1. This chart should not be construed as engineering advice.

UltraFiber 500 reinforces concrete at the micro level to combat crack formation and increase the stress carrying capacity of the concrete prior to reaching the first crack level (i.e. flexural strength). Flexural strength testing *is* required by ICC (and universally recognized by Structural/Civil Engineers) in their evaluation criteria for fibers in concrete (synthetic and cellulose). Flexural strength testing has shown that UltraFiber 500 fibers are equal to or better than synthetic fibers when used for secondary reinforcement

ARS History– A Synthetic Fiber Marketing Tool

The first synthetic fibers introduced for use in fiber reinforced concrete were fibrillated polypropylene fibers. The average fiber length was 2 - 2 ¼" and the recommended fiber dosage was 1.5 lb/cy. The fiber dosage, based on the longer fiber length, was not a high enough volume and therefore produced poor results. These fibers also proved to be difficult to finish and produced a "hairy" look on the concrete surface. Monofilament polyproylene fibers were soon introduced in response to these issues. In an effort to differentiate between these fiber types, tests such as average residual strength (ARS) and toughness were developed. ARS is a marketing tool developed by polypropylene fiber suppliers to support the replacement of WWF. ARS test methods produce an extremely high rate of variability and are currently being debated and modified in ASTM and ACI committees. Problems in interpreting ARS and toughness of fiber reinforced concrete are discussed by Banthia and Mindess (see ASTM Journal of Testing and Evaluation, March 2004, Vol. 32 (#2), pp 1-5). Synthetic polypropylene fiber producers claim that these tests indicate the "crack holding power" of fibers. Neither of these tests is required by International Code Council in their evaluation criteria for the use of fibers (synthetic or cellulose) in concrete for secondary reinforcement. Furthermore, these tests results are not considered by Structural/Civil Engineers in the design of concrete slabs or other fiber reinforced concrete structures. All secondary reinforcing fibers are discontinuous and are considered only as crack control. Fibers are not considered structural reinforcement. To minimize product liability claims, caution should be taken when presenting post cracking ARS strength results to architects and engineers.

UltraFiber 500 Benefits vs. WWF

UltraFiber 500 provides a reduction in plastic shrinkage cracking and is distributed throughout the concrete matrix to provide three dimensional reinforcement. UltraFiber 500 will not corrode, provides internal curing, and improves concrete strength, durability, permeability and freeze-thaw properties. UltraFiber 500 is also more cost effective to use than WWF.

WWF is typically not positioned in the proper location in the concrete and only reinforces the concrete after cracking has occurred.

Visit www.ultrafiber500.com to calculate your cost savings vs. WWF and to learn more about the benefits of UltraFiber 500 !