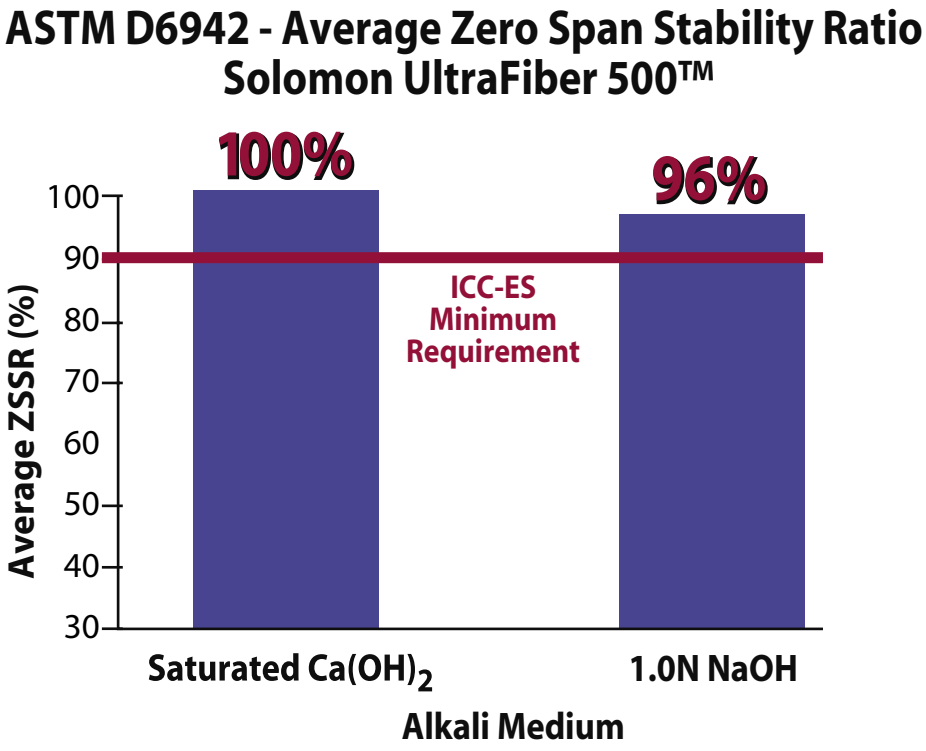
UltraFiber Technical Bulletin
UFTB #3
Alkali Resistance

TESTING PURPOSE:

To measure the long-term chemical durability of Solomon UltraFiber 500™ exposed to concentrations of alkali similar to and exceeding the alkali concentration found in concrete. Testing was conducted based on the requirements of ICC-ES Acceptance Criteria 217 (AC-217), Section 4.6 which specified the use of ASTM D6942, "Standard Test Method for Stability of Cellulose Fibers in Alkaline Environments." Exposure to saturated calcium hydroxide and 1.0N sodium hydroxide out to 35 days was specified.

TESTING CONCLUSIONS:

Solomon UltraFiber 500™ easily exceeds the ICC-ES minimum requirement of 90% average Zero-Span Stability Ratio (ZSSR) after exposure to both saturated calcium hydroxide and 1.0N sodium hydroxide. The results are shown below:



TESTING METHODOLOGY:

ASTM D6942 consists of three basic steps: 1) Exposing the fibers to alkali, 2) Forming standard fiber handsheets, and 3) Testing for fiber strength by the zero-span tensile test.

The dry individualized fibers are placed in an appropriate glass beaker and the liquid alkali is dosed onto the fibers. The alkali soaked fibers are held in open containers for the required exposure time intervals of 1, 3, 7, 14, 21, 28, and 35 days in accordance with AC-217. Once the exposure time is reached, the fibers are rinsed with standard tap water over a 100-mesh screen until the washings are neutral to quench the alkali.

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TESTING METHODOLOGY (continued):

Each set of alkali exposed fibers are formed into standard fiber handsheets with a basis weight of 60 g/m^2 (see Figure 1). Along with the alkali exposed fibers, a control set of handsheets is made from fiber that was NOT treated with alkali. Once all the standard fiber handsheets are made, they are ready for zero-span tensile testing.

The zero-span tensile test requires that the handsheets be cut into appropriately sized strips (see Figure 1) that are inserted between the "jaws" of the zero-span tensile tester. The jaws are loaded down and clamped onto the fiber strip with no space between the jaws (see Figure 2). The test apparatus is engaged to pull the jaws apart until the strip breaks. The force required to break the strip is measured. Since there is no space or "span" between the clamped jaws, the energy required to break the fiber strip comes from the forced rupturing of thousands of individual fibers (see Figure 3) resulting in an accurate measurement of the average fiber strength.

The zero-span stability ratio is calculated by the following formula:

$$\frac{\textbf{Zero-Span Tensile of Alkali Exposed Fiber}}{\textbf{Zero-Span Tensile of Control Fiber}} \times 100\% = \textbf{Zero-Span Stability Ratio}$$

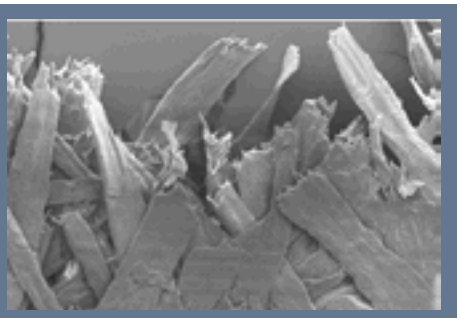
Figure 1

Fiber Handsheet and Strips

Figure 2

Strip Loaded in Zero-Span Tensile Tester

Figure 3



Broken Edges of Strips Showing Ruptured Fibers

TESTING RESULTS:

The results obtained by Stork Twin Cities Testing are summarized in the table below:

Alkali	1-Day	3-Day	7-Day	14-Day	21-Day	28-Day	35-Day	Average ZSSR (%)
Sat. $Ca(OH)_2$	103.2	102.3	98.6	101.1	103.2	103.4	104.3	102
1.0N NaOH	96.6	98.2	92.4	96.3	93.4	92.6	100.3	96

The test results show that Solomon UltraFiber 500™ retains 100% of its fiber strength when exposed to saturated calcium hydroxide and 96% of its fiber strength when exposed to 1.0 N sodium hydroxide. Solomon UltraFiber 500™ easily exceeds the 90% minimum strength retention established by ICC-ES making it alkali resistant in concrete. The 1.0N sodium hydroxide solution is approximately 100 times stronger than saturated calcium hydroxide and represents an extreme alkali environment not found in concrete.

REFERENCES

Stork Twin City Testing Corporation, St. Paul, MN
• Project No.: 033411, January 23, 2004

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