

TESTING PURPOSE:

To demonstrate the hydration benefit provided by Solomon UltraFiber 500™ hydrophilic concrete reinforcing fibers.

TESTING CONCLUSIONS:

After petrographic examination using a stereoscopic microscope, Dixon & Associates, Inc. found the following:

- Concrete samples utilizing Solomon UltraFiber 500™ **contained less unhydrated cement** compared to concrete containing no fiber (control samples).
- Concrete samples utilizing Solomon UltraFiber 500™ had **no internal micro-cracking** compared to concrete containing no fiber that had internal micro-cracking (viewed up to 140x magnification).



RESEARCH METHODOLOGY:

Solomon UltraFiber 500™ concrete reinforcing fibers are hydrophilic (can absorb water) and can hold up to approximately 85% of their weight in water. When initially mixed into concrete, UltraFiber 500® fibers will take up and hold water. After the concrete is placed, the fibers will slowly release that water to unhydrated cement during the critical early phases of curing which assist in more complete hydration.

To demonstrate this benefit, three sets of 4" x 8" concrete cylinders were carefully cast and then examined by a certified petrographer in accordance with ASTM C856, "Petrographic Examination of Hardened Concrete." One set contained no fiber and both the other sets contained 1.5 lbs./yd³ and 3.0 lbs./yd³ of UltraFiber 500® respectively. A standard 4 cubic foot concrete mixer was used and each batch was prepared following the same identical mixing procedure (fibers were added immediately after the large aggregate and sand). The only variable in each mix design was the amount of fiber used. The exact mix designs and material quantities for each batch are shown below:

Mix Design Details for Each Batch

| | Cement | Coarse Aggregate | Fine Aggregate | Water | Total Batch Weight | UltraFiber 500® Dosage | |
|------------|--------|------------------|----------------|--------|--------------------|------------------------|-------------------------|
| Batch I.D. | (lbs.) | (lbs.) | (lbs.) | (lbs.) | (lbs.) | (g) | (lbs./yd ³) |
| Control | 28.7 | 94.4 | 75.8 | 18.1 | 217.0 | 0 | 0 |
| UF500-1.5 | 28.7 | 94.4 | 75.8 | 18.1 | 217.0 | 37.7 | 1.5 |
| UF500-3.0 | 28.7 | 94.4 | 75.8 | 18.1 | 217.0 | 75.7 | 3.0 |

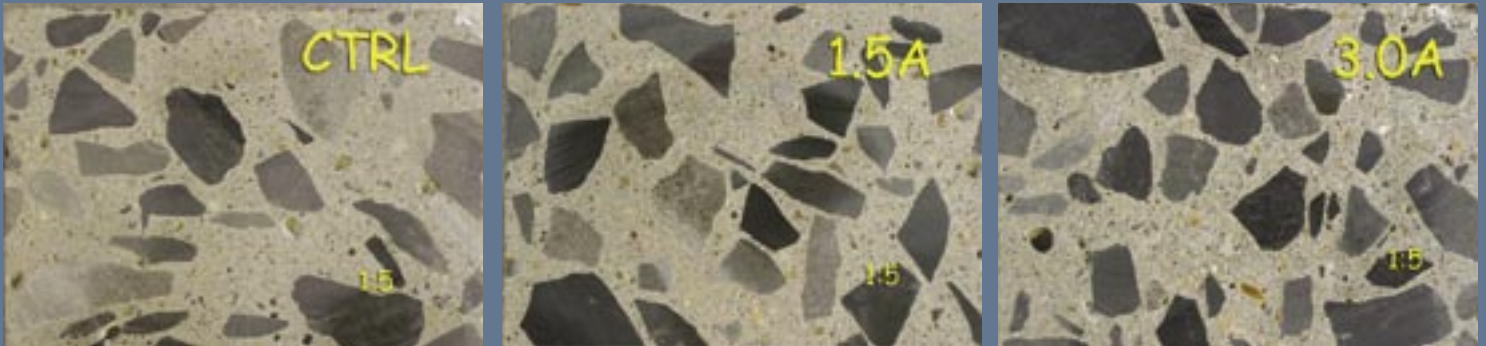
RESEARCH METHODOLOGY (continued):

The 4" x 8" specimens were demolded 24 hours after casting and were individually sealed tightly in heavy plastic wrapping to allow no air contact and to minimize evaporation. On the 7th day, Dixon & Associates unsealed each specimen and cut a thin vertical cross section from each cylinder for petrographic examination in accordance with ASTM C856, "Petrographic Examination of Hardened Concrete". The samples were re-sealed and on the 28th day, the wrapping was removed again, and additional cross-sections were cut from each cylinder. Immediately following extraction of the thin cross-sections, Dixon & Associates used a stereoscopic microscope to examine each sample at magnifications up to 140X.

Summary of Petrographic Observations by Dixon and Associates

| Observation | 7-Day Observations | | | 28-Day Observations | | |
|---------------------------|--------------------|----------------------------|--|---|-----------------------------------|---------------------------------|
| | Control Concrete | UF500-1.5 | UF500-3.0 | Control Concrete | UF500-1.5 | UF500-3.0 |
| Unhydrated Cement | Some | Less Than Control Concrete | Less than Control Concrete, Similar to UF500-1.5 | Little less than 7-day Control Concrete | Less than 28-day Control Concrete | Less than 28-day UF500-1.5 |
| Presence of Cracks | None | None | None | Visual Micro-cracks | None | None |
| Fiber Presence | None | Few Noted | Some noted, more than UF500-1.5 | None | Few Noted | Some noted, More than UF500-1.5 |

Figure 1: Petrographic slides taken from specimens at 5X magnification



RESEARCH CONCLUSIONS:

The hydrophilic nature of Solomon UltraFiber 500™ enhances hydration in concrete by storing water inside the fiber during initial concrete mixing and then releasing that water for hydration later during curing. This "internal curing" action results in more completely hydrated cement in the concrete which contributes to strength development and to the control of internal micro-cracking.

REFERENCES

Dixon & Associates, Inc., Project No. J2783

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