

**NanoCrete
Nano Jelly
ASTM C 494 – Type S Standardized Testing, Level 1
Lot No. – 24-031010**

**Prepared for:
NanoCrete
Aurora, CO**

**Start Date – 11 June 24
28 day Report**

**Report Authored By:
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23 August 2024

Introduction

Intelligent Concrete, LLC (INT CONC) is pleased to present this report for ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete, Type S Special Performance Admixtures, Level 1 for Nano Jelly (hereinafter referred to a “NNC”) as supplied by NanoCrete.

This work was requested and authorized by Shaun Lane of NanoCrete. The scope of INT CONC’s work has been to perform ASTM C 494 laboratory tests on concrete batched with and without the NNC chemical admixture in accordance with the requirements of ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete, Type S Special Performance Admixtures.

All sample preparation and testing was performed in accordance with the application sections of ASTM C 494 to include: material types, material content, and procedures for batching, casting, curing, and testing.

Test Procedures

Testing was initiated on 11 June 2024 when three individual reference (without chemical admixture) batches and three individual experimental (with chemical admixture) batches were produced. All sample batching, casting, curing and testing was performed by INT CONC technicians in the INT CONC laboratory in Howell, NJ, USA. The INT CONC laboratory is fully inspected and certified by the Cement and Concrete Reference Laboratory (CCRL), an organization operating under the auspices of the National Institute of Standards and Technology (formerly the National Bureau of Standards).

The ASTM C 494 standard requires the production of at least three separate concrete batches for each experimental concrete mixture (chemical admixture assessed) compared to a reference concrete mixture. The concrete mixtures assessed are listed in **Table 1**.

Table 1 – Concrete Mixture Identifications and Test Matrix

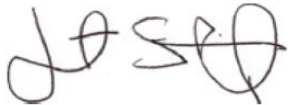
| Concrete Mixture Identification | REFERENCE CONCRETE MIXTURE (without Nano Jelly, REF) | | | EXPERIMENTAL CONCRETE MIXTURE (with Nano Jelly, NNC) | | |
|---------------------------------|---|---------|---------|--|---------|---------|
| | REF - 1 | REF - 2 | REF - 3 | NNC - 1 | NNC - 2 | NNC - 3 |
| Start Date | 11-JUN-24 | | | 13-JUN-24 | | |

Conclusions

The summarized results that are listed in **Table 2** are averaged results from the tests presented later in the report. Based on the results presented in the current report, Nano Jelly meets the specifications and requirements for an ASTM C 494, Type S Special Performance Admixture for all criteria. Please note that samples will be disposed of at the completion of testing.

For and behalf of

Intelligent Concrete, LLC

A handwritten signature in black ink, appearing to read "Jon S. Belkowitz". The signature is stylized and cursive.

Name: Jon S. Belkowitz, PhD, PE

Title: Chief Technology Officer

23 August 2024

Table 2 – Summary of Averaged Test Results Admixture

| Test | REF | NNC | Change from Reference | ASTM C 494 – Type S Specifications | Results |
|----------------------|--|-------|-----------------------|--|------------------------------------|
| Water Content (pcy*) | 245 | 245 | 0% | See Table 3 (below) | - |
| Break Date | ASTM C39 - Compressive Strength (psi) | | | | |
| 1 | 1680 | 1757 | +5% | Minimum 90% of the Reference | Met ASTM C 494 Type S Requirements |
| 3 | 3106 | 3282 | +6% | | |
| 7 | 4260 | 4767 | +12% | | |
| 28 | 5210 | 5502 | +6% | | |
| Break Date | ASTM C78 - Flexural Strength (psi)** | | | | |
| 1 | 626 | 746 | +20% | Minimum 90% of the Reference | Met ASTM C 494 Type S Requirements |
| 7 | 739 | 861 | +17% | | |
| 28 | 886 | 975 | +10% | | |
| Time (days) | ASTM C157 MOD - Modified Shrinkage (Length Change, %) | | | | |
| 28 | -0.0413 | .0413 | +0% | Less than 135% of Reference. Footnote D Part 1 | Met ASTM C 494 Type S Requirements |

**pcy – Pounds per Cubic Yard*

*** Reported as Modulus of Rupture in ASTM C78*

Table 3 – Concrete Mixture and ASTM C 494 Fresh Property Specifications

| Materials / Mix ID | REF | NNC | ASTM C 494 Requirements |
|------------------------|------|------|----------------------------|
| Portland Cement (pcy) | 517 | 517 | 517 ± 5 |
| Water (pcy) | 269 | 269 | As needed to achieve slump |
| Coarse Aggregate (pcy) | 1750 | 1750 | Based on ACI 211.1-91 |
| Fine Aggregate (pcy) | 1250 | 1250 | |
| Slump (inches) | 3.5 | 4.0 | 3.50 ± 0.5 |
| Air Content (%) | 2.6 | 2.6 | 6.0 ± 1.0 |

Table 4 – Concrete Mixture Proportions and Averaged Fresh Properties

| Materials / Mix ID | REF | NNC |
|-------------------------------|-------|-------|
| Portland Cement (pcy) | 517 | 517 |
| Water (pcy) | 269 | 269 |
| w/c Ratio | 0.52 | 0.52 |
| Coarse Aggregate (pcy) | 1750 | 1750 |
| Fine Aggregate (pcy) | 1250 | 1250 |
| Fine / Coarse Aggregate Ratio | 0.71 | 0.71 |
| SIKA 686, fl oz per cwt | 4.50 | 4.50 |
| NNC (fl oz per cwt) | - | 1.00 |
| Slump (inches) | 3.5 | 4.0 |
| Air Content (%) | 2.6 | 2.6 |
| Unit Weight (pcf) | 144.3 | 142.2 |

Table 5 – Properties and Gradation of Coarse Aggregate*

| | | |
|---|-----------------------------------|--------------------------------|
| Material / ID | Coarse Aggregate | |
| Manufacturer | Clayton Materials | |
| Aggregate Type | ASTM C 33, 57/67 Coarse Aggregate | |
| Aggregate Specific Gravity, SSD (g/cc) | 2.68 | |
| Aggregate Absorption (%) | 2.5% | |
| Percent Passing (%) | | |
| Sieve Size (mm) | Coarse Aggregate | ASTM C 494 Requirements |
| 1.5 inch (37.50 mm) | 100 | - |
| 1.0 inch (24.50 mm) | 73 | 100 |
| 0.75 inch (18.38 mm) | 61 | 90-100 |
| 0.5 inch (12.25 mm) | 58 | 25-60 |
| 3/8 inch (4.75 mm) | 56 | 20-55 |
| #4 (4.75 mm) | 0 | 0-10 |
| #8 (2.36 mm) | 0 | 0-5 |
| #16 (1.19 mm) | 0 | - |
| #30 (0.59 mm) | 0 | - |
| #50 (2.36 mm) | 0 | - |
| #100 (1.49 mm) | 0 | - |
| #200 (0.74 mm) | 0.0 | 0-1.5 |

Table 6 – Properties and Gradation of Fine Aggregate

| | | |
|---|--------------------------|--------------------------------|
| Material / ID | Fine Aggregate | |
| Manufacturer | Clayton Materials | |
| Aggregate Type | ASTM C 33, Concrete Sand | |
| Aggregate Specific Gravity, SSD (g/cc) | 2.65 | |
| Aggregate Absorption (%) | 1.5% | |
| Percent Passing (%) | | |
| Sieve Size (mm) | Fine Aggregate | ASTM C 494 Requirements |
| 1.0 inch (25.40 mm) | 100 | - |
| 0.75 inch (18.38 mm) | 100 | - |
| 0.5 inch (12.25 mm) | 100 | - |
| 3/8 inch (4.75 mm) | 100 | 100 |
| #4 (4.75 mm) | 98 | 95-100 |
| #8 (2.36 mm) | 93 | 80-100 |
| #16 (1.19 mm) | 78 | 50-85 |
| #30 (0.59 mm) | 35 | 25-60 |
| #50 (2.36 mm) | 11 | 5-30 |
| #100 (1.49 mm) | 3 | 0-10 |
| #200 (0.74 mm) | 0.1 | 0-3 |
| Fineness Modulus | 2.82 | 2.3-3.1 |

Table 7 – Admixture Information

| | |
|--|------------|
| Admixture Product Name | Nano Jelly |
| Admixture Supplier / Manufacturer | NanoCrete |
| Lot Identification | 24-031010 |
| Lot Size (Gal) | 5 |
| Sample Size (mL) | 300 |
| Relative Density (g/mL) | 1.182 |
| Residue by Oven Drying (%) | 27.1 |

Appendices

Appendix A – Individual Batches with Fresh and Hardened Properties

Appendix B – ASTM C 157 (Modified) Data, Length Change of Hardened Hydraulic-Cement Concrete

Appendix C – ASTM C494 – FT-IR Scan

Appendix A – Individual Batches with Fresh and Hardened Properties

A.1 – Constituents and Fresh Properties

| | Materials / Action Item | REF | | | NNC | | |
|-------------------------|---|----------|----------|----------|----------|----------|----------|
| | | REF - 1 | REF - 2 | REF - 3 | NNC - 1 | NNC - 2 | NNC - 3 |
| Constituents | Batch Date, mm/dd/yy | 06/11/24 | 06/11/24 | 06/11/24 | 06/13/24 | 06/13/24 | 06/13/24 |
| | Time, hh:mm | 9:39 AM | 10:30 AM | 11:17 AM | 9:30 AM | 10:20 AM | 11:15 AM |
| | Portland Cement, pcy | 517 | 517 | 517 | 517 | 517 | 517 |
| | Batch Water, pcy | 269 | 269 | 269 | 269 | 269 | 269 |
| | Coarse Aggregate, pcy | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 |
| | Fine Aggregate, pcy | 1250 | 1250 | 1250 | 1250 | 1250 | 1250 |
| | SIKA 686 HRWR, fl oz per cwt | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| | NNC, fl oz per cwt | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| | w/c ratio | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 |
| | Fine Agg / Coarse Agg ratio | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 |
| Fresh Properties | Slump, inches (C 143) | 3.50 | 3.50 | 3.50 | 4.00 | 4.00 | 4.00 |
| | Air Content, % (C 173) | 2.7 | 2.6 | 2.6 | 2.7 | 2.5 | 2.6 |
| | Unit Weight, pcf (C 138) | 144.3 | 144.3 | 144.3 | 142.2 | 142.2 | 142.2 |
| | Concrete Temperature, F (C 1064) | 74.0 | 74.0 | 74.0 | 75.0 | 75.0 | 75.0 |

A.2 – Compressive Strengths, Reference

| Age (days) | Sample ID | Ave Diameter (in) | Area (in ²) | Max Pound Force (lb-f) | Comp. Strength (psi) | Ave Comp Strength (psi) | FRACT Type |
|------------|-----------|-------------------|-------------------------|------------------------|----------------------|-------------------------|------------|
| 1 | REF - 1 | 3.03 | 7.19 | 11610 | 1615 | 1680 | 3 |
| | REF - 2 | 3.03 | 7.19 | 10830 | 1507 | | 5 |
| | REF - 3 | 3.02 | 7.14 | 13690 | 1918 | | 5 |
| 3 | REF - 1 | 3.02 | 7.16 | 22270 | 3109 | 3106 | 5 |
| | REF - 2 | 3.02 | 7.16 | 21330 | 2978 | | 5 |
| | REF - 3 | 3.03 | 7.19 | 23220 | 3231 | | 5 |
| 7 | REF - 1 | 3.01 | 7.12 | 30480 | 4283 | 4260 | 5 |
| | REF - 2 | 3.02 | 7.16 | 30160 | 4210 | | 5 |
| | REF - 3 | 3.02 | 7.16 | 30710 | 4287 | | 5 |
| 28 | REF - 1 | 3.02 | 7.14 | 36470 | 5108 | 5210 | 5 |
| | REF - 2 | 3.02 | 7.14 | 37820 | 5297 | | 5 |
| | REF - 3 | 3.02 | 7.14 | 37300 | 5224 | | 5 |

***No defects were found in any of the specimens and caps**

A.3 – Compressive Strengths, Nano Jelly

| Age (days) | Sample ID | Ave Diameter (in) | Area (in ²) | Max Pound Force (lb-f) | Comp. Strength (psi) | Ave Comp Strength (psi) | FRACT Type |
|------------|-----------|-------------------|-------------------------|------------------------|----------------------|-------------------------|------------|
| 1 | NNC - 1 | 3.03 | 7.19 | 11950 | 1663 | 1757 | 5 |
| | NNC - 2 | 3.03 | 7.19 | 13280 | 1848 | | 5 |
| | NNC - 3 | 3.02 | 7.16 | 12620 | 1762 | | 5 |
| 3 | NNC - 1 | 3.02 | 7.16 | 23520 | 3283 | 3282 | 2 |
| | NNC - 2 | 3.02 | 7.14 | 23280 | 3261 | | 5 |
| | NNC - 3 | 3.02 | 7.14 | 23580 | 3303 | | 5 |
| 7 | NNC - 1 | 3.01 | 7.09 | 34120 | 4811 | 4767 | 5 |
| | NNC - 2 | 3.02 | 7.14 | 34640 | 4852 | | 5 |
| | NNC - 3 | 3.01 | 7.09 | 32890 | 4638 | | 5 |
| 28 | NNC - 1 | 3.01 | 7.09 | 37560 | 5296 | 5502 | 5 |
| | NNC - 2 | 3.01 | 7.09 | 39640 | 5589 | | 5 |
| | NNC - 3 | 3.01 | 7.09 | 39860 | 5620 | | 5 |

***No defects were found in any of the specimens and caps**

A.4 – Flexural Strength, Reference

| Age (days) | Sample ID | Ave. Width (in) | Ave. Depth (in) | Ave. Length (in) | Fail. Zone Check | Max Pound-Force (lb-f) | Modulus of Rupture (psi) | Ave. MOR (psi)* |
|------------|-----------|-----------------|-----------------|------------------|------------------|------------------------|--------------------------|-----------------|
| 3 | REF, 1 | 4.02 | 4.08 | 17.9 | Middle | 2350 | 628 | 626 |
| | REF, 2 | 4.03 | 4.04 | 17.9 | Middle | 2300 | 625 | |
| | REF, 3 | 4.03 | 4.04 | 17.9 | Middle | 2300 | 625 | |
| 7 | REF, 1 | 4.03 | 4.06 | 17.9 | Middle | 2700 | 728 | 739 |
| | REF, 2 | 4.03 | 4.06 | 17.9 | Middle | 2800 | 755 | |
| | REF, 3 | 4.03 | 4.04 | 17.9 | Middle | 2700 | 735 | |
| 28 | REF, 1 | 4.02 | 4.07 | 17.9 | Middle | 3200 | 861 | 886 |
| | REF, 2 | 4.02 | 4.06 | 17.9 | Middle | 3390 | 917 | |
| | REF, 3 | 4.03 | 4.05 | 17.9 | Middle | 3250 | 881 | |

* Flexural strength reported as Modulus of Rupture per ASTM C78

A.5 – Flexural Strength, Nano Jelly

| Age (days) | Sample ID | Ave. Width (in) | Ave. Depth (in) | Ave. Length (in) | Fail. Zone Check | Max Pound-Force (lb-f) | Modulus of Rupture (psi) | Ave. MOR (psi)* |
|------------|-----------|-----------------|-----------------|------------------|------------------|------------------------|--------------------------|-----------------|
| 3 | NNC, 1 | 4.06 | 4.06 | 17.9 | Middle | 2700 | 734 | 746 |
| | NNC, 2 | 3.98 | 3.98 | 17.9 | Middle | 2800 | 756 | |
| | NNC, 3 | 3.97 | 3.97 | 17.9 | Middle | 2750 | 748 | |
| 7 | NNC, 1 | 4.01 | 4.01 | 17.9 | Middle | 3100 | 847 | 861 |
| | NNC, 2 | 3.99 | 3.99 | 17.9 | Middle | 3200 | 887 | |
| | NNC, 3 | 4.01 | 4.01 | 17.9 | Middle | 3150 | 849 | |
| 28 | NNC, 1 | 4.00 | 4.00 | 17.9 | Middle | 3500 | 965 | 975 |
| | NNC, 2 | 4.01 | 4.01 | 17.9 | Middle | 3600 | 985 | |
| | NNC, 3 | 4.00 | 4.00 | 17.9 | Middle | 3550 | 976 | |

* Flexural strength reported as Modulus of Rupture per ASTM C78

Appendix B – ASTM C 157 (Modified) Data, Length Change of Hardened Hydraulic-Cement Concrete

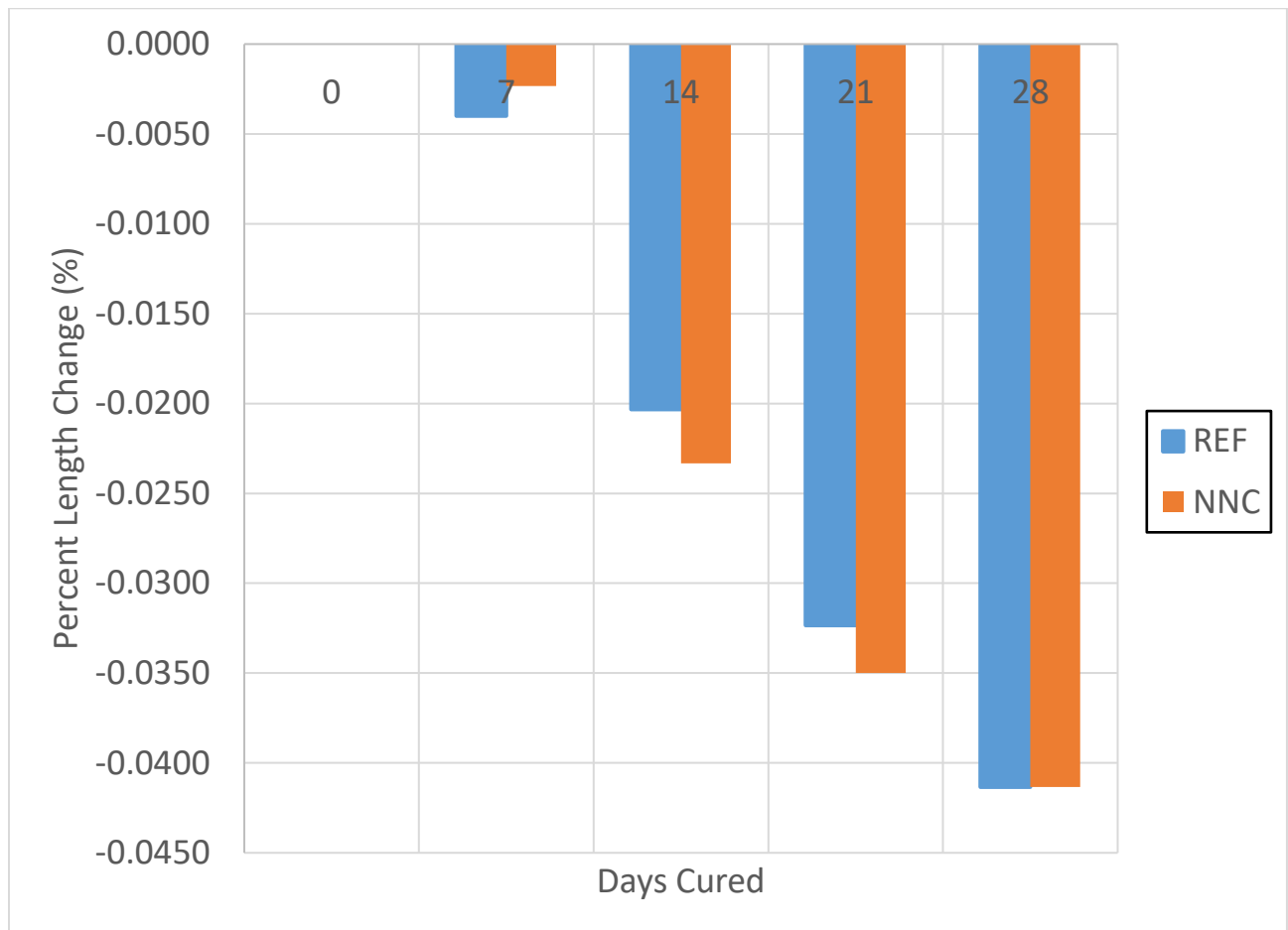
B.1 – Length Change, Reference

| Time (Days) | Average REF (% Change) | REF - 1 (% Change) | REF - 2 (% Change) | REF - 3 (% Change) |
|--------------------|-------------------------------|---------------------------|---------------------------|---------------------------|
| 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 7 | -0.0040 | -0.0050 | -0.0020 | -0.0050 |
| 14 | -0.0203 | -0.0220 | -0.0200 | -0.0190 |
| 21 | -0.0323 | -0.0330 | -0.0320 | -0.0320 |
| 28 | -0.0413 | -0.0430 | -0.0410 | -0.0400 |

B.2 – Length Change, Nano Jelly

| Time (Days) | Average NNC (% Change) | NNC - 1 (% Change) | NNC - 2 (% Change) | NNC - 3 (% Change) |
|--------------------|-------------------------------|---------------------------|---------------------------|---------------------------|
| 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 7 | -0.0023 | -0.0030 | -0.0030 | -0.0010 |
| 14 | -0.0233 | -0.0240 | -0.0240 | -0.0220 |
| 21 | -0.0350 | -0.0360 | -0.0360 | -0.0330 |
| 28 | -0.0413 | -0.0460 | -0.0430 | -0.0350 |

B.3 – Length Change, Comparative Chart



Appendix C – ASTM C494 – FT-IR Scan

