Information To Build On
Engineering • Consulting • Testing

February 9, 2016

Penetron USA, Inc.
45 Research Way, Suite 203
East Setauket, NY 11733
Attn: Mr. Chris Chen

RE: PSI Report No. 08122128-2
6 Months Report for Penetron Admix SB, Compliance Verification Testing Type S Admixture ASTM C-494 Standard Specification for Chemical Admixtures for Concrete.
PSI Project No. 08122128

Dear Mr. Chen:

Professional Service Industries, Inc. (PSI) is pleased to present this report of our compliance verification testing of Penetron Admixture SB, an ASTM C 494-13 Type S (Specific Performance) admixture. All sample preparation and testing was performed in accordance with applicable sections of ASTM C 494 and documents referenced therein. Material and procedures outlined in ASTM C 494 -13 were used. Based on our results, Penetron Admixture SB at 1 year complies with the requirements in Table 1 of ASTM C 494. These test results pertain only to the sample tested.

The compliance verification was performed in PSI's laboratory in Pittsburgh, PA. Concrete batching was performed on February 2, 2015. Three control mixtures and three test mixtures containing Penetron Admixture SB, both meeting the requirements of ASTM C 494 for fresh concrete properties, were produced each day. Two 40lb pails of Penetron Admixture SB was manufactured and supplied to PSI by Penetron USA, Inc.

Mixture proportions and results of our testing are presented in Tables 1 through 3. Information and test data for fine and coarse aggregates are presented in Tables 4 through 6. Table 7 contains information supplied by the producers of the Penetron Admixture SB. Product information and test data on the Type I cement is included in Table 8. Test results for each of the six batches prepared for this report are included in Tables 9 through 12. A sample of Penetron Admixture SB was taken and delivered to KTA Tator for infrared analysis. Test results were provided under separate cover.

If you have any additional questions or require additional assistance concerning this the information provided herein and attached, please feel free to contact us.

Very truly yours,
PROFESSIONAL SERVICE INDUSTRIES, INC.

Luke Lance
Department Manager
Construction Services

Stephen M. Simonette, P.E., AWS CWI
District Manager/CS Principal Consultant

Enclosures

Table 1. Admixture performance and ASTM C 494 requirements for a Type S admixture:

	Penetron Admix SB	Specification Requirements
Water content (percent of control)		NA
Time of setting, deviation of control		
Initial (hr:min)	0: 38min	-1:00 to +1:30
Final (hr:min)	0: 23min	-1:00 to +1:30
Compressive strength (percent of control)		
3 days	107%	90 % (min)
7 days	111%	90 % (min)
28 days	107%	90 % (min)
90 days	108%	NA
6 months	107%	90 % (min)
1 year	110%	90 % (min)
Flexural strength (percent of control)		
3 days	123%	90 % (min)
7 days	106%	90 % (min)
28 days	115%	90 % (min)
Length change (increase over control)	0.001	0.010 (max)
Relative durability factor	98.9%	80 % (min)

Table 2. Mixture proportions, fresh concrete properties, and ASTM C 494 requirements for a Type S admixture

Average of Three Separate Tests	Control Mixture	Penetron Admix SB	Specification Requirements
Cement factor (lb/yd3)	517	517	517 ± 5
Water (lb/yd3)	166	164	
Water-cement ratio	0.320	0.316	
Coarse aggregate	1734	1734	
Fine aggregate	1430	1430	
Fine aggregate-total aggregate ratio	0.45	0.45	
Slump (in.)	3.50	3.25	3 ½ ± ½
Air content (%)	5.9	5.8	5-7 (± 0.5 of control)
Time of setting (hr.min)	7:26	7:34	
Initial (hr:min)	5:46	6:01	

Table 3. Properties of hardened concrete

	Control Mixture	Penetron Admix SB
Compressive strength (psi)		
3 days	3580	3810
7 days	4330	4790
28 days	5660	6070
90 days	6220	6700
6 months	7012	7498
1 year	7442	8181
Flexural strength (psi)		
3 days	530	650
7 days	640	670
28 days	680	780
Length change (%)	0.030%	0.031%
Percent of Control Increase (135 minimum)	104%	
Durability factor (%)	99.6	98.1
Durability factor (%)	98.5%	

Table 4. Properties of fine and coarse aggregate

	Fine aggregate	Coarse aggregate
Manufacturer	Shelly Sand	Gavco
Aggregate type	Sand	No. 57 Stone
Specific gravitySSD	2.63	2.69

Table 5. Gradation of fine aggregate

Percent passing		
Sieve	Fine aggregate	Specifications Requirements
No. 4 (4.75 mm)	98	95 to 100
No. 16 (2.36 mm)	71	65 to 75
No. 50 (300 µ m)	22	12 to 20
No. 100 (150 µ m)	6	2 to 5

Table 6. Gradation of coarse aggregate

Percent passing		
Sieve	Coarse aggregate	Specifications Requirements
1.5 in. (37.5 mm)	100	100
1.0 in. (25.4 mm)	96	95 to 100
0.5 in. (12.5 mm)	32	25 to 60
No. 4 (4.75 mm)	2	0 to 10
No. 8 (2.36 mm)	1	0 to 5

Table 7. Admixture information

	Type S, Specific Performance
Brand name	Penetron Admix SB
Manufacturer	Penetron
Lot ID	20141201222
Lot Size	4000 lbs
Solids Content %	100%
Specific Gravity	2.730

Table 8. Cement information and test data

ASTM C 150 Type I cement			
Brand name		Cemex Portland Type I	
Manufacturer		Cemex Cement Company	
Standard Chemical Requirements (ASTM C 114) %			
Silicon dioxide (SiO2)	19.0	Aluminum oxide (Al2O3)	4.60
Iron oxide (Fe2O3)	3.1	Calcium oxide (CaO)	62.2
Sulfur trioxide (SO3)	3.1	Loss on ignition (950ºC)	2.40
Magnesium oxide (MgO)	4.5	Insoluble residue	0.35
Alkalies as Na2O	0.78		
Calculated potential compounds as per ASTM C 150-05 (%)			
Tricalcium silicate (C3S)	58.8	Tricalcium aluminate (C3A)	6.9
Dicalcium silicate (C2S)	9.8	Tetracalcium aluminoferrite (C4AF)	9.0
Physical Testing and Results			
Fineness Specific Surface (Blaine)	407 m2/Kg	Air Content (%)	6.8
Setting Times (Vicat) Initial	93 minutes	Autoclave Expansion (%)	0.21
Final	184 minutes		
Compressive 3 Day Strength (psi)	4365	Compressive 7 Day Strength (psi)	5142

Table 9. Mixture proportions, fresh concrete properties and time of set for 3 control batches.

	Control 1	Control 2	Control 3	Average
Cement factor (lb/yd3)	517	517	517	517
Water (lb/yd3)	170.2	163.5	163.5	165.7
Water-cement ratio	0.329	0.316	0.316	0.320
Coarse aggregate (lb/yd3)	1734	1734	1734	1734
Fine aggregate (lb/yd3)	1430	1430	1430	1430
Fine aggregate total aggregate ratio	0.45	0.45	0.45	0.45
Slump (in.)	3.25	3.75	3.25	3.50
Air content (%)	6.2	5.7	5.8	5.9
Density (lb/ft3)	144.0	143.5	144.2	143.9
Time of setting				
Initial (hr:min)	6:32	5:15	5:32	5:46
Final (hr:min)	7:49	6:59	7:29	7:26

Table 10. Properties of hardened concrete from three control test batches

	Control 1 C	Control 2 C	Control 3 C	Average
Compressive strength (psi)				
3 days	3420	3540	3660	3540
	3580	3660	3580	3610
	3340	3740	3660	3580
Average	**3450**	**3650**	**3630**	**3577**
7 days	4140	4540	4620	4430
	3900	4380	4380	4220
	4140	4300	4540	4330
Average	**4060**	**4410**	**4510**	**4320**
28 days	5760	5670	5910	5780
	5160	5680	5890	5577
	5330	5850	5750	5643
Average	**5420**	**5730**	**5850**	**5670**
90 days	5970	6260	6740	6323
	5790	6320	6200	6103
	5950	6310	6450	6237
Average	**5900**	**6300**	**6460**	**6220**
6 months	6730	7130	7150	7003
	6580	6620	6910	6703
	6740	7690	7560	7330
Average	**6683**	**7147**	**7207**	**7012**
1 year	7040	7650	7950	7547
	6830	7430	8060	7440
	7120	7300	7600	7340
Average	**6997**	**7460**	**7870**	**7442**
Flexural strength (psi)				
3 days	500	515	565	**527**
7 days	650	660	595	**635**
28 days	630	685	720	**678**
Length change (%)	0.026%	0.031%	0.033%	0.030%
Durability Factor (%)	100.0%	99.0%	98.5%	99.2%

Table 10 B. Properties of hardened concrete from three control test batches

Approximate Total Cycles Completed	Fundamental Transverse						Relative Dynamic Modulus,					
	Control 1	Control 2	Control 3	Control 4	Control 5	Control 6	Control 1	Control 2	Control 3	Control 4	Control 5	Control 6
0 cycles	1807	1772	1787	1768	1812	1826						
16 cycles	1763	1753	1748	1758	1782	1792	95.2	97.9	95.7	98.9	96.7	96.3
35 cycles	1770	1761	1753	1760	1790	1798	95.9	98.7	96.2	99.1	97.6	97.0
45 cycles	1769	1760	1750	1758	1785	1795	95.8	98.7	95.9	98.9	97.0	96.6
67 cycles	1802	1753	1755	1763	1800	1812	99.4	97.9	96.5	99.4	98.7	98.5
94 cycles	1777	1753	1768	1758	1787	1816	96.7	97.9	97.9	98.9	97.3	98.9
128 cycles	1782	1763	1772	1768	1792	1821	97.3	99.0	98.3	100.0	97.8	99.5
160 cycles	1792	1768	1772	1777	1797	1826	98.3	99.5	98.3	101.0	98.4	100.0
195 cycles	1797	1772	1777	1777	1802	1831	98.9	100.0	98.9	101.0	98.9	100.5
218 cycles	1797	1772	1782	1782	1807	1836	98.9	100.0	99.4	101.6	99.4	101.1
247 cycles	1802	1772	1777	1777	1807	1836	99.4	100.0	98.9	101.0	99.4	101.1
281 cycles	1802	1777	1777	1787	1802	1836	99.4	100.6	98.9	102.2	98.9	101.1
313 cycles	1802	1772	1772	1777	1807	1836	99.4	100.0	98.3	101.0	99.4	101.1

Table 11. Mixture proportions, fresh concrete properties, and time of set for three test batches containing Penetron admix SB

	Penetron SB Test 1	Penetron SB Test 2	Penetron SB Test 3	Average
Cement factor (lb/yd3)	517	517	517	517
Water (lb/yd3)	164	164	164	164
Water-cement ratio	0.317	0.316	0.316	0.316
Coarse aggregate (lb/yd3)	1734	1734	1734	1734
Fine aggregate (lb/yd3)	1430	1430	1430	1430
Fine aggregate-total aggregate ratio	0.45	0.45	0.45	0.45
Slump (in.)	3.25	3.25	3.25	3.25
Air content (%)	6.0	5.8	5.6	5.80
Density (lb/ft3)	144.8	144.6	146.0	145.1
Time of setting				
Initial (hr:min)	5:56	6:09	5:58	6:01
Final (hr:min)	7:26	7:40	7:34	7:34

Table 12. Properties of hardened concrete from three batches containing Penetron admix SB

	Penetron SB Test 1 P	Penetron SB Test 2 P	Penetron SB Test 3 P	Average
Compressive strength (psi)				
3 days	3900	3500	3660	3690
	3980	3900	3660	3850
	4140	3660	3900	3900
Average	**4010**	**3690**	**3740**	**3810**
7 days	4380	4850	4700	4640
	4850	4930	4700	4830
	4930	4970	4810	4790
Average	**4720**	**4920**	**4740**	**4790**
28 days	5750	6310	5770	5940
	6060	6510	6290	6290
	5840	6050	6070	5990
Average	**5880**	**6290**	**6040**	**6070**
90 days	6420	6860	6920	6730
	6060	6640	6680	6460
	6640	6800	7250	6890
Average	**6370**	**6770**	**6950**	**6700**
6 months	7230	7380	7240	7283
	7480	7720	7800	7667
	7360	7500	7770	7543
Average	**7357**	**7533**	**7603**	**7498**
1 year	7820	8440	8250	8170
	8200	8500	7810	8170
	8090	8140	8380	8203
Average	**8037**	**8360**	**8147**	**8181**
Flexural strength (psi)				
3 days	620	700	640	**650**
7 days	735	650	625	**670**
28 days	795	780	765	**780**
Length change (%)	0.031%	0.031%	0.031%	0.031%
Durability Factor (%)	100.0%	99.0%	97.5%	98.8%

Table 12. B. Properties of hardened concrete from three batches containing Penetron admix SB

Approximate Total Cycles Completed	Fundamental Transverse						Relative Dynamic Modulus					
	Penetron SB Admix 1	Penetron SB Admix 2	Penetron SB Admix 3	Penetron SB Admix 4	Penetron SB Admix 5	Penetron SB Admix 6	Penetron SB Admix 1	Penetron SB Admix 2	Penetron SB Admix 3	Penetron SB Admix 4	Penetron SB Admix 5	Penetron SB Admix 6
0 cycles	1821	1851	1831	1821	1802	1763						
16 cycles	1792	1826	1802	1787	1758	1748	96.8	97.3	96.9	96.3	95.2	98.3
35 cycles	1790	1835	1806	1817	1760	1742	96.6	98.3	97.3	99.6	95.4	97.6
45 cycles	1790	1834	1802	1815	1748	1738	96.6	98.2	96.9	99.3	94.1	97.2
67 cycles	1802	1782	1807	1802	1758	1750	97.9	92.7	97.4	97.9	95.2	98.5
94 cycles	1812	1836	1807	1802	1763	1748	99.0	98.4	97.4	97.9	95.7	98.3
128 cycles	1816	1846	1812	1807	1768	1753	99.5	99.5	97.9	98.5	96.3	98.9
160 cycles	1821	1846	1816	1812	1768	1763	100.0	99.5	98.4	99.0	96.3	100.0
195 cycles	1821	1851	1821	1812	1772	1763	100.0	100.0	98.9	99.0	96.7	100.0
218 cycles	1821	1855	1821	1816	1777	1763	100.0	100.4	98.9	99.5	97.2	100.0
247 cycles	1826	1855	1821	1816	1777	1758	100.5	100.4	98.9	99.5	97.2	99.4
281 cycles	1831	1851	1831	1821	1777	1763	101.1	100.0	100.0	100.0	97.2	100.0
313 cycles	1826	1841	1821	1816	1777	1763	100.5	98.9	98.9	99.5	97.2	100.0