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December 13, 2016

Ms. Katheryn Malusky
NTPEP
444 N Capitol Street NW
Suite 249
Washington DC, 20001

CADD-2015-01-063

Final Compliance Report: Fritz-Pak Corporation, Slick-Pak II, Type S

ASTM C494/C494M – 13, “Standard Specification for Chemical Admixtures for Concrete”
AASHTO M194/M194 – 12, “Standard Specification for Chemical Admixtures for Concrete”
AET Project No. 29-01968

Dear Ms. Malusky:

American Engineering Testing, Inc. (AET) is pleased to present this report of our compliance verification testing of Fritz-Pak Corp. Slick-Pak II Concrete Pumping Aid. The attached report presents the final test results of the referenced admixture. Three 8-oz. bags of the admixture were received on September 28, 2015 and the NTPEP notification to proceed was received on September 23, 2015.

All sample preparation and testing was performed in accordance with the applicable sections of AASHTO M194M/M194M, ASTM C494/C494M – 13, “Standard Specification for Chemical Admixtures for Concrete” and all referenced documents. Based on our results through one year, Slick-Pak II, Type S complies with the requirements in AASHTO M194/M194 and Table 1 of ASTM C494 for a Type S, specific performance admixture.

Concrete batching and test specimen fabrication was conducted on three consecutive days. One control mixture and one test mixture containing Slick-Pak II, both meeting the requirements of AASHTO M194 and ASTM C494 for fresh concrete properties, were produced each day. A commercially available vinsol resin air-entraining admixture was used for the concrete mixtures. Holcim Type I/II portland cement from the St. Genevieve plant was used for all concrete mixtures.

Product information and cement chemical and physical properties are presented in Table 1 and 2. Aggregate properties and gradations are presented in Tables 3 and 4. Mixture proportions and results of testing are given in Tables 5 and 6.

If there are any questions with regard to this report, please contact me.

Sincerely,
American Engineering Testing, Inc.

A handwritten signature in black ink that reads 'Willy Morrison'.

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Table 1 Admixture Information

	Reference Admixture	Test Admixture
Manufacturer	General Resource Technology	Fritz-Pak Corporation
Brand Name	Vinsol Resin	Slick-Pak II
NTPEP CADD Number	--	CADD-2015-01-063
Lot Number	E093014	01150706
Quantity Supplied	1 Quart	Three 8-oz. Bags
Total Solids, %	15.01	97.62
Specific Gravity	1.044	Not Required for Powder Admixtures
pH	10.7	11.4
Chloride, %	0.009	0.097

Table 2 Portland Cement Analysis – Chemical and Physical

ASTM C150 Type I/II Cement			
Brand Name	St. Genevieve		
Manufacturer	Holcim (US) Inc.		
Chemical Analysis, %			
Silicon dioxide (SiO ₂)	19.8	Tricalcium silicate (C ₃ S) (%)	61
Aluminum oxide (Al ₂ O ₃)	4.5	Dicalcium silicate (C ₂ S) (%)	8
Iron oxide (Fe ₂ O ₃)	3.2	Tricalcium aluminate (C ₃ A) (%)	6
Magnesium oxide (MgO)	2.7	Tetracalcium alumino ferrite (C ₄ AF) (%)	9
Sulfur trioxide (SO ₃)	3.4	C ₃ S + 4.75C ₃ A (%)	90.7
Calcium oxide (CaO)	64.2		
Insoluble Residue (%)	0.47	Loss on Ignition (%)	2.6
Alkalies as Na ₂ O (%)	0.54		
Physical Analysis			
Fineness, Blaine (m ² /kg)	379	Air Content (%)	7
Vicat Time of Set (Initial), minutes	90	Autoclave Expansion (%)	0.04
Compressive Strength			
3 Day (psi)	4330	7 Day (psi)	5360
Mortar Bar Expansion (%) (C 1038)	0.013		

Table 3 - Properties of Fine and Coarse Aggregates

	Fine Aggregate	Coarse Aggregate
Manufacturer	Aggregate Industries	Aggregate Industries
Aggregate type, ID	Natural Sand, Elk River	River Gravel, Lakeville #57
Specific gravity, SSD	2.675	2.740
Absorption %	0.6	1.1

Table 4 – Gradations of Fine and Coarse Aggregates

ASTM C136, Gradation of fine aggregate

Percent passing		
	Fine Aggregate	ASTM C494/AASHTO M194 Requirements
No. 4 [4.75 mm]	100	100
No. 16 [1.18 mm]	72	65 to 75
No. 50 [300 µm]	13	12 to 20
No. 100 [150 µm]	2	2 to 5

ASTM C136, Gradation of coarse aggregate

Percent passing		
	Coarse Aggregate	ASTM C494 Requirements
1.5 in. [37.5 mm]	100	100
1.0 in. [25.0 mm]	100	95 to 100
0.5 in. [12.5 mm]	58	25 to 60
No. 4 [4.75 mm]	9	0 to 10
No. 8 [2.36 mm]	1	0 to 5

TABLE 5 Laboratory Data	Concrete Mixtures and Testing Results									Slick-Pak II added at a rate of 0.1 oz/cwt
	Slick-Pak II									
	Batch No. Cast Date	Vinsol Resin				Slick-Pak II				
	Control #1 10/12/2015	Control #2 10/13/2015	Control #3 10/14/2015	AVER. (Test Value)	Test #1 10/12/2015	Test #2 10/13/2015	Test #3 10/14/2015	AVER. (Test Value)		
Cement, pcy	513	519	516	516	517	519	516	517	517 ± 5	
Sand, pcy	1,289	1,303	1,296	1,296	1,300	1,303	1,296	1,300		
Gravel, pcy	1,774	1,794	1,784	1,784	1,789	1,794	1,784	1,789		
Water, pcy	280	283	281	281	282	283	281	282		
Water Content (Percent of Control)	---	---	---	---	101	100	100	100		
AEAName	Vinsol Resin				Vinsol Resin					
AEA Dosage, oz/cwt	0.5	0.5	0.5	0.5	0.8	0.8	0.8	0.8		
Admixture Name	---				Slick-Pak II					
Admixture Dosage, oz/cwt	---	---	---	---	0.1	0.1	0.1	0.1		
WATER CEMENT RATIO	0.55	0.55	0.54	0.55	0.55	0.55	0.54	0.55		
Slump, inches	4.00	4.00	3.50	3.75	3.50	3.75	4.00	3.75	3.5 ± 0.5	
Air Content, %	6.0	6.2	6.0	6.1	5.7	6.5	6.4	6.2	± 0.5	
Density, pcf	142.8	144.4	143.6	143.6	144.0	144.4	143.6	144.0		
SETTING TIME										
Initial, hr:mn	4:01	4:18	4:00	4:06	4:07	4:14	3:58	4:06		
Final, hr:mn	5:36	5:58	5:36	5:43	5:49	5:55	5:23	5:42		
TIME of SETTING (deviation from reference)										
Initial, hr:mn	---	---	---	---	0:06	-0:04	-0:02	0:00	Not more than 1:00 earlier nor 1:30 later	
Final, hr:mn	---	---	---	---	0:13	-0:03	-0:13	-0:01	Not more than 1:00 earlier nor 1:30 later	
COMPRESSIVE STRENGTH										
3 Days, psi	3,120	3,260	3,540	3,310	3,740	3,100	3,050	3,300		
7 Days, psi	4,070	4,440	4,360	4,290	4,650	4,430	3,580	4,220		
28 Days, psi	5,220	5,620	5,540	5,460	5,450	5,450	5,330	5,410		
90 Days, psi	5,790	6,180	5,860	5,940	6,130	6,400	5,520	6,020		
6 Months, psi	6,000	6,210	6,520	6,240	6,500	6,430	5,610	6,180		
1 Year, psi	6,290	6,740	6,630	6,550	6,720	7,330	6,420	6,820		
3 Days, % reference	---	---	---	---	120	95	86	100	≥90%	
7 Days, % reference	---	---	---	---	114	100	82	98	≥90%	
28 Days, % reference	---	---	---	---	104	97	96	99	≥90%	
90 Days, % reference	---	---	---	---	106	104	94	101	N/A	
6 Months, % reference	---	---	---	---	108	104	86	99	≥90%	
1 Year, % reference	---	---	---	---	107	109	97	104	≥90%	
FLEXURAL STRENGTH										
3 Days, psi	590	615	545	585	605	570	515	565		
7 Days, psi	680	650	735	690	685	605	715	670		
28 Days, psi	850	850	760	820	825	885	730	815		
3 Days, % reference	---	---	---	---	103	93	94	97	≥90%	
7 Days, % reference	---	---	---	---	101	93	97	97	≥90%	
28 Days, % reference	---	---	---	---	97	104	96	99	≥90%	
LENGTH CHANGE, %										
Increase over control	-0.019	-0.013	0.000	-0.011	-0.011	-0.014	-0.018	-0.014		
	---	---	---	---	-0.008	0.001	0.018	0.003	≤0.010^A	
RESISTANCE TO FREEZING AND THAWING										
Relative Dynamic Modulus, %										
	0	cycles	100/100	100/100	100/100	100	100/100	100/100	100/100	100
	36	cycles	96/94	99/98	99/99	98	99/99	98/98	98/99	99
	72	cycles	98/94	100/99	98/98	98	99/99	97/98	99/98	98
	108	cycles	95/94	99/98	99/96	97	99/99	98/98	99/99	99
	144	cycles	95/93	99/98	99/96	97	98/99	97/98	98/98	98
	180	cycles	94/93	100/99	99/95	97	99/100	97/98	98/98	98
	216	cycles	95/93	100/99	99/95	97	98/99	97/98	99/99	98
	252	cycles	93/90	99/99	99/95	96	98/99	95/98	99/99	98
	288	cycles	89/95	98/98	97/94	95	98/99	95/98	98/99	98
	324	cycles	89/95	99/98	95/91	95	98/99	90/96	99/99	97
RELATIVE DURABILITY FACTOR									102	min 80

A. Increased shrinkage over control.

TABLE 6
TESTS OF CHEMICAL ADMIXTURES FOR CONCRETE
SLICK-PAK II
ASTM SPECIFICATION C494 / AASHTO M194
TYPE S, SPECIFIC PERFORMANCE

MIXTURE DESIGNATION	<u>CONTROL</u>	<u>SLICK-PAK II</u>	<u>CHANGE vs. CONTROL</u>	<u>SPECIFICATION REQUIREMENT</u>
MIXTURE PROPORTIONS				
CEMENT, pcy	516	517	1	517 ± 5
SAND, pcy	1,296	1,300		
GRAVEL, pcy	1,784	1,789		
NET WATER, pcy	281	282		
AEA (Vinsol Resin), oz/cwt	0.5	0.8		
ADMIXTURE DOSAGE, oz/cwt	---	0.1		
RATIO OF FINE TO TOTAL AGG., %				
WATER/CEMENT RATIO, lb./lb.	42	42		
	0.55	0.55		
SLUMP, inches				
	3.75	3.75	0.00	3.5 ± 0.5
ENTRAINED AIR, %				
	6.1	6.2	0.1	± 0.5
UNIT WEIGHT, pcf				
	143.6	144.0		
SET TIME, hr:min				
INITIAL	4:06	4:06	0:00	Not more than 1:00 earlier nor 1:30 later
FINAL	5:43	5:42	-0:01	Not more than 1:00 earlier nor 1:30 later
COMPRESSIVE STRENGTH, psi				
3 DAYS	3,310	3,300	100%	≥90%
7 DAYS	4,290	4,220	98%	≥90%
28 DAYS	5,460	5,410	99%	≥90%
90 DAYS	5,940	6,020	101%	N/A
180 DAYS	6,240	6,180	99%	≥90%
365 DAYS	6,550	6,820	104%	≥90%
FLEXURAL STRENGTH, psi				
3 DAYS	585	565	97%	≥90%
7 DAYS	690	670	97%	≥90%
28 DAYS	820	815	99%	≥90%
LENGTH CHANGE				
Increase over control	-0.011	-0.014	0.003	≤0.010^A
RELATIVE DURABILITY FACTOR, %				
			102	≥80%

A. Increased shrinkage over control.