

DATE: July 7, 2009Material Testing • Non-Destructive Testing
Product Evaluation • Construction Materials**TO:** Mr. Charles Green
Kel-Crete Industries, Inc.
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Website : www.storktct.com**PROJECT:** PERFORMANCE EVALUATION
CHEMICAL ADMIXTURES**PROJECT NO.:** 308119.2**PAGE:** 1 of 7**TESTING OF CHEMICAL ADMIXTURES IN CONCRETE****INTRODUCTION:**

This report presents the results of our laboratory testing work conducted on samples of concrete containing Kel-Crete Premium Liquid Admixture (3 oz/yd³ dosage rate). Our work was requested and authorized by Mr. Charles Green of Kel-Crete Industries on February 8 and May 22, 2008, respectively. The scope of our testing work was as follows:

1. Perform laboratory batching of concrete with and without chemical admixture according to ASTM C494 and ASTM C260 for
 - A. Water Content
 - B. Time of Set
 - C. Bleed Water
 - D. Compressive Strength
 - E. Flexural Strength
 - F. Freeze/Thaw Durability (Method A)
 - G. Length Change
2. Prepare a written report stating the results of the areas tested in accordance with ASTM criteria.

SUMMARY OF TEST RESULTS:

The following is a summary of the average test results:

<u>Test</u>	<u>Control</u>	<u>Test - (Admixture)</u>	<u>Relative to the Control</u>
w/c Ratio	0.471	0.471	100.0%
Initial Time of Set	240 min	220 min	20 min earlier
Final Time of Set	355 min	340 min	15 min earlier
Bleed Water	0.97%	0.45%	46.3%
Compressive			
1 Day	1,740 psi	2,010 psi	115.5%
3 Days	3,030 psi	3,180 psi	104.9%
7 Days	4,150 psi	4,240 psi	102.3%
28 Days	6,470 psi	6,680 psi	103.3%
90 Days	7,410 psi	7,460 psi	100.7%
6 Months	8,070 psi	8,320 psi	103.1%
1 Year	8,880 psi	9,180 psi	103.4%
Flexural			
3 Days	395 psi	410 psi	103.4%
7 Days	515 psi	525 psi	102.6%
28 Days	660 psi	650 psi	98.5%
Freeze/Thaw			
Durability Factor	68.7	99.5	144.9%
Length Change	-0.040%	-0.043%	108.3%

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Independent Test Report

The following ASTM C-494 and C-260 tests were conducted with just 2 ounces of Kel-Crete Premium Liquid Admixture per cubic yard instead of 3 ounces as directed. Because the test report results were still positive we chose not to have the test redone. We do however suggest that 3 to 5 ounces be considered per cubic yard for various aggregate and climatic conditions in a project area.

Please also note that one ounce of Kel-Crete Premium Super Dry Admixture by weight is equal to 3 ounces of Kel-Crete liquid admixture. Once again let me say that each project has its own set of variables in application such as flat work, overhead work such as tunnels, etc. It is for these reasons we suggest 8 to 12 ounces per cubic yard of dry gunite application.

We ask that you call our office at 800-845-1833 for technical questions regarding your projects. We may be able to make labor and material cost savings suggestions based upon 51 years of feedback from your industry. Before you make that call though try to have the following information on hand:

1. Climatic conditions: hot, cold, windy, etc.
2. Type of aggregates: round, sharp, etc.
3. Cement: fly ash content per cubic yard, seven sack, eight sack, etc.

ASTM C-494 and ASTM C-260 test reports follow.

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TEST PROCEDURES:

The testing was initiated on June 18, 2008 and subsequent dates, based on our understanding of Section 4.0, the comparative test mixes and procedures of those that are outlined in ASTM:C494 Sections 11-15. Applicable portions of these sections were used and no special manufactures mixing procedure was provided or employed. The mix design was approved by the client and is included in the Concrete Materials section of this report along with the other pertinent information. Additional ASTM procedures were also used in conjunction with the ASTM C494 Criteria. All of the samples were prepared using concrete mixtures fabricated by Stork Twin City Testing Corporation personnel at our facility located in St. Paul, Minnesota.

FIBER DATA:

The client identified, selected and shipped the sample to Stork TCT, from which Stork TCT personnel selected the sample necessary to cast the various test specimens. The sample came in its original packaging which included the product label on it.

Admixture: Kel-Crete Premium Liquid Admixture

Date Submitted: May 29, 2008

Application/mixing: 5 minutes

CONCRETE MATERIALS:

Concrete Trial Mixtures

Mix Number	1	2
Mixture Type	Control	Admixture
Slump, in.	3-4	3-4
Nominal Coarse Aggregate, in.	3/8	3/8
Air Content, %	n/a	n/a
Specified Minimum		
Compressive Strength, psi	5,000	5,000

Batch Weights, per yd³

Mix Design Number	1	2
Mixture Type	Control	Admixture
Portland Cement, lbs	705	705
Fly Ash, lbs	60	60
Admixture:		
Kel-Crete, oz	--	3.0
Fine Aggregate, lbs	1,735	1,735
Total Coarse Aggregate, lbs	898	898
Water, lbs	312	312

Mix design numbers 1 and 2 were used in casting of all samples.

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CONCRETE MATERIALS: (cont.)

Materials – Batches 1 & 2

Cementitious

Holcim Type I Portland Cement (ASTM C 150)

Fly Ash (ASTM C 618/Class F)

Fine Aggregate

Quikrete (All-Purpose Sand meeting the requirements of ASTM C 33 and C 494).

Coarse Aggregate

Nelson Pit (3/8" Gravel meeting the requirements of ASTM C 33 and C 494).

Admixtures

Kel-Crete Premium Admixture

TEST RESULTS:

	CONCRETE TEST DATA					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
Date Batched	6/18/2008	6/19/2008	6/23/2008	6/18/2008	6/19/2008	6/23/2008
Air, %	2.6	2.8	2.9	4.9	6.1	4.5
Slump, in	2 1/4	6	1	1 3/4	4 1/2	1 1/2
Temperature, °F	75	75	75	75	75	75
Unit Weight, lbs/ft³	140.4	141.2	147.2	138.4	136.0	144.0

	WATER CONTENT					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
Net Wt. of Water, lbs	77.0	92.4	100.4	77.0	92.4	100.4
Wt. of Cement, lbs	156.7	208.9	208.9	156.7	208.9	208.9
W/C Ratio	0.491	0.442	0.481	0.491	0.442	0.481

	TIME OF SET					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
Initial Time of Set, min	245	250	220	220	230	205
Final Time of Set, min	365	390	315	350	375	295

	BLEED WATER					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
Net Wt. of Water, g	2,030.7	1,854.8	1,985.0	2,039.5	1,841.5	1,976.9
Bleed Water, g	26.0	24.2	6.8	12.6	9.2	4.6
Bleeding, %	1.28	1.30	0.34	0.62	0.50	0.23

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TEST RESULTS: (cont.)

	COMPRESSIVE STRENGTH					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
1 Day						
Diameter, in	4.00	4.00	3.98	4.00	4.00	3.98
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.44	12.57	12.57	12.44
Days Moist Cured	0	0	0	0	0	0
Type of Fracture	5	6	3	5	5	5
Load at Failure, lbs.	21,380	20,110	24,060	26,190	21,480	27,980
Strength, psi	1700	1600	1930	2080	1710	2250
3 Days						
Diameter, in	4.00	4.00	4.01	4.00	4.00	4.01
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.63	12.57	12.57	12.63
Days Moist Cured	2	2	2	2	2	2
Type of Fracture	4	6	5	4	5	5
Load at Failure, lbs.	35,070	36,990	42,500	39,520	37,510	43,380
Strength, psi	2790	2940	3370	3140	2980	3430
7 Days						
Diameter, in	4.00	4.00	4.00	4.00	4.00	4.00
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.57	12.57	12.57	12.57
Days Moist Cured	6	6	6	6	6	6
Type of Fracture	5	5	5	5	5	5
Load at Failure, lbs.	51,740	49,830	54,850	53,840	51,790	54,350
Strength, psi	4120	3960	4360	4280	4120	4320
28 Days						
Diameter, in	4.00	4.00	4.00	4.00	4.00	4.00
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.57	12.57	12.57	12.57
Days Moist Cured	27	27	27	27	27	27
Type of Fracture	4	5	5	5	5	5
Load at Failure, lbs.	85,680	78,160	80,020	81,850	91,170	79,040
Strength, psi	6820	6220	6370	6510	7250	6290

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TEST RESULTS: (cont.)

	COMPRESSIVE STRENGTH					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
90 Days						
Diameter, in	4.00	4.00	4.00	4.00	4.00	4.00
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.57	12.57	12.57	12.57
Days Moist Cured	89	89	89	89	89	89
Type of Fracture	5	5	3	5	5	5
Load at Failure, lbs.	94,280	94,780	90,370	98,360	92,650	90,360
Strength, psi	7500	7540	7190	7820	7370	7190
6 Months						
Diameter, in	4.00	4.00	4.00	4.00	4.00	4.00
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.57	12.57	12.57	12.57
Days Moist Cured	182	182	182	182	182	182
Type of Fracture	5	2	5	2	2	5
Load at Failure, lbs.	107,930	99,090	97,410	99,110	118,060	96,610
Strength, psi	8590	7880	7750	7880	9390	7690
1 Year						
Diameter, in	4.00	4.00	4.00	4.00	4.00	4.00
Height, in	8.00	8.00	8.00	8.00	8.00	8.00
Area, in ²	12.57	12.57	12.57	12.57	12.57	12.57
Days Moist Cured	365	365	365	365	365	365
Type of Fracture	2	2	1	2	1	5
Load at Failure, lbs.	124,310	103,690	106,810	115,470	125,280	105,370
Strength, psi	9890	8250	8500	9190	9970	8380

*Unbonded caps were used on all samples. Type of fracture numbers correlate with descriptions in ASTM:C39.

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TEST RESULTS: (cont.)

	FLEXURAL STRENGTH					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
3 Days						
Width, in	5.95	6.05	6.10	6.00	6.00	6.15
Depth, in	6.10	6.10	6.00	6.10	6.10	6.10
Span, in	18.00	18.00	18.00	18.00	18.00	18.00
Days Moist Cured	2	2	2	2	2	2
Location of Fracture	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third
Load at Failure, lbs.	4550	5250	4820	4960	4340	6040
Modulus of Rupture, psi	370	420	395	400	350	475
7 Days						
Width, in	6.05	6.00	6.15	6.10	6.05	6.10
Depth, in	5.90	6.00	5.95	6.05	6.05	6.05
Span, in	18.00	18.00	18.00	18.00	18.00	18.00
Days Moist Cured	6	6	6	6	6	6
Location of Fracture	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third
Load at Failure, lbs.	5730	6720	5930	6950	6030	6570
Modulus of Rupture, psi	490	560	490	560	490	530
28 Days						
Width, in	5.95	6.10	6.05	6.15	6.05	6.10
Depth, in	5.80	6.00	6.00	6.00	6.05	6.05
Span, in	18.00	18.00	18.00	18.00	18.00	18.00
Days Moist Cured	27	27	27	27	27	27
Location of Fracture	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third	Middle Third
Load at Failure, lbs.	7450	8420	7500	7870	8370	7810
Modulus of Rupture, psi	670	690	620	640	680	630

*Leather shims were used and equation 2 from ASTM:C78, Section 8.1 was used for the calculations.

	FREEZE/THAW DURABILITY					
	Control Batch			Admixture Batch		
	1A	1B	1C	2A	2B	2C
Wt. Loss, %	1.48	9.28	2.81	1.22	1.98	0.93
Initial Trans. Freq., kHz	2.20	2.14	2.17	2.20	2.03	2.14
Final Trans. Freq., kHz	2.09	1.72	2.04	2.19	2.02	2.14
Durability Factor	90.3	38.1	88.4	99.1	99.0	100.0
	1A	1B	1C	2A	2B	2C
Wt. Loss, %	2.08	5.69	1.98	0.53	1.91	0.71
Initial Trans. Freq., kHz	2.18	2.16	2.20	2.15	2.12	2.24
Final Trans. Freq., kHz	1.89	1.85	1.93	2.15	2.11	2.24
Durability Factor	75.2	43.3	77.0	100.0	99.1	100.0

Both Control samples 1B were discontinued at 177 out of the 300 cycles, due to significant weight loss.

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TEST RESULTS: (cont.)

	LENGTH CHANGE						
	Control Batch				Admixture Batch		
	1A	1B	1C		2A	2B	2C
Initial , %	0.000	0.000	0.000		0.000	0.000	0.000
After Cure, %	0.010	0.015	0.010		0.015	0.010	0.015
4 Day , %	-0.015	-0.010	-0.020		-0.015	-0.015	-0.015
7 Day , %	-0.030	-0.025	-0.025		-0.030	-0.035	-0.025
14 Day , %	-0.040	-0.040	-0.040		-0.040	-0.050	-0.040

REMARKS:

The samples were discarded at the completion of testing.

If you have any questions concerning this report, or if we may be of further assistance, please contact me at (651) 659-7401.

STORK TWIN CITY TESTING CORPORATION



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Construction Materials Department Manager
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