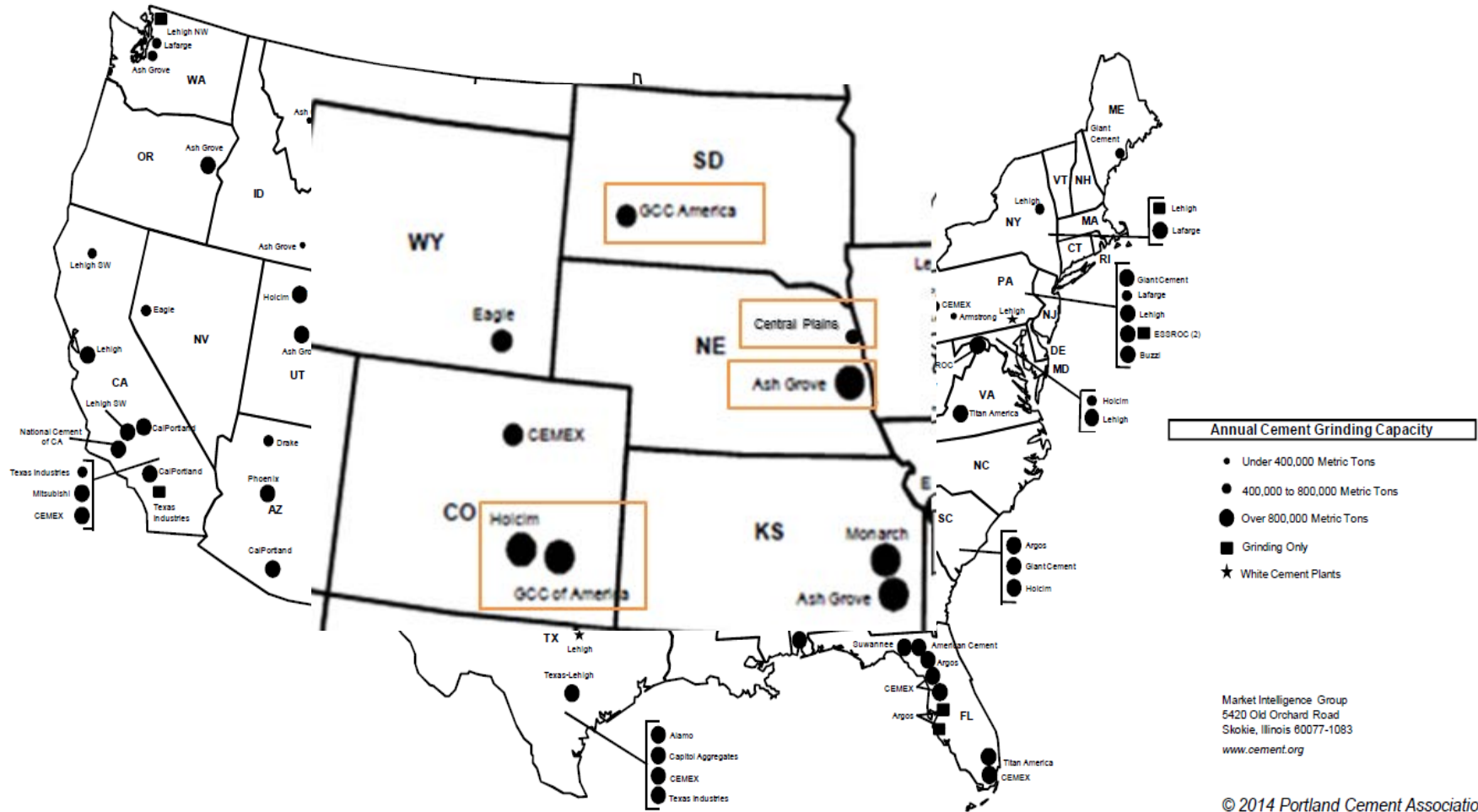




**Nebraska's Aggregates Reactivity
Evaluation According to
AASHTO PP 65-10**

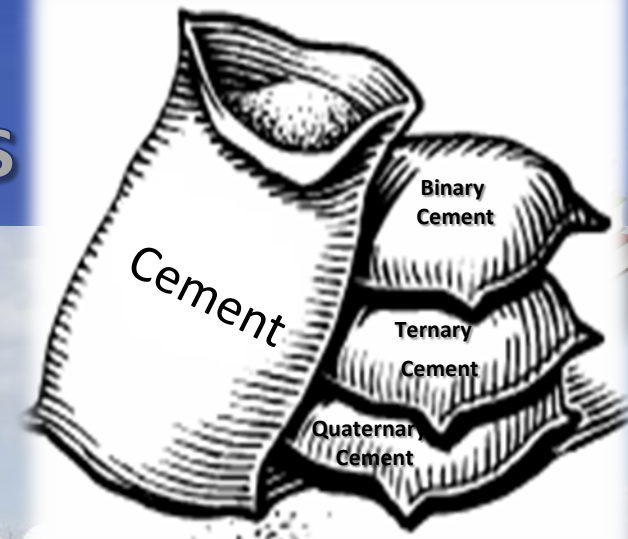
CEMENT MANUFACTURING PLANTS IN THE US

United States Portland Cement Plant Locations



Market Intelligence Group
 5420 Old Orchard Road
 Skokie, Illinois 60077-1083
www.cement.org

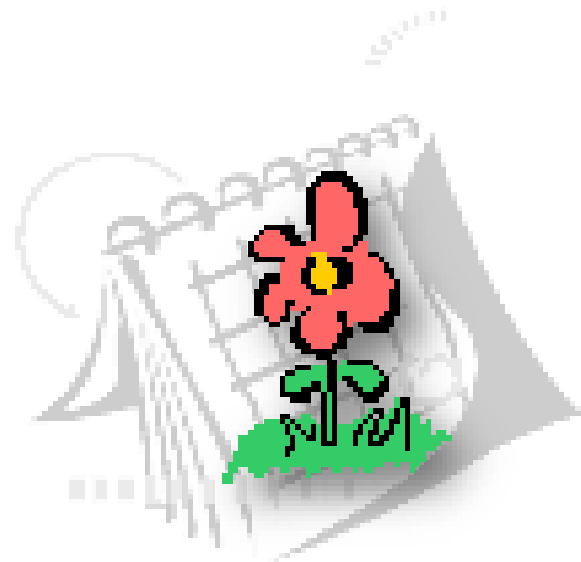
Nebraska Interground/Blended Cements



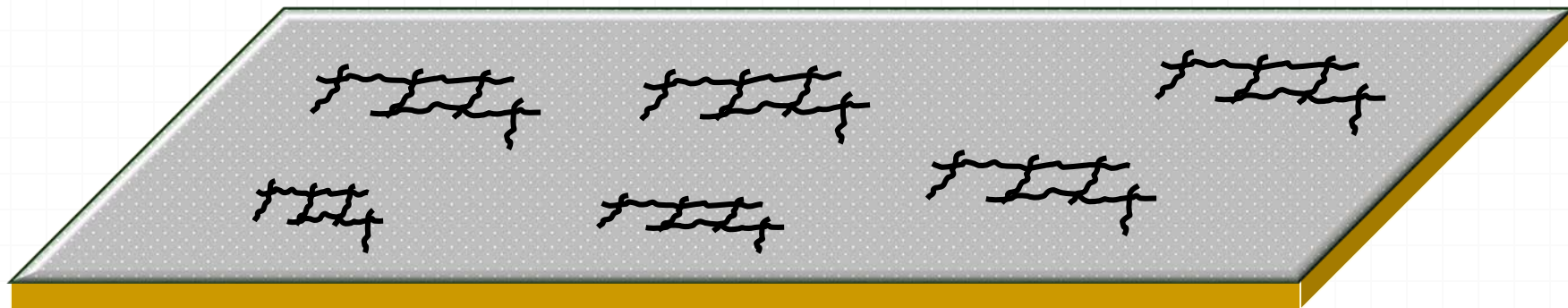
- Ready Mix Plant blending is not allowed
- Terminal blend supply only
 - Consistency in the final product
 - Accuracy of Quality Assurance per project
 - If there is a supply issue of SCM's, the Department knows a year in advance

HISTORY

Designs PCC Pavement to Last 50 Years



Began to notice pavements less than 10 years old displaying severe deterioration



What is causing the early deterioration



NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF ROADS

**Alkali Silica Reactivity (ASR)
Project Summer
2003**



FHWA (2008)

*Report on Determining the Reactivity of Concrete Aggregates and
Selecting Appropriate Measures for Preventing Deleterious
Expansion in New Concrete Construction*



U.S. Department of Transportation
Federal Highway Administration

AASHTO (2010)

Standard Practice for

**Determining the Reactivity of
Concrete Aggregates and Selecting
Appropriate Measures for
Preventing Deleterious Expansion
in New Concrete Construction**

AASHTO Designation: PP 65-10



American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001



Adopted in 2010

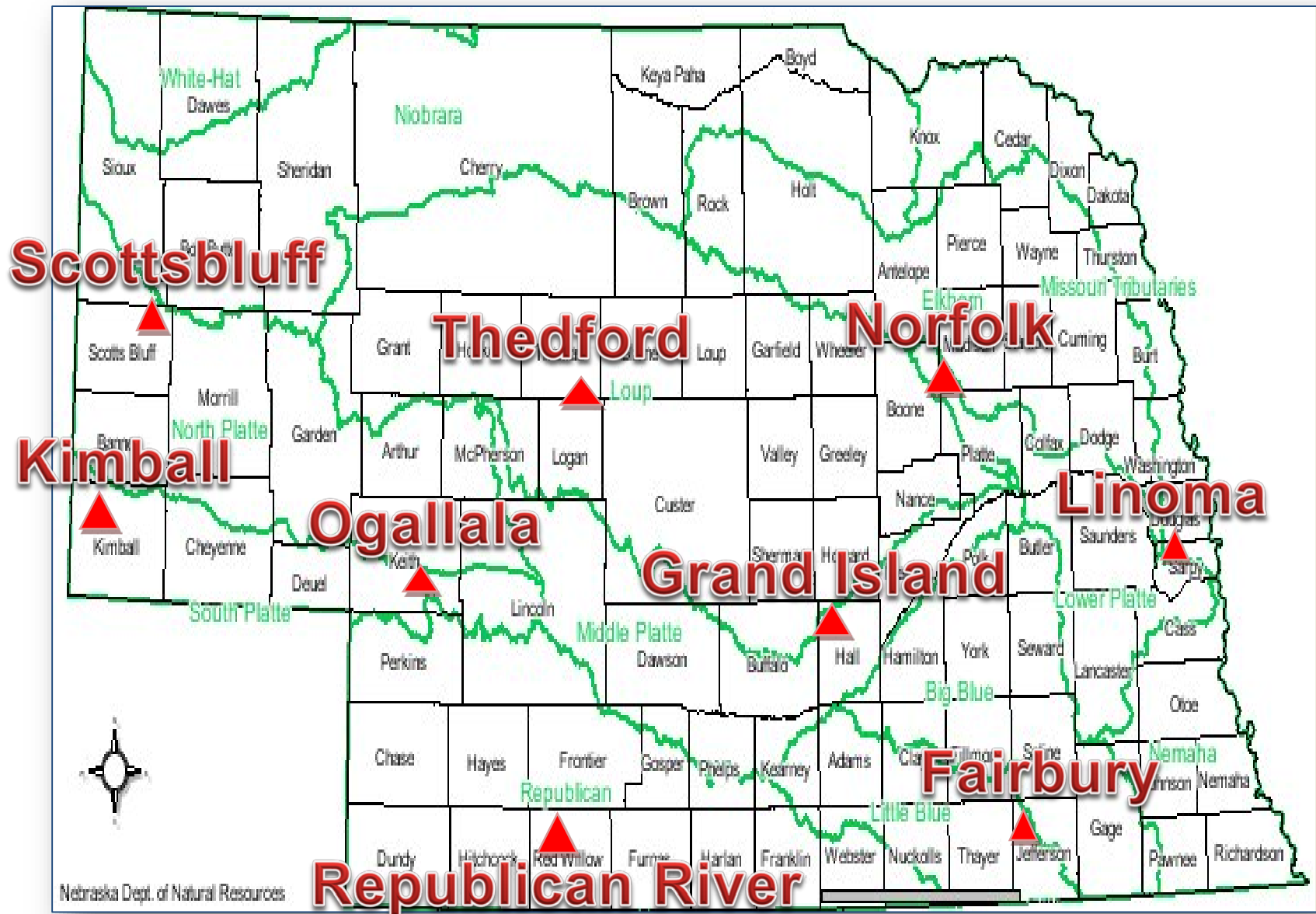
AASHTO PP 65-10

Determining the Reactivity of Concrete Aggregate

To determine if the Nebraska's Specifications meet the requirements of AASHTO PP 65-10



Aggregate Sources Evaluated



A photograph showing four concrete test blocks submerged in a white bucket filled with water. The blocks are arranged in a cluster, and the water surface is visible. The background shows a wooden floor and some papers.

***Determining the Reactivity of Concrete Agg. And
Selecting Appropriate Measures for Preventing
Deleterious Expansion in new Concrete Construction***

Table 4. Structures Classified on the Basis of the Severity of the Consequences Should ASR[†] Occur (Modified for Highway Structures from RILEM TC 191-ARP)

Class	Consequences of ASR	Acceptability of ASR	Examples ^{††}
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Table 6. Minimum Levels of SCM to Provide Various Levels of Prevention

Type of SCM	Alkali level of SCM (% Na ₂ O _e)	Minimum Replacement Level ^{††} (% by mass)				
		Level W	Level X	Level Y	Level Z	Level ZZ
Fly ash (CaO ≤ 18%)	< 3.0	15	20	25	35	Table 7
	3.0 – 4.5	20	25	30	40	
Slag	< 1.0	25	35	50	65	
Silica Fume [†] (SiO ₂ > 85%)	< 1.0	1.2 x LBA or 2.0 x KGA	1.5 x LBA or 2.5 x KGA	1.8 x LBA or 3.0 x KGA	2.4 x LBA or 4.0 x KGA	

[†]The minimum level of silica fume (as a percentage of cementing material) is calculated on the basis of the alkali (Na₂O_e) content of the concrete contributed by the portland cement and expressed in either units of lb/yd³ (LBA in Table 6) or kg/m³ (KGA in Table 6). LBA is calculated by multiplying the cement content of the concrete in lb/yd³ by the alkali content of the cement divided by 100. For example, for a concrete containing 500 lb/yd³ of cement with an alkali content of 0.81% Na₂O_e the value of LBA = 500 x 0.81/100 = 4.05 lb/yd³. For this concrete, the minimum replacement level of silica fume for Level Y is 1.8 x 4.05 = 8.1%. KGA is calculated by multiplying the cement content of the concrete in kg/m³ by the alkali content of the cement divided by 100. For example, for a concrete containing 300 kg/m³ of cement with an alkali content of 0.91% Na₂O_e the value of KGA = 300 x 0.91/100 = 2.73 kg/m³. For this concrete, the minimum replacement level of silica fume for Level X is 2.5 x 2.73 = 6.8%. Regardless of the calculated value, the minimum level of silica fume shall not be less than 7% when it is the only method of prevention.

^{††} Note: the use of high levels of SCM in concrete may increase the risk of problems due to deicer salt scaling if the concrete is not properly proportioned, finished and cured.

				(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)	
Aggregate Type Location	ASTM C 1260 14 days Results (%)	ASTM C 1260 28 days Results (%)	ASTM C 1293 1 Year Results (%)	Description of Agg. Reactivity	Aggregate Reactivity Class	Determining the Level of ASR Risk	Determining Level of Prevention	Mim. Replacement Level of SCM
Platte River Grand Island	0.26	0.39	0.09	Moderate Reactive	R1	Level 3	X	20
Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25

Performed

				(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)	
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Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25
Republican River Indianola	0.34	0.48	0.45	Very Highly Reactive	R3	Level 5	Z	35

Performed

				(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)	
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Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25
Republican River Indianola	0.34	0.48	0.45	Very Highly Reactive	R3	Level 5	Z	35
North Platte River Scottsbluff	0.33	0.46	0.15	Highly Reactive	R2	Level 4	Y	25









Performed

				(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)	
Aggregate Type Location	ASTM C 1260 14 days Results (%)	ASTM C 1260 28 days Results (%)	ASTM C 1293 1 Year Results (%)	Description of Agg. Reactivity	Aggregate Reactivity Class	Determining the Level of ASR Risk	Determining Level of Prevention	Mim. Replacement Level of SCM
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Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25
Republican River Indianola	0.34	0.48	0.45	Very Highly Reactive	R3	Level 5	Z	35
North Platte River Scottsbluff	0.33	0.46	0.15	Highly Reactive	R2	Level 4	Y	25
South Platte River Ogallala	0.15	0.25	0.06	Moderate Reactive	R1	Level 3	X	20

Performed

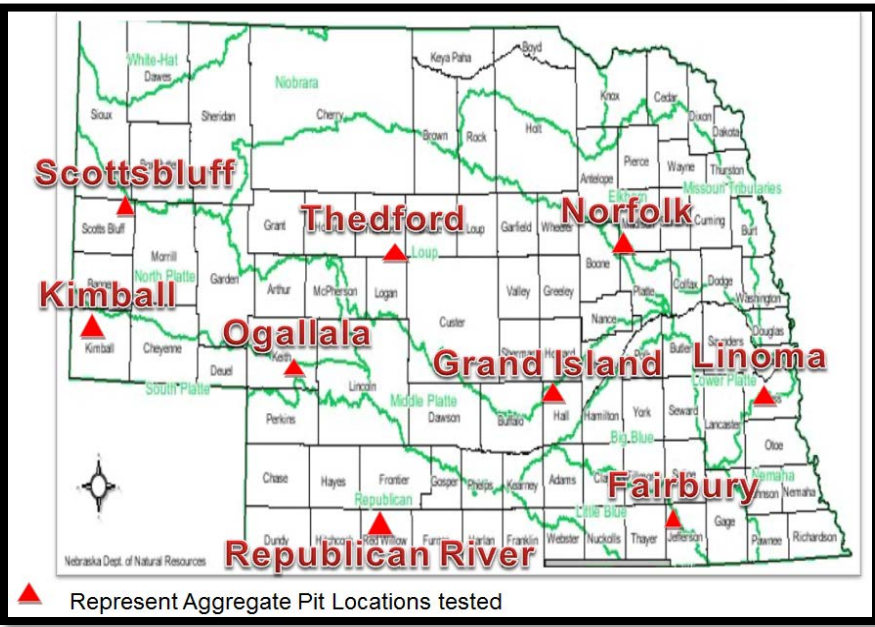
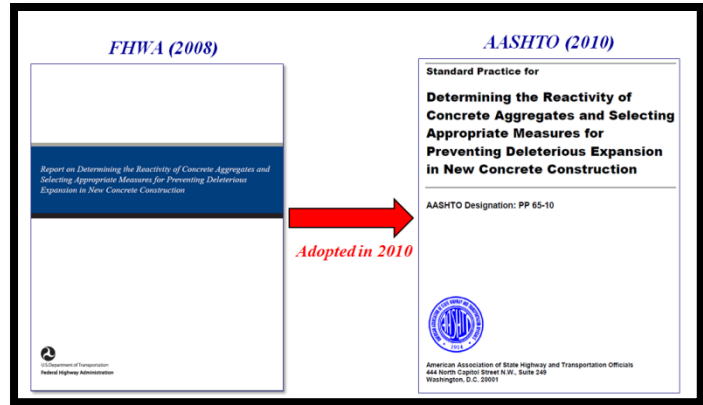
					(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)
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Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25
Republican River Indianola	0.34	0.48	0.45	Very Highly Reactive	R3	Level 5	Z	35
North Platte River Scottsbluff	0.33	0.46	0.15	Highly Reactive	R2	Level 4	Y	25
South Platte River Ogallala	0.15	0.25	0.06	Moderate Reactive	R1	Level 3	X	20
Middle Loup River Thedford	0.29	0.39	0.19	Highly Reactive	R2	Level 4	Y	25
Little Blue River Fairbury	0.28	0.48	0.10	Moderate Reactive	R1	Level 3	X	20

Performed

					(Table 1- AASHTO PP 65-10)	(Table 2- AASHTO PP 65-10)	(Table 3- AASHTO PP 65-10)	(Table 6- AASHTO PP 65-10)	
Aggregate Type Location	ASTM C 1260 14 days Results (%)	ASTM C 1260 28 days Results (%)	ASTM C 1293 1 Year Results (%)	Description of Agg. Reactivity	Aggregate Reactivity Class	Determining the Level of ASR Risk	Determining Level of Prevention	Mim. Replacement Level of SCM	Nebraska's Spec Since Late 2004 IP with 25% Class F
Platte River Grand Island	0.26	0.39	0.09	Moderate Reactive	R1	Level 3	X	20	
Dry Pit Kimball	0.25	0.32	0.21	Highly Reactive	R2	Level 4	Y	25	
Republican River Indianola	0.34	0.48	0.45	Very Highly Reactive	R3	Level 5	Z	35	
North Platte River Scottsbluff	0.33	0.46	0.15	Highly Reactive	R2	Level 4	Y	25	
South Platte River Ogallala	0.15	0.25	0.06	Moderate Reactive	R1	Level 3	X	20	
Middle Loup River Thedford	0.29	0.39	0.19	Highly Reactive	R2	Level 4	Y	25	
Little Blue River Fairbury	0.28	0.48	0.10	Moderate Reactive	R1	Level 3	X	20	
Elkhorn River Norfolk	0.40	0.57	0.30	Very Highly Reactive	R3	Level 5	Z	35	

Nebraska's Evaluation of Statewide Aggregate Reactivity

(Table 6-AASHTO PP 65-10)
Type I/II Cement
Low Alkalinity



Aggregate Type Location	Description of Agg. Reactivity	Mim. Replacement Level of SCM	Mim. Replacement Level of SCM Mitigate ASR	Nebraska's Spec Since Late 2004 IP with 25% Class F
Platte River Grand Island	Moderate Reactive	20	15	✓
Dry Pit Kimball	Highly Reactive	25	20	✓
Republican River Indianola	Very Highly Reactive	35	25	✗
North Platte River Scottsbluff	Highly Reactive	25	20	✓
South Platte River Ogallala	Moderate Reactive	20	15	✓
Middle Loup River Thedford	Highly Reactive	25	20	✓
Little Blue River Fairbury	Moderate Reactive	20	15	✓
Elkhorn River Norfolk	Very Highly Reactive	35	25	✓
Platte River Linoma	Highly Reactive	25	20	✓

Republican River Indianola's Aggregate Non-Approved Aggregate

Aggregate Reactivity



Route-Built	Project Number	Cement Type	ASTM C 1293	Min. Replacement Level of SCM to Provide Various Levels of Prevention by AASHTO PP 65-10	Mim. Replacement Level of SCM Mitigate ASR Due to Low Alkali Cement
Chester Hebron 1995	F-81-1 (1017)	Type I Added 17% Class F	0.10 Moderate Reactive	20%	15%



Route-Built	Project Number	Cement Type	ASTM C 1293	Min. Replacement Level of SCM to Provide Various Levels of Prevention by AASHTO PP 65-10	Mim. Replacement Level of SCM Mitigate ASR Due to Low Alkali Cement
Chester Hebron 1995	F-81-1 (1017)	Type I Added 17% Class F	0.10 Moderate Reactive	20%	15%
In Ansley 2001	S-2-3 (1019)	Type I Added 17 % Class F	0.19 Highly Reactive	25%	20%



Route-Built	Project Number	Cement Type	ASTM C 1293	Min. Replacement Level of SCM to Provide Levels of Prevention by AASHTO PP 65-10	Mim. Replacement Level of SCM Mitigate ASR Due to Low Alkali Cement
Chester Hebron 1995	F-81-1(1017)	Type I Added 17% Class F	0.10 Moderate Reactive	20%	15%
Ansley 2001	S-2-3 (1019)	Type I Added 17 % Class F	0.19 Highly Reactive	25%	20%
Norfolk East 2005	F-275-6 (1020)	Led with 98 Spec Type 17% IPN +9% C	0.30 Very Highly Reactive	35%	25%







Interground/Blended Cement Approval Process

NEBRASKA

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DEPARTMENT OF ROADS

Interground/Blended Cement Approval Process

For Concrete Applications:

- NDOR no longer maintain Supplemental Cementitious Materials (SCM's) on the Approved Product List (APL) for the following products:
 - Fly Ash (C&F), Calcined Clays (N-Pozzolan), and Slag
- NDOR allows the use of ASTM C 1697- Standard Specification for Blended Supplementary Cementitious Materials
- NDOR allows the use IP and IT cement in accordance with ASTM C595

Supplier Approval Process for Blended SCM's

Supplier when using ASTM C 1697

- The supplier reports Chemical Composition for the final SCM's
 - NDOR verifies the chemical composition of the final blend
 - The Final SCM's blend is reported by the classification of SCM's final Blended SCM_b

For Example :

A binary mixture SCM_b -65F/35C

65% class F and 35% C fly ash

Supplier Acceptance Requirements

Interground/Blended Cement

- **The supplier shall conform to ASTM C 595**
 - NDOR verifies the chemical and physical composition of the final Interground/Blended Cement
 - NDOR pre-establish (CaO/SiO₂) ratio
- **Supplier provides the Alkali Silica Reaction (ASR) testing**
 - (ASTM C 1567 less than 0.10% @ 28 days)
 - Platte River and Norfolk aggregate
 - NDOR verify ASTM C 1567
- **Total Cement Replacement with SCM's**
 - 20% min
 - 40% max

Project Level Quality Assurance

- **Cement is Sampled and Tested**
 - 750 tons
 - NDOR verifies pre-established
 - (CaO/SiO₂) ratio

Concrete Tough

