TxDOT SCM Specifications and ASR Mitigation

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Texas Department of Transportation

4/8/2026

SCMs Available in Texas

- DMS-4610 – Coal Ash
- DMS-4620 – Slag Cement
- DMS-4630 – Silica Fume
- DMS-4635 – Natural Pozzolans

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Fly Ash

- History of quality Class F fly ash with Texas lignite coal
- Coal sources began switching mid-2000s through 2010s
- Sources began proposing blending in late 2010s

Fly Ash

Source A	Source B	Chemical Composition	Durability Behavior*
Class F	Class F	Class F	Class F
Class C	Class C	Class C	Class C

*ASR Mitigation, Sulfate Attack

Fly Ash

Source A	Source B	Chemical Composition	Durability Behavior*
Class F	Class F	Class F	Class F
Class C	Class C	Class C	Class C
Class F	Class C	Class F	Class C

*ASR Mitigation, Sulfate Attack

How do we classify?

Coal Ash

Source A	Source B	Chemical Composition	Durability Behavior
Class F	Class F	Class F	Class F
Class C	Class C	Class C	Class C
Class F	Class C	Class F	Class C
Fly Ash	GBA	Depends on coal	Depends on coal

*ASR Mitigation, Sulfate Attack

How do we predict behavior?

~~Fly~~ Coal Ash – DMS-4610

- Removed ash classification
- Physical requirements remain the same as C618
- TxDOT determines
  - minimum replacement percentage or testing requirement for ASR mitigation
  - whether ash is appropriate for sulfate resistance

Coal Ash

Table 1: Coal Ash Sources

Supplier	Producer Code	Plant	Location	Unit [1,2]	Minimum Replacement for Option 1, % [3,4]	Allowed for SRC, Yes or No
Amrize Cement Inc.	99775	Harrington	Amarillo, TX	1; 2; 3	Option 8	No
Amrize Cement Inc.	99752	Tolk Station	Earth, TX	1 & 2	Option 8	No
Amrize Cement Inc.	98418	Trimble	Bedford, KY	1 & 2	25	Yes
Charah Solutions, Inc.	99507	Flint Creek	Louisville, KY	1	Option 8	No
Charah Solutions, Inc.	99376	Independence	Newark, AR	1; 2	Option 8	No
Charah Solutions, Inc.	98389	John E. Amos	Winfield, WV	1;2;3	25	Yes
Charah Solutions, Inc.	98399	Mountaineer	New Haven, WV	1	30	Yes

Natural Pozzolans

- Originally only included Metakaolin
- Series of research projects from 2011 – 2021 looking into "fly ash alternatives"
  - 0-6717: Natural pozzolans (pumice, perlite, zeolite, expanded shale)
    - More expensive, not widely available (at the time)
  - 0-6966: Industry byproducts, reclaimed/remediated ash
    - How do we measure reactivity?

ASTM C618 "Reactivity" Tests

- Chemical analysis
  - No indication of crystalline structure
- Strength Activity Index (SAI)
  - Influence of particle size
  - Min requirements generally < replacement %

R3 Testing (ASTM C1897)

- Heat of Hydration
  - SCM + $Ca(OH)_2$ + $CaCO_3$ + KOH + K_2SO_4
  - Isothermal calorimeter @ 40C
  - Cumulative heat released at 7 days

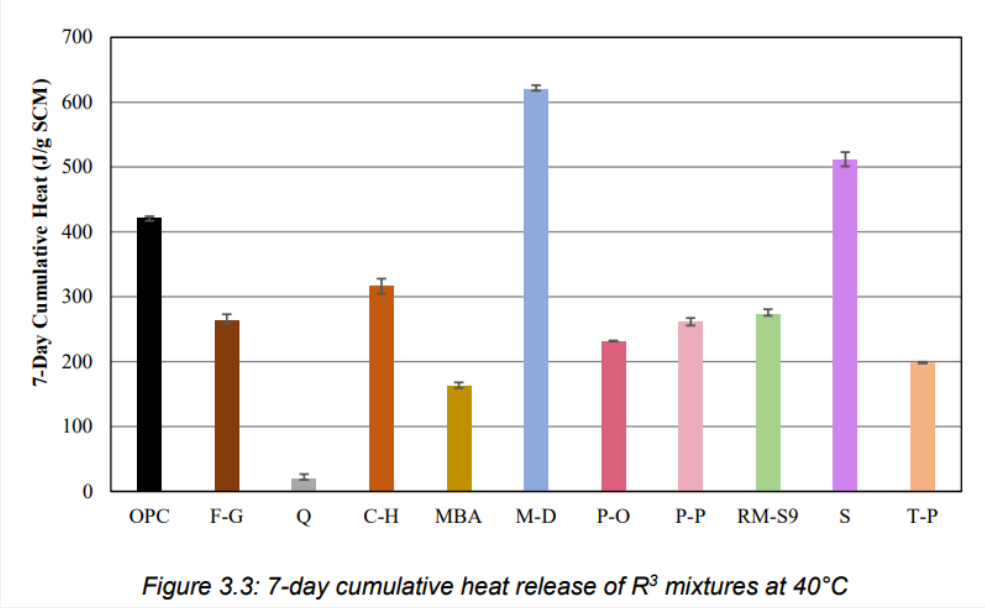

Figure 3.3: 7-day cumulative heat release of R³ mixtures at 40°C

Saif, Al-Shmaisani, et al. *Supplementary Cementitious Materials: Assessment of Test Methods for New and Blended Materials*. University of Texas at Austin. Center for Transportation Research, 22 Mar. 2021.

R3 Testing (ASTM C1897)

- Bound Water
  - Mass loss between 40C and 350C

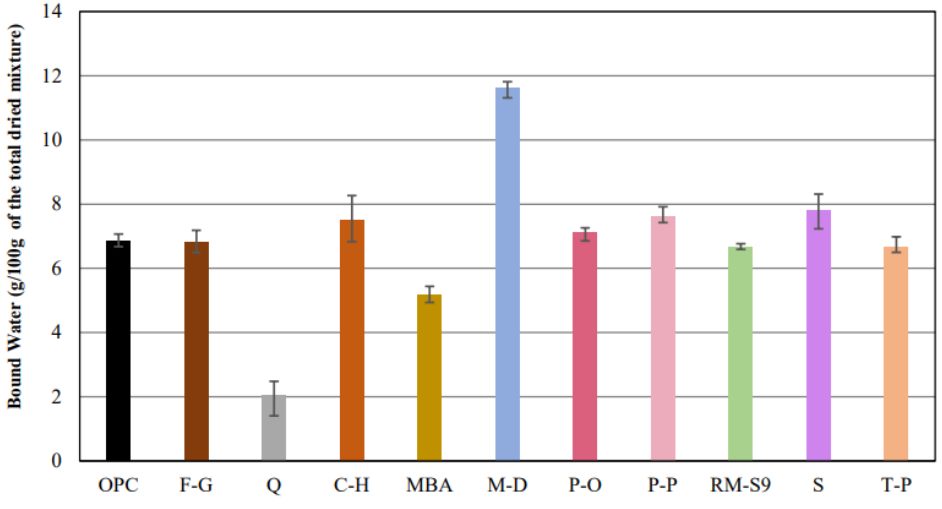

Figure 3.7: 7-day bound water content of R^3 mixtures at 40°C

Saif, Al-Shmaisani, et al. *Supplementary Cementitious Materials: Assessment of Test Methods for New and Blended Materials*. University of Texas at Austin. Center for Transportation Research, 22 Mar. 2021.

Natural Pozzolans

Requirement	Limit	DMS-4635	ASTM C1945
Reactivity, 7 day	Min, g/100g dry	--	3.6
Reactivity, 7 day	Min, J/g of pozzolan	125	Report only

4/8/2026

ASR Mitigation

ASR Mitigation

- Almost 200 aggregate sources in QM program
  - Full range of ASR reactivity
- Specification addresses worst case scenario
  - Add SCMs or limit cement content

- Guilty until proven innocent!

ASR Mitigation

- Item 421 – Hydraulic Cement Concrete
  - Mix Design Options 1, 2, and 3
    - Replace cement with SCMs
    - Minimum replacement percentage tested annually
      - Control mix expansion ≥0.3% (required by spec)
      - Control mix expansion >0.5% (actual)

ASR Mitigation

- Item 421 – Hydraulic Cement Concrete
  - Mix Design Option 4
    - Use a blended cement (Type IS, IP, or IT)
    - SCM source must be approved
    - SCM content must meet or exceed minimum

ASR Mitigation

- Item 421 – Hydraulic Cement Concrete
  - Mix Design Option 6
    - Lithium treatment
  - Mix Design Option 7
    - Limit alkali loading to 3.5 lb/cy
    - Calculation part of mix design record

ASR Mitigation

- Item 421 – Hydraulic Cement Concrete
  - *Table 1: Coal Ash Sources*

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ASR Mitigation

- Item 421 – Hydraulic Cement Concrete
  - Mix Design Option 8
    - Testing!
      - ASTM C1260/C1567 with project specific materials
      - Coarse and fine aggregates tested separately
      - Requires annual testing to maintain

ASR Mitigation

- We know some aggregates fool C1260 / C1293
  - TxDOT research project 0-6656
    - How do we validate designs for tricky aggregate?
    - Accelerated Concrete Cylinder Test (AASHTO TP142)

Texas Department of Transportation

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