Concrete Damage at Carters Dam

January 2005
Reregulation Dam – Downstream View
Reregulation Dam – Downstream View
Downstream D-2, Lifts 23, 24?
Upstream D-2

ML 22
Downstream Joint - D-8 and D-9

Top of ML

Bottom of ML
Upstream D-9

D-10

D-9

Lift 23

D-8
Upstream D-1

Lift 23
Emergency Spillway
Shaft in ML 11
Aggregate

- Single source – Dalton Quarry
- At least 3 distinct types in the 1.5 and 3 inch sizes
  - One suspected of ACR
  - Problems with ACR rock: Sep – Nov 71
Portland Cement

• 3 sources
  – All low alkali
  – $0.45 - 0.55\text{ Na}_2\text{O}_{eq}$
• Pozzolan
  – Probably not
Reactive Pieces
Rhombs
Reaction Products
Expected Damage – Upstream Face

- Not visible (back filled or water covered)
- Expected Damage based on placing date
Expected Damage - Downstream Face

Not visible (backfilled)

Expected damage based on placing slate
Strength

- Strength ~ number reactive particles/ft
  - Low counts: 3935 psi
  - Moderate counts: 3357 psi
  - High counts: 2884 psi (best of the worst!!)
Residual Expansion

![Graph showing residual expansion over time for different lifts. The graph plots length change as a percentage against time in days. Different lifts are represented by distinct lines and markers.]

- Lift 26 (9)
- Lift 22/23 (26)
- Lift 14/15 (9)
- Lift 23 (29)
- Lift 9 (3)
- Lift 11 (2)
Remaining Reaction

Time to Cessation of Reaction

- Reaction Rate = 3
- Particle Radius
  - 30 mm
  - 22 mm
  - 15 mm
  - 11 mm
  - 7 mm
  - 2.5 mm

Graph showing the relationship between reactive surface area, mm², and time, years, for different particle sizes. The graph illustrates how the reaction rate affects the time to cessation of reaction.
Similar Structures

- Chickamauga
  - Lock soon to be replaced
- Center Hill
Major Materials Issue

- Aggregate QC
- Alkali Carbonate Reaction
  - First analysis suggests
  - Bad news for aggregate sources
- Alkali Silica Reaction
  - Similar in some features
  - Better news for aggregate sources
- AAR - Do we really know what we’re doing?