Biomass Fly Ash in Concrete III

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Objective:

Investigate the mitigation of Alkali Silica Reaction (ASR) expansion by biomass / coal ash replacing different percentages of high alkali cement: the results show that the biomass fly ashes cut down equal or more ASR expansion than class C, and some are comparable to that of class F.

Experimental Setup

- Fly ashes (soluable Na_2O%) : C (1.03), F(0. 53), wood (1.78), SAW(2.88), 10P(2.71) and 20P(2.46)
- High alkali cement: 1.15% (equiv. Na_2O) (ASTM: max. 0.6%)
- Reactive Aggregate: wood opal from Virgin Valley, Nevada
- Fly ash / cement (mass): 15/85, 25/75, 35/65
- Expansion measuring dates: 1, 14, 28, 56, 84, 126, 182 and 364 days after mixing
- Pore solution extrusion: with max. load of 240 thousand pounds.
- Pore solution analysis: AA (Atomic Absorption) and IC (Ion Chromatography)

Expansion Measurement
(± 0.0001in)

Alkali Silica Reaction (ASR)-Cancer of Concrete

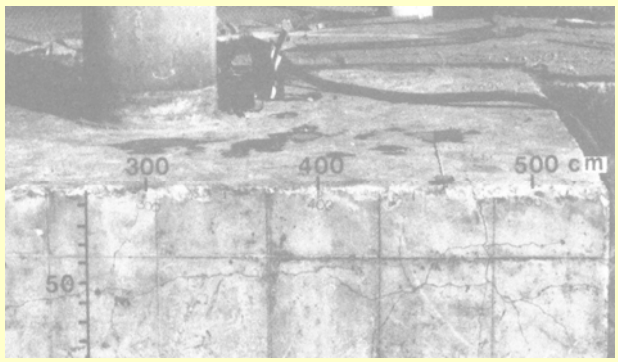
ASRs are reactions generally occurring between alkali in the cement and the reactive silica from the aggregate. The ASRs expansion is severely deleterious and hard for recovery.

Chemical Mechanism:

$4SiO_2 + 2NaOH = Na_2Si_4O_9 + H_2O$

$SiO_2 + 2NaOH = Na_2SiO_3 + H_2O$

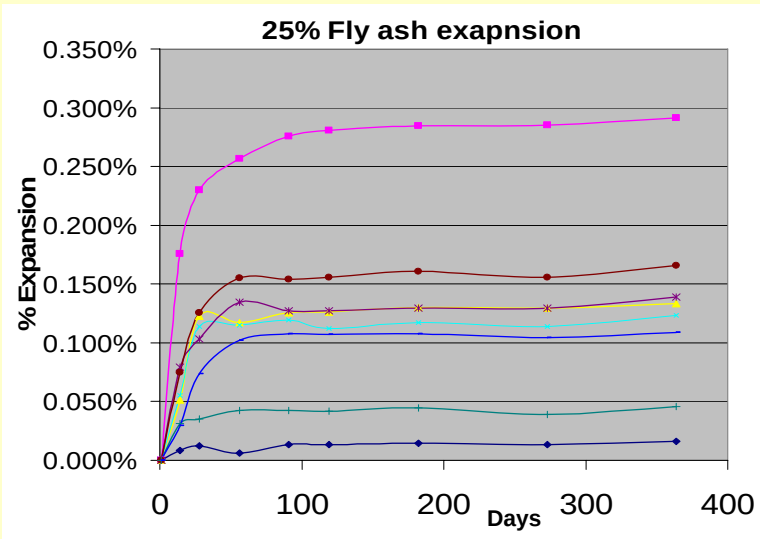
Concrete: Expansion → cracks → failure



Cracks of field concrete caused by the Alkali Silica Reaction (ASR)

High Pressure Mold

Double-layered prestressed cylinder



ASTM standard C-33 allows max 0.10% ASR expansion at 6 months after mixing.