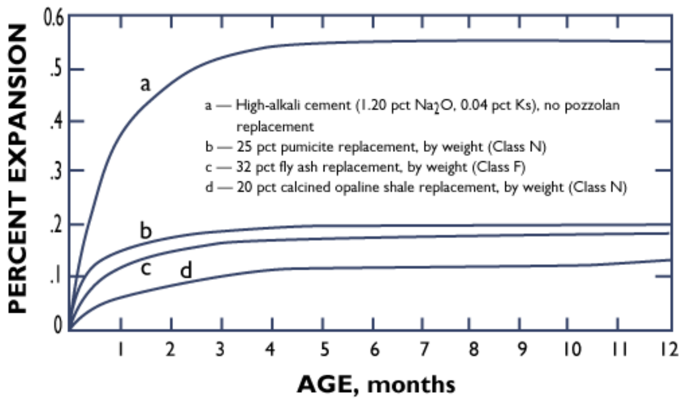
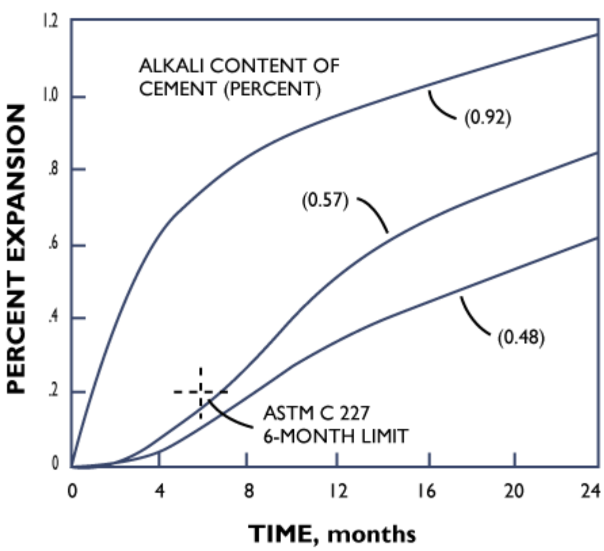
Technical Bulletin

8 Fly Ash Decreases Alkali/Silica Reaction

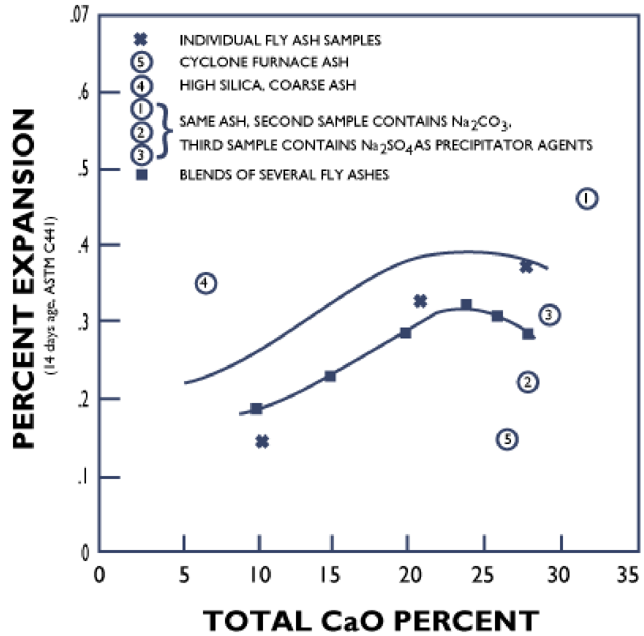
UNDER CERTAIN CONDITIONS and in certain areas, reactive silica in aggregates will react with soluble alkalis from any available source, causing excessive and deleterious expansion.[1] A volume change will occur over a period of time which causes the concrete to "spall" at the surface. In addition to resulting surface ruptures, interior stresses may occur which cause cracking and seriously impair structural integrity of the concrete.



The use of low alkali (LA) cement (<0.6% alkalis) has become standard for combating reactive aggregates, although it may by itself prove ineffective over time. ASTM C-227 limits expansion at six months to 0.01%. While a mixture may prove acceptable in the test, it may well undergo destructive expansion later. Alkalis from other sources, including the aggregate, can fuel the expansion reaction. Some aggregates may also be so reactive that they expand to failure before six months with low alkali cement. Stark reported failure of a mixture containing cement with as little as .35% total alkalies.[2]



Including Class F fly ash in the mix design invariably reduces this reaction, protecting the concrete (and the steel reinforcement) from the deterioration which follows expansion. Larger quantities of Class C fly ash may be required to control expansion. Dunstan notes that CaO content may be a useful parameter to indicate the effectiveness of an ash to combat alkali/silica reaction[3]. ASTM C-618 provides for evaluation of pozzolans to be used where alkali/silica expansion is expected. Supplementary optional physical requirements provide for expansion limits for the C-441 expansion test with Pyrex glass aggregate.



The decrease in alkali/silica reaction comes from the fact that Class F fly ash reacts chemically with and absorbs alkalis in the cement, thus making them unavailable for reaction later with the reactive aggregate.

One example of fly ash's unique propensity to reduce alkali/silica reactions was documented by the State of Alabama. In 1960, the Alabama Highway Department specified that Class F fly ash be utilized in all concrete pavement, bridges and culverts. Time-tested results in hundreds of lane-miles of fly ash concrete placed since then have been positive, according to department representatives. Bridges more than 20 years old have exhibited improved resistance to alkali/silica reaction. In addition to the use of pozzolanic material, it is recommended that low alkali cement (less than 0.6%) and acceptable aggregates be used in order to prevent alkali/silica reaction.[4]

1 Elfert, R. J., "Bureau of Reclamation Experiences with Fly Ash and Other Pozzolans in Concrete", Third International Ash Utilization Symposium, 1973, p. 14.
2 Stark, D. C., "Alkali-Silica Reactivity: Some Reconsiderations", Research Development Bulletin RD076.OIT, Portland Cement Association, 1981.
3 Dunstan, E. R., "Fly Ash and Fly Ash Concrete", Bureau of Reclamation, Denver, Colorado, May 1984.
4 Graham. D. E., "Fly Ash and Its Use in Concrete", NRMCA Publication No. 138, 1972, p. 10.

For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Headwaters Resources Technical Sales Representative or call 1-888-236-6236.

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