THE ASHFORD FORMULA AND ALKALI SILICA REACTION

The California Department of Highways first identified Alkali Silica Reaction (ASR) in 1940. Despite more than 60 years of research, several questions have not been satisfactorily addressed, and many have not been addressed at all yet.

ASR is a complex chemical process that occurs when alkaline "pore" fluid mixes with certain reactive aggregates occasionally found in concrete. The reaction forms a gel that absorbs water, subsequently expands, and can prove detrimental to concrete. This process occurs when reactive aggregates (usually coarse aggregates) chemically combine with the alkaline components of portland cement and water (the internal relative humidity of the concrete requires a constant in excess of 80 %.)

This gel, can occupy more space than the original silica, resulting in a reaction where the pores can undergo additional pressures. The surface pressure is balanced by tensile stresses in the ambient cement paste and the center of the aggregate particle. These stresses may exceed the tensile strength of the concrete and create multiple cracks that generally radiate from the interior of the aggregate out into the surrounding paste. The cracks are empty when initially formed, but ASR gel may subsequently emanate from the cracks.

In summary, for ASR to occur and produce a potentially expansive gel, besides the reactive aggregates, a significant source of alkalis such as sodium, potassium and soluble metal alkali ions contained in the pore solution must also be present. In addition, large amounts of water also need to be present. If one of these three conditions is absent, ASR cannot occur.

Because reactive aggregate is found in very small concentrated areas throughout the world, ASR related problems are not very common. In many areas of the United States where the lack of native reactive aggregate has long been ascertained, no instances of concrete failures have ever been attributed to ASR where extensive, credible studies have been carried out.

As the dynamics of ASR are mostly unidentified, it is important to understand that evidence of cracking does not necessarily imply the presence of ASR. In fact, unless the local availability of reactive aggregate has been previously verified, concrete cracking, will not be the result of ASR.

Cracking is the result of internal expansion of concrete; many more factors, other than rare ASR conditions, will produce similar results. Extreme care must be exercised

before blaming ASR for any concrete failures that is not substantiated by valid petrographic analyses—a practice that has become common-place as of late.

While it is possible to prevent ASR related failures during the construction stage, no established methods to reverse it in structures that have already been attacked are available. The use of expensive chemical admixtures such as lithium salts, silicofluoride and alkyl alkoxy silane have shown some varied, but limited, effect in the prevention and reduction of ASR expansion. However, such reduction effects have been achieved mostly under controlled laboratory environments, and should not be used in actual field practice[1]. The very nature of ASR calls for preventive procedures rather than relying on the expectation that excessive expansion might be limited once the reaction has initiated.

For many years, architects, engineers and general contractors have acknowledged The Ashford Formula will significantly reduce the alkalinity of concrete. This is accomplished through the chemical reaction with the alkali, free-lime and other salts common to concrete that The Ashford Formula uses in its crystallization process as it permanently densifies, hardens and dustproofs a concrete surface.

The American Concrete Institute refers to the use of a breathable concrete sealer as beneficial in preventing ASR. If concrete is not placed in contact with a damp subgrade or any other source of moisture other than the surface, concrete sealers that rely on a range of mechanisms to allow the concrete to "breathe" but prevent the penetration of moisture--such as The Ashford Formula—will prove beneficial and not detrimental[1]. Products that rely on solids to "plug" a concrete surface, cannot meet these requirements since they will prevent adequate breathing of the concrete.

Because the majority of reactive aggregate is coarse and water primarily migrates into the concrete slab from the substrate, ASR reactions normally originate from depths equal to the level of the course aggregate, or in the case reinforced concrete, the level of the reinforcement or deeper.

To date, no validated incidences of ASR have been attributed to the use of The Ashford Formula.

Alkali Silica Reaction has, and continues to be very complex and little-understood. Curecrete Distribution, Inc. has carried out extensive research on the subject and upon request, will furnish additional technical information on the subject made available through recognized industry and scientific research. For more information, please contact Curecrete Distribution, Inc.'s Technical Services.

[1] ACI Manual of Concrete Practice (2000)