

Alkali Silica Reaction (ASR) is where alkalis in the cement react with certain types of silica in aggregates such as sand /gravel. This reaction creates a gel-like substance that swells causing expansion and cracking to the concrete.

High Alumina Cement (HAC) is where high alumina cement (contains large amounts of alumina) reacts with the environment or external agents, leading to the deterioration of the cement which binds the concrete together. The HAC reacts with sulfate ions forming compounds that expand causing cracking.

ASR Preventative measures:

- Use low alkali cement
- Use Aggregates that are less reactive with alkalis
- Incorporate supplementary materials to mitigate the effects of ASR by binding with alkalis (Fly ash, Silica Fume).
- Ensure the water to cement ratio is correct. Too much water can increase the effects of ASR
- Use lithium compounds as they act as a deterrent to ASR

HAC Preventative measures:

- Use cements with lower alumina content.
- Use aggregates with lower alumina content.
- Ensure the water to cement ratio is correct. Too much water can increase porosity and therefore vulnerability to HAC
- apply a protective coating to create a barrier against any harsh environmental exposure and external agents.
- Prevent excessive heat during curing as this could break down the cement matrix and lead to the onset of HAC issues.

ASR Repair:

Once ASR has set within the concrete compound, there is little one can do to reinstate what is existing. Ultimately one has to remove and replace the failed concrete caused by the expansive gel, and replace with a cementitious repair mortar.

It may be wise to also apply a coating or sealer to the concrete to prevent the entry of any harmful substance and reduce reactions with the environment.

HAC Repair:

Once HAC has set within the concrete compound one has to remove and replace the failed concrete using cementitious repair mortar.

Whilst repairing, corrosion inhibitors can be introduced. These products mitigate the impact of ongoing reactions.

Cathodic protection can also be included where HAC is severe. Anodes are installed and attached to the reinforcing bar to provide an electronic current that prevents corrosion.

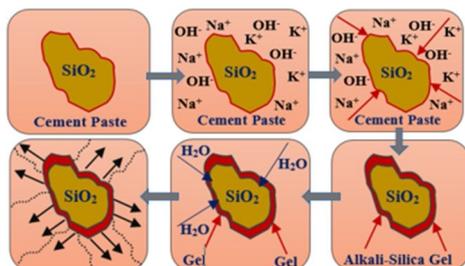
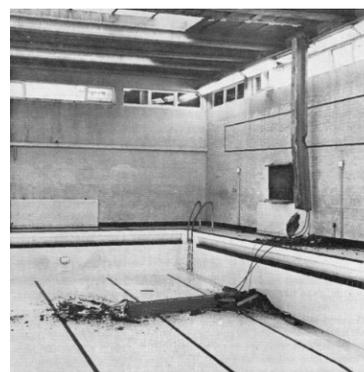


Image courtesy of: Fanijo, E.O., Kolawole, J.T. and Almakrab, A. (2021) 'Alkali-silica reaction (ASR) in concrete structures: Mechanisms, effects and evaluation test methods adopted in the United States', *Case Studies in Construction Materials*, 15.



HAC causes collapse of roof beam in stepney school pool: Courtesy of:

Neville, A. (2009) 'History of high-alumina cement. part 1: Problems and the stone report', *Proceedings of the Institution of Civil Engineers - Engineering History and Heritage*, 162(2), pp. 81-91. doi:10.1680/ehh.2009.162.2.81.