

Alkali-Silica Reaction (ASR)

Pop-outs



Introduction

Concrete is a mixture of natural sand and stone that is glued together with portland cement, supplementary cementitious materials, water, and admixtures. You can expect some variations in surface and performance because concrete is mostly made of natural materials. Concrete can provide long-term durability and value when you use quality materials, and place, cure and maintain it properly. This document addresses a specific concrete issue and provides guidance on how to prevent it.

What are Alkali-Silica Reaction (ASR) Sand Pop-outs?

These occasionally occur in some parts of Minnesota, Iowa and South Dakota when glacial sands react with cement in a way that causes spotty surface discoloration or small pop-outs in local concrete flatwork projects. Specifically, the sands contain silica shale particles, which react to the alkali in the cement.

These pop-outs are most often found on hard-troweled surfaces and appear within a few hours to a week after a concrete flatwork project is finished. They have a maximum diameter of about 1/4 inch (6mm) and depth of about 1/8 inch (3mm).

Field evidence indicates that a combination of factors – the aggregates, alkali in cement, weather conditions, and finishing and curing techniques - determine the frequency and severity of ASR pop-out formation.

Is my concrete OK?

Yes, ASR sand pop-outs do not harm the concrete structurally or otherwise shorten its life; they only affect the concrete's appearance. Talk to your contractor about your expectations for the appearance of your concrete project.

What is the science behind these ASR pop-outs?

The ASR reaction described above is the most common form of alkali-aggregate reactions in concrete.

A series of laboratory concrete tests were performed to evaluate the factors influencing pop-out formation, and test possible remedies. These tests showed that the following situations aggravate the problem:

- Alkalis rising to the drying surface during and after finishing.
- High temperature and low humidity during finishing.
- Common curing techniques, such as membrane curing, and curing under tarps or polyethylene sheeting.

Sealing concrete with spray-on, membrane-forming compounds or using chemical hardeners such as sodium silicate on freshly placed concrete may also increase the number of pop-outs.

How do I minimize ASR sand pop-outs?

The following procedures offer the best protection against the formation of ASR sand pop-outs when reactive sands must be used. These curing techniques must be initiated soon after finishing is completed.

1. Protect fresh concrete from drying before the final finishing work.
2. Avoid hard troweling because it often causes ASR sand pop-outs.
3. Flush the surface with flowing water.
4. Start wet curing as soon as possible. This can be done by ponding, or by curing under continuously moist sand or burlap.
5. Do not cure the surface with spray-on, membrane forming compounds.
6. Do not use chemical hardeners such as sodium silicate on freshly placed concrete.

If you are concerned about ASR sand pop-outs, please contact your contractor and concrete producer for the most suitable materials and methods for your application.

References

1. Surface Pop-outs Caused by Alkali-Aggregate Reaction, Robert Landgren, David W. Havley, Portland Cement Association (PCA), Research and Development Bulletin, RD121, July 2002, Illinois, USA

For more information, call your local concrete contractor, ready mix producer or www.chooseconcrete.com.

11/16/17