

# Surface Popout Research Project

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MCC is undertaking a research program to explore methods for cost effective remedies to mitigate shale popouts within the concrete surface. The occurrence of these deleterious particles impacts both the metro and out-state areas.

The purpose of the research will be to explore potential remedies for the formation of shale popouts in the concrete. Shale popouts typically occur due to the formation of a silica gel product through a chemical reaction between the opaline shales and the alkalinity of cement. The formation of this gel causes an expansive process. This alkali silica gel forms and as it imbibes water, expansive pressures are created which interrupts the mortar between the confined gel and the concrete surface, thus forming a popout.

Studies have shown many factors affect the incidence of popouts for a given aggregate source. These factors include the following:

- alkalinity of the cement
- cement content
- water/cement ratio
- finishing and curing techniques
- ambient conditions
- and slab thickness

Previous studies have shown both lithium hydroxide and ground, granulated, blast furnace slag, if batched with the concrete, help in reducing and/or controlling alkali silica reactivity where the aggregate source contains particles susceptible to alkali silica reactivity. In comparison to other aggregates nationwide, the opaline shales (which cause popouts) present in Minnesota are much more expansive and react much quicker.

MCC is planning a test program which will include casting test panels. This test program will include topical applications of both liquid and granular lithium hydroxide, as well as another lithium-based liquid product, supplied by FMC, Inc. In addition, we are planning to incorporate blast furnace slag into some of the concrete mixtures. Our current plan for this work is to cast a series of 3' x 3' x 4" thick slab-on-grade sections using potentially reactive (1% shale) aggregates and a high alkali (1% alkalinity) cement, as this combination typically leads to numerous popouts. This work will be performed in the early summer of 1997, i.e., late June, as this will give a curing period of the hottest part of the summer and the highest incident of shale popouts. Variables of the test program will include the water/cement ratio; presence of ground, granulated, blast furnace slag; finishing techniques; topical application of both liquid and granular lithium hydroxide; topical application of another lithium product and curing techniques. Currently, we are planning for a manageable number of test panels, possibly 30-50, depending on the test parameters chosen.

As always, MCC being a non-profit organization, we are looking for volunteers who will help supply the necessary labor, materials, and supplies to build, place, and monitor the test panels. Of course, once the testing is completed and the results are compiled, a report will be issued for our membership. If you have any questions or would like to get involved with this project, please contact me at (612) 659-1361.