

MITIGATING ALKALI-SILICA REACTIVITY (ASR) WITH SLAG CEMENT

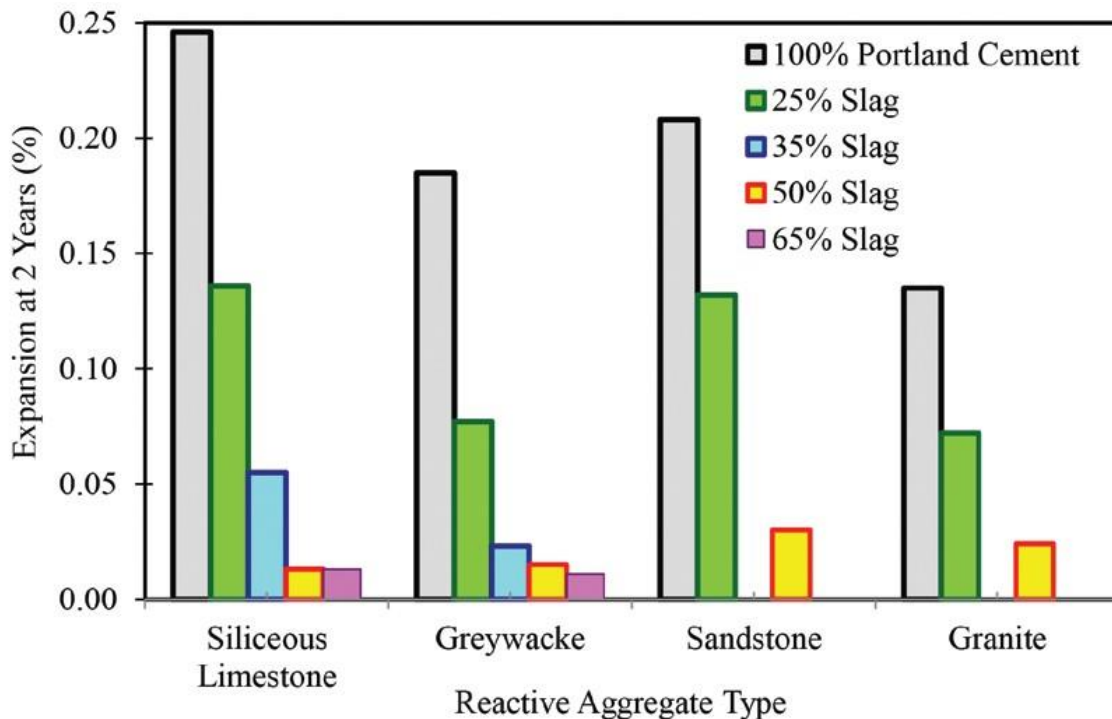
Alkali-silica reaction or (ASR) is a chemical reaction between the alkalis in portland cement and certain types of silica present in some aggregates. The reaction product is a hygroscopic gel, which absorbs moisture and swells. Under certain circumstances, the formation of the gel can cause expansion and, eventually, cracking of the concrete. Factors that affect the rate and severity of ASR include:

- Aggregate reactivity.
- The availability of alkalis in the concrete.
- The exposure conditions (moisture availability and temperature).
- The type of concrete element (size and reinforcement details).
- Calcium hydroxide depleted paste.

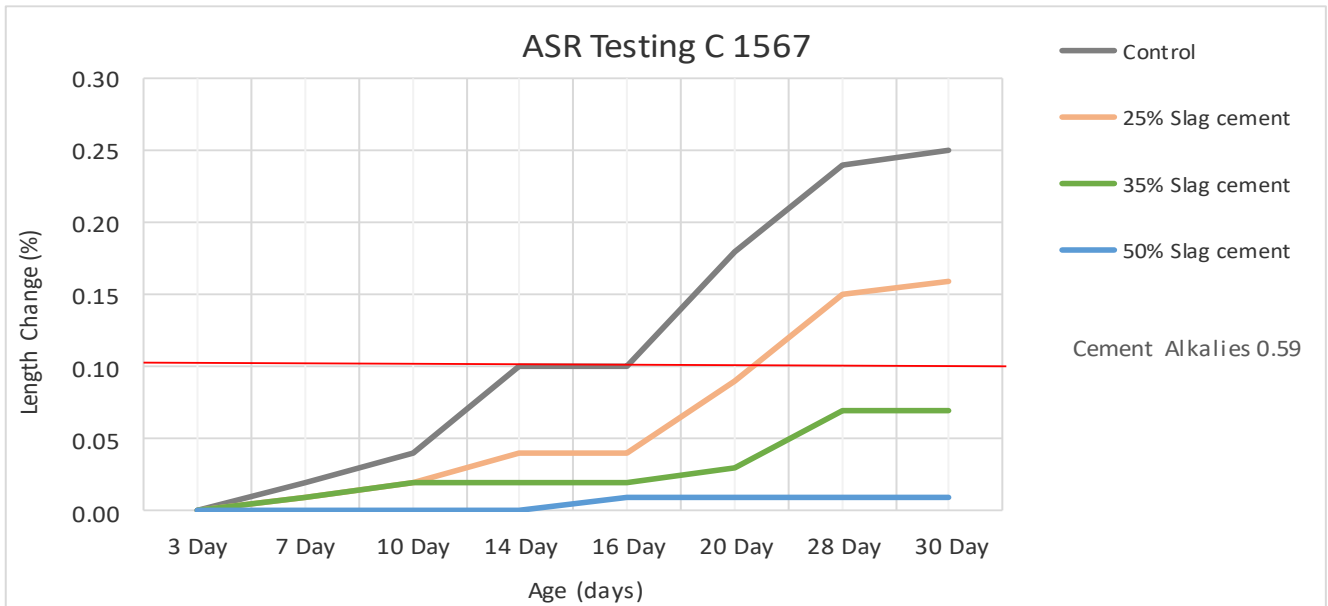
In some cases, ASR may cause severe concrete deterioration causing the concrete to be more susceptible to damage by freeze/thaw or chloride ingress and corrosion. ASR appears as map-cracking and spalled concrete and typically appears where moisture is present.

Slag Cement Association

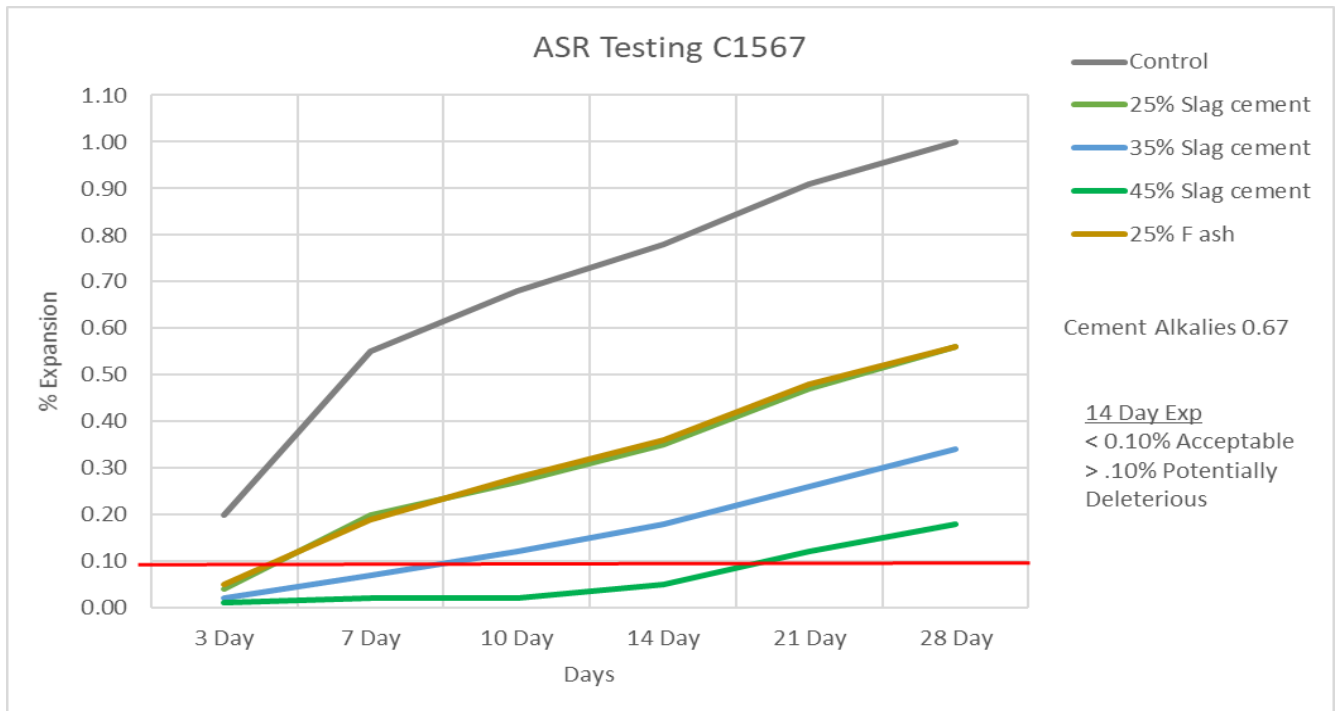
Effect of slag cement on the expansion of concrete containing reactive aggregate



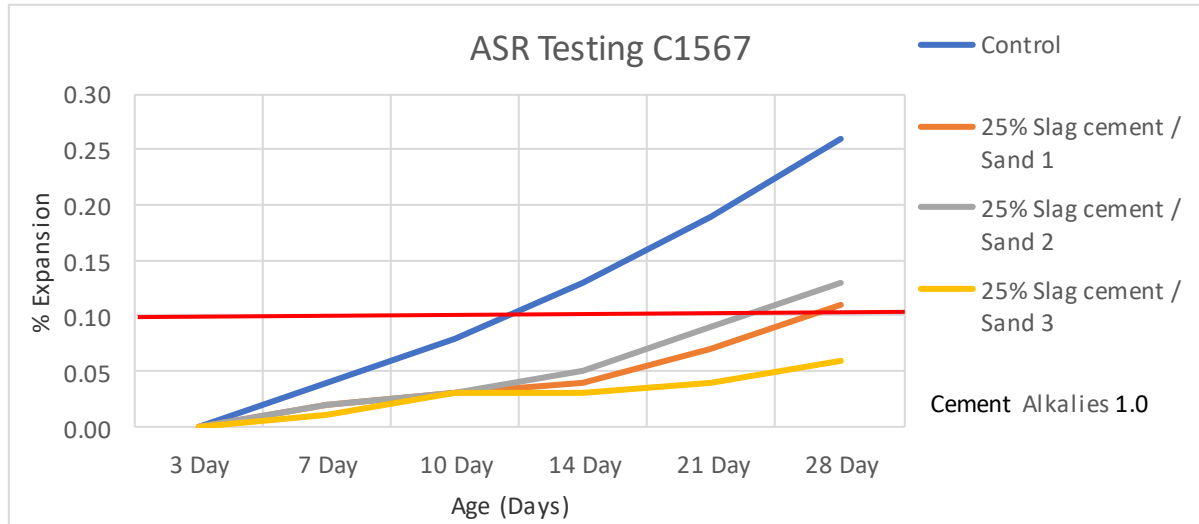
TEST RESULTS



The graph below shows the F ash mix falling at 25%. The slag cement replacement percentage needs to be at least 50% cement replacement to meet the 0.10 expansion limit.



This graph shows the expansion with different sands with a high alkali cement. Even with a high alkali cement ASR mitigation can be achieved,



The amount of slag cement required with a reactive aggregate can be determined by testing various slag cement replacement percentages (20% - 60%) using the accelerated mortar bar test ASTM C1567 (14 days) or the concrete prism test ASTM C1293 (1 -2 years). The prescriptive approach of AASHTO PP65-11 can also be used.