Everlast Concrete Technologies

Best Permanent Concrete Protection

EVERLAST CONCRETE TECHNOLOGIES RESEARCH & DEVELOPMENT

CPS, addressing ALKALI – SILICA REACTION

In Portland cement concrete there are several deleterious chemical reactions that can take place between the aggregate and the surrounding hydrated cement paste. The most common reaction is that between the active silica constituents of the aggregate and the alkali in Portland cement.

The reaction starts with the attack on the siliceous minerals in the aggregate by the alkaline hydroxides derived from the alkalis in cement. As a result of this reaction, an alkali-silicate gel is formed, either in planes of weakness or pores in the aggregate, where reactive silica is present, or on the surface of the aggregate particles. In the latter case, a characteristic altered surface zone is formed. This may destroy the bond between the aggregate and the surrounding hydrated cement paste.

The gel is of the "unlimited swelling" type: it imbibes water with a consequent tendency to increase in volume. Because the swelling gel is confined by the surrounding hydrated cement paste, internal pressures result and may eventually lead to expansion, cracking and disruption of the hydrated cement paste. Thus, expansion appears to be due to hydraulic pressure generated through osmosis, but expansion can also be caused by the swelling of the still-solid products of the alkali silica reaction. For this reason, it is believed that it is the swelling of the hard aggregate particles that is most harmful to concrete. Some of the relatively soft gel is later leached out by water and, deposited in the cracks already formed by the swelling of the aggregate. The size of the siliceous particles affects the speed with which reaction occurs, fine particles (20 to 30mm) leading to expansion within a month or two, larger one only after many years.

The progress of alkali silica reaction is complex, but it is important to bear in mind that it is not the presence of alkali-silica per se, but the chemical response to the reactions that lead to the cracking of concrete.

The alkali-silica reaction occurs only **in the presence of water**. Because water is essential for the alkali-silica reaction to continue, drying out the concrete and prevention of future contact with water is an effective means of stopping the reaction; it is in fact the only means. Conversely, alternating wetting and drying aggravates the migration of the alkali ions, which move from the wet to the drier part of the concrete. A moisture gradient has a similar effect.

Other factors influencing the progress of alkali-silica reaction include the permeability of the hydrated cement paste, because this controls the movement of water and the various ions, as well

2050 South Blvd, # 1064, Bloomfield Hills, MI 48303, USA
info@everlastconcretetech.com
www.everlastconcretetech.com

as the silica gel. Everlast Concrete Technologies' CPS has the ability to halt alkali-silica reaction in its tracks by utilizing a large portion of the concrete's free (unbound) alkali to produce a very unique colloidal material barrier which intern prevents further water movement into or through concrete. Virtually eliminating the possibility of alkaline pore water existence. (Reference: Properties of concrete, by Adam Nevill).

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