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Chlorides? What's all the fuss?

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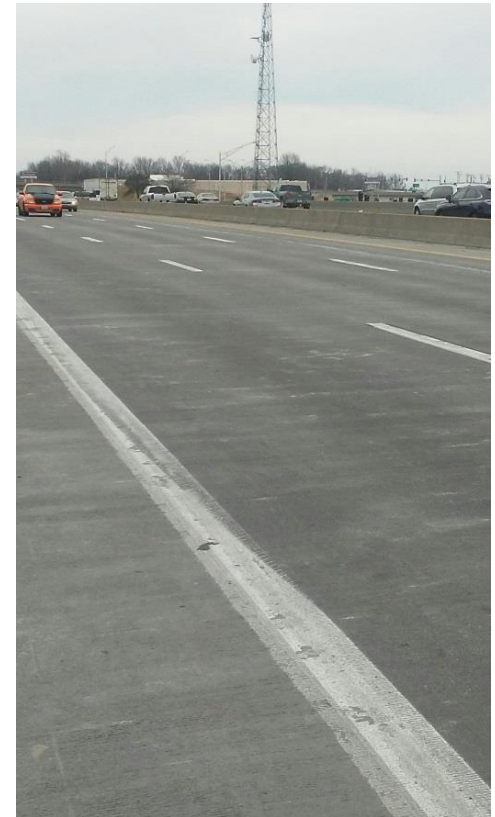
In many parts of the United States, the use of calcium chloride to treat bridge decks in the deicing process is a common occurrence. The use of these chemicals can have a profound effect on accelerating the deterioration of bridge decks. For many agencies the combination of chlorides and reinforced concrete causes them to shudder. But is all the angst over chlorides in a concrete bridge deck worth all the concern? Can we live with chlorides in a bridge deck?

No doubt chlorides are definitely part of the mechanism that can lead to the initiation of the corrosion process on the reinforcing steel within the deck. When that reinforcing steel starts corroding, it leads to the expansion of the steel, which in turn causes the surrounding concrete to delaminate around the bars. This fracture, as it propagates, eventually leads to spalling within the area of cracking. But what does all this mean with regard to diagnosing the problem and determining if the bridge deck can be rehabilitated with chlorides still in it?

A common threshold that agencies have adhered to in evaluating their decks for chloride contamination with regard to determining treatment options has been 2.0 lbs/cu yd. Often, below that level, decks were designated potentially as rehab candidates, while levels reached in excess of the threshold were thought to be too far gone, and needed to be replaced, or at least have all the chlorides extracted from the area of repair.

So, what happens if a deck is rehabbed with heavy chloride content? Will its life expectancy be drastically reduced or will the overlay system fail?

To answer that, let's think about what is happening with the corrosion process and the strength of the concrete. First of all, just because concrete has chlorides within it does not mean corrosion is initiated. It is only a factor that can lead to the initiation of that corrosion. The corrosion process requires three things – the presence of chlorides being one, but also moisture and air. When corrosion is initiated the surrounding concrete quality is



IS 70 WB over US 40 in Kansas City. Hydrodemolition used to rehab deck in 2011. Chloride content at rebar level was 3.5 lbs/cu yd when tested in June 2010. LMC overlay is performing very well.

compromised. Delamination of the concrete occurs from around the reinforcing steel, due to the forces caused by the steel volume trying to increase, creating stresses on the concrete. This leads to fracture of the concrete. The concrete is micro fracturing and loses its bonding strength and original capacity quickly. Over time it becomes easy to remove by mechanical methods (such as jackhammering or hydrodemolition).

Now, let's look at that same slab that has been saturated with chlorides but has not experienced any notable corrosion yet. Is the quality of that concrete satisfactory? Is it weakened, and if so, to what point?

Hydrodemolition is a very powerful tool that can help to determine the effectiveness and soundness of existing concrete. Using pressures in ranges of 15,000 psi to 20,000 psi, this method of concrete removal can remove sound concrete to desired depths, plus any weakened or deteriorated concrete, which it will quite quickly be able to break up. If there is concrete within the slab that is even slightly compromised in its capacity, it will easily be identified and removed by the hydrodemolition jet.

When looking at a chloride contaminated slab, if any form of corrosion has initiated on that section of slab, the concrete will be weakened and hydrodemolition will find it, pressurize and blast apart the micro fracturing present, and break that concrete apart. Or, if the compressive strength in any way has been reduced, from the effects of chloride contaminated concrete, the impact from the high pressure nozzle on the robot will break up the area. The process also cleans up any exposed reinforcing steel, so that no layers of delamination on the steel itself will remain.

That leaves the question, what about the chlorides left in place? With the addition of a very dense, waterproof overlay (latex modified concrete) to encapsulate and shut off the path for water and air to get to the reinforcing steel, two of the three needs for corrosion have been eliminated from the equation. Even though there may be chlorides still in the deck, the corrosion process has been essentially suspended.

For many years the Missouri Department of Transportation (MoDOT) performed deck testing through sampling of chloride contents, electrical testing methods (half-cell potential) and sounding of the deck. They used this data in decision making for deck rehabilitation and replacements. Many decks, however, were rehabilitated with hydrodemolition and latex modified concrete in the early to mid-2000's, despite their chloride content. The condition of these deck overlays are still good and show no ill effects from any residual chlorides.

About six to seven years ago MoDOT even eliminated deck testing from its deck evaluation process altogether. Now their decks are evaluated through the visual deck inspection process only – both top and bottom side. The nice thing about hydrodemolition is that it will seek out and find the bad concrete in your deck. You don't need to sound and mark, or guess where the

weakened concrete is. Just let the equipment do it for you.

There are a number of agencies that continue to hesitate programming deck rehabs for Fast Track Hydro due to chloride content. This has led to needlessly programming decks for either total replacement or as a deck rehab that includes removal with total bar exposure to try and isolate the top mat of reinforcing steel entirely, and then re-pour the top portion of the slab. The cost of doing this is astronomical when compared to Fast Track Hydrodemolition, adding double or more to the cost of, and time required, for the deck work. Try this recipe instead:

1. For chloride contaminated or deteriorated decks, remove the top layer of concrete by conventional milling down to the top mat of reinforcing steel.
2. Perform total surface Fast Track Hydrodemolition across the entire deck.
3. Clean up all the debris, wash and sound the deck to insure all deteriorated or weakened concrete has been removed. Any chloride-laden concrete remaining will be very sound.
4. Place the latex modified concrete overlay.

Watch how the combination of Fast Track Hydrodemolition with latex modified concrete protects the deck for 20...25...or more years of extended service life. It is well worth the investment.

Bridge	County	Route	Chlorides @ Rebar	Deck Test Year	Overlay Year	Overlay Condition
A2898	Jefferson	A	2.7	Dec-04	2007	Good
L0972	Jackson	IS 70 EB	2.3	Jun-10	2011	Good
L0973	Jackson	IS 70 WB	3.5	Jun-10	2011	Good