Investigation of Some Current Issues Relating to Electrochemical Chloride Extraction from Reinforced Concrete

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In bridge structures, de-icing and sea salts are considered significant factors in the corrosion of reinforcing steel. Reinforcing steel is vulnerable to corrosion due to concrete's porous nature and its' susceptibility to cracking. The pores and cracks provide ionic pathways, through which the mobile chloride ions can migrate. Upon reaching the reinforcing steel, the chloride ions promote and increase the localized corrosion. A second detrimental factor transpires when the corrosion product requires a larger volume of space than the original iron. This creates tensile stresses and the concrete becomes susceptible to cracking and spalling. Therefore, finding an economical method of reducing chloride levels adjacent to the reinforcing steel in chloride contaminate concrete would lessen the financial burden associated with bridge restoration.

One enterprising technique in bridge restoration is electrochemical chloride extraction (ECE). It is similar to cathodic protection except that ECE utilizes higher current densities and is a temporary in-situ procedure [1-3]. ECE is a proven means of removing chlorides from the concrete structure while increasing the alkalinity of the pore solution that is adjacent to the reinforcing steel. Despite prior successes, four important aspects remain:

- Identify the factors that decrease the current and current efficiency over time (decreasing the rate of chloride extraction).
- Determine if initial parameters can be related to the duration of time required for chloride extraction.
- Devise a model for the expected beneficial life of a treated structure.
- Suggest techniques for altering the procedure and/or materials to improve and expedite the process.

Data from field and laboratory experiments indicate certain regions appear more inefficient during ECE. Tightly adherent surface formations have been observed during the extraction process and are shown in Figure 1.

Presumably, by determining the regions of low efficiency and the controlling mechanisms, questions relating to extraction rates, efficiency, and beneficial life can be addressed. Subsequent modeling in conjunction with additional laboratory testing are expected to provide the remaining details necessary to address the final issue regarding process improvement.

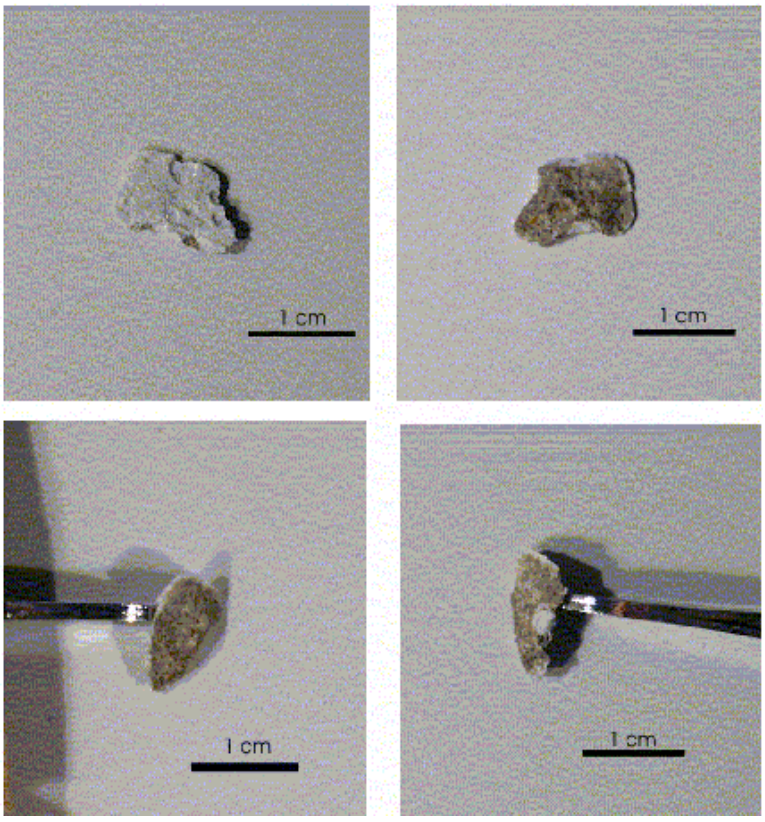

Figure 1 Surface formation on concrete following ECE. (Top Left) Top view showing surface formation. (Top Right) Underside of concrete/surface formation sample. (Bottom) Side views of concrete/surface formation sample.

References

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