

TDS-NAVFAC EXWC-CI-1405

## Corrosion Inhibitors for Concrete Repairs

December 2013

### Technology Description

Despite the advances in corrosion control technology, corrosion of reinforcing steel is still the primary cause of deterioration of concrete waterfront structures. Inorganic compounds have been added to concrete for a number of years with the belief that they increase concrete life by inhibiting corrosion. These same compounds are now being employed in repair overlays and patches with the intent of improving the repairs, which typically last only a couple of years in marine environments. While accelerated tests have shown some benefit to the use of these compounds, the results in actual structures have not been as favorable.

New organic (ester-amines and alcohol-amines) are being introduced as alternatives to the previously employed inorganic compounds. Laboratory and field studies by the Federal Highway Administration and various DOT's indicated mixed results with the use of corrosion inhibiting admixtures in new construction. Information on the use of inhibitors (especially the organic type) as admixtures or topically applied in repairs is limited, but studies by at least one state DOT recommends against their use in patches and overlay applications made to chloride contaminated concrete. Since the vast majority of waterfront concrete structure deterioration is the direct result of

corrosion induced by the ingress of chlorides from seawater, the viability of corrosion inhibitor use in their repairs was investigated by EXWC.

Inhibitor evaluation was integrated into an ongoing repair project of the main berthing wharf at Naval Station Pearl Harbor. The investigation included all known commercially "available" types employed as admixtures or applied topically. A control mix that did not include any inhibitors or additives (water reducers, etc.), and the standard contractor repair mix, specified for repair of the wharf, was also included in the test matrix.



Repair pour

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## **Value to the Warfighter**

Repair of concrete represents a major expenditure on the waterfront infrastructure. Spalling continues to reoccur subsequent to patching, overlaying, and rehabilitation despite the routine use of corrosion inhibiting admixtures. While the cost of these inhibitors is low, reliance on them for prolonged integrity in a major rehabilitation project negates the benefit of the entire project expenditure if the repairs are short lived due to resumption of corrosion.



Deck Monitoring

## **Economics of the Technology: ROI or Payback**

No benefit of using of corrosion inhibiting admixtures in concrete repair patches has been demonstrated by this investigation. Differences in the patch material and the existing concrete material, which are responsible for the initiation of corrosion cells, have not been shown to be altered sufficiently to cause a reduction in activity over the test period. Subsequent corrosion (around the patch) with the inhibitors would be expected to be as large or greater with respect to macro-cell corrosion. Corrosion within the patch itself may be reduced to some degree by some of the inhibitors either inherently on the micro-cell level, or by behaving cathodically in the macro-cell, however, uninhibited repair material of good quality would be expected to outlast the existing base material.

## **Technology Transition Documentation**

Transition Category 4 - to provide the Government the knowledge base or information to make decisions

The Technical Report TR-NAVFAC ESC-CI-1220 Corrosion Inhibitor Evaluation for Concrete Repairs February 2012.

## **Site Implementation**

In 2013 the repairs were re-examined and additional measurements were made for assessment of corrosion activity. Reinforcement within the patch areas remains relatively cathodic to reinforcement of adjacent concrete with some corrosion visible at interfaces. To date no benefit of using of corrosion inhibiting admixtures in concrete repair patches has been demonstrated.

Recommend re-examination of repairs, and additional measurements for re-assessment of corrosion activity at future dates. In addition, concrete chemistry analysis (including chloride profile measurements) may be of benefit in determination of the subject inhibitors influence on behavior in new construction

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