A Sustainable and Cost-Effective Treatment for Accelerated Low Water Corrosion

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Summary

Accelerated low water corrosion (ALWC) is a microbiological form of attack in steel in marine environments and affects steel structures such as harbour walls and jetties. The bacterial activity produces an aggressive local environment which eats steel away at up to 25 times the rate of normal corrosion, leading to costly repairs or contributing to premature structural failure. An innovative method to treat this phenomenon has been developed, using the components of seawater to sterilise and then deposit a protective coating onto marine steel structures affected by accelerated low water corrosion.

Keywords: Accelerated low water corrosion, ALWC, sheet pile walls, marine corrosion, microbial corrosion, ports and harbours, bacterial influenced corrosion (BIC).

1. Introduction

Accelerated low water corrosion (ALWC) affects steel marine structures such as harbour walls and jetties. Caused by bacterial activity, it eats steel away at up to 25 times the rate of normal corrosion, contributing to premature structural failure. ALWC as a phenomenon has been reported globally and a variety of methods have traditionally been used, singly and in combination, to protect against it. This process has been developed as targeted treatment to address ALWC.

2. The ALWC Corrosion Problem

ALWC occurs generally at the low tidal zone in bands, although at some locations this appears to extend down to bed level. Both sulphur reducing bacteria (SRB) and sulphur oxidising bacteria (SOB) are present and exist in layers depending upon oxygen availability. The corrosion surface of a structure under attack is identifiable by a bright orange product, (ferric hydroxide), a sludge like black deposit (iron sulphide) and a steel surface which is bright with characteristic deep pits on the surface.

The emergence of ALWC in recent years has been suggested to be linked to cleaner inshore waters which have been influenced by modern environmental regulation imposed upon polluting industries. Certainly the coastal waters around many ports in Europe are cleaner than they have been for well over 100 years. However, the phenomena remains somewhat puzzling in that it attacks particular structural forms in preference to others and can be found in one part of a harbour and not another. Some speculation on the reasons for this have been offered by suggesting it is due to inherent stresses within structures or due to the presence of micro-defects caused during manufacture.

The Institute of Civil Engineers Maritime Board (1) conservatively estimated that current repair costs resulted from ALWC on port infrastructure in the UK was in excess of £250 million (over

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€313 million). In a worldwide perspective the costs are likely to run into the billions of Euros, with a similarly heavy impact on berth availability and overall trade.

3. Conventional Methods for dealing with ALWC

Over the last 15 to 20 years a great deal of work has gone into identifying and adapting relatively conventional treatment methods in attending to the effects of ALWC in ports and harbours. These represent established methods, either already used in the industry to treat related problems or imported from other industries. All of these come with some degree of track record and are defined in the 2005 CIRIA Report "Management of Accelerated Low Water Corrosion in Steel Maritime Structures (2).

Protective methods typically utilise a protective coating system allied with a matched cathodic protection (CP) system. This approach, (and others), have some disadvantages, including expense, difficulties in application, disruption to port operations, introduction of contamination into the water and ongoing maintenance and monitoring requirements.

4. The developed solution to ALWC

This process has been developed as a focused treatment using only components from seawater to provide a holistic treatment against ALWC. The technique cleans, sterilises and deposits a protective calcareous coating onto ALWC affected areas only.

A major advantage of this process is that it is an environmentally-friendly, where all the active agents are derived from seawater. The process also greatly reduces the requirements for new material resources to repair ALWC damage, thereby minimising waste and enhancing the sustainability of existing port and maritime structures. Further it has advantages in not requiring permanent installation of elements to the substrate steel or complicated systems to isolate the piled structure from seawater during treatment.

5. Discussion and Conclusion

The process is now a fully developed commercial product and has provoked a great deal of interest in the ports and harbour community, principally in the UK where it is best known but also within the wider industry worldwide. As the trialling of this innovative process has included application at a number of key UK ports, where operators are familiar with the process and have been seeking to roll out the method across considerable lengths of sheet pile walls and other structures.

Additionally, the technique has been recognised in the industry and gained success in recent awards during 2011, being chosen as the "Innovation of the Year" at the British Expertise International Awards and winning top place in the Research, Studies and Consulting category at the Engineering Excellence Awards held by the Association of Consulting Engineers.

6. Acknowledgements

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7. References

[1] ICE Maritime Board, *"Concentrated Corrosion on marine steel structures"*, 2000.

[2] Construction Industry Research and Information Association (CIRIA), *"Management of Accelerated Low Water Corrosion in Steel Maritime Structures"*, Report C634, 2005.