


 **MARKHAM**
adding life to concrete

INCREASING COASTAL CONCRETE LIFE WITH HYDROGEL TECHNOLOGY

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- CONCLUSION



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Introduction

BACKGROUND AND CHALLENGES



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BACKGROUND AND CHALLENGES

MARINE CONCRETE AT RISK

- Coastal concrete is an integral part of global ports and supply chain infrastructure.
- Maintenance efforts have largely fallen behind as issues associated with the chemical attack of concrete persist.
- Chemical and physical attack is due to the aggressive marine environment.
- Harmful and reactive chemicals permeate through the 'hardened sponge' of concrete porosity, reaching the reinforcing steel, and triggering and feeding a cycle of deterioration.

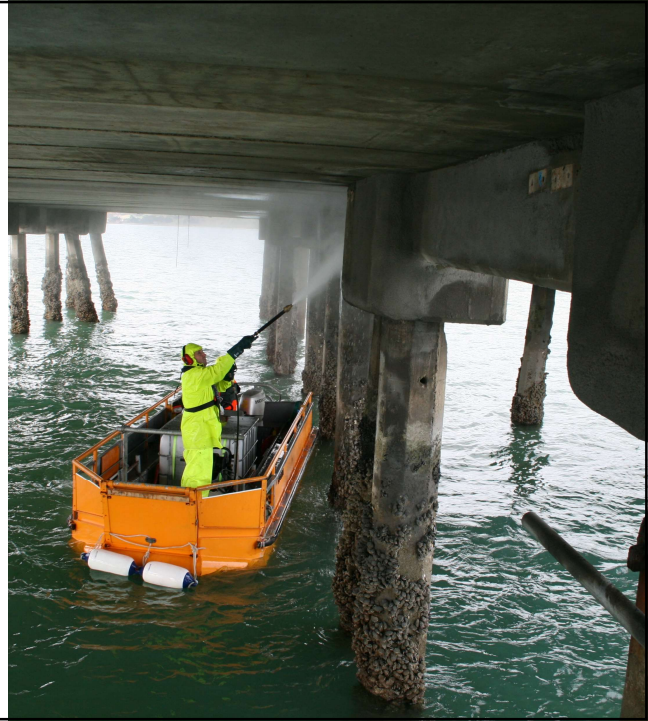


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Practical solution

CONCRETE HYDROGELS



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CONCRETE HYDROGELS

WHAT IS A HYDROGEL?

- A hydrogel, in any context, is a water-based gel formation consisting of cross-linked polymeric chains.
- In the context of concrete, a hydrogel formation can be induced within the porosity of the concrete, by the application of a catalytic colloidal silica.
- This hydrogel formation reduces the number of pathways available for migration of deleterious materials.
- The silica-based hydrogel can absorb cementitious pore water, maintain the hydrogel 3D integrity, and develop into more of the backbone of concrete strength, calcium-silicate-hydrate (C-S-H).



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CURRENT RESEARCH

- The research described in this paper examines the efficacy of hydrogel technology to increase the service life of concrete structures in ports and coastal situations.
- Experimental methods were used to investigate
 - permeability under water pressure, and
 - chloride migration from ponding.
- The hydrogel technology used in this research was designed for both new concrete susceptible to extensive damage, and existing damaged structures.



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Detail of research outcomes

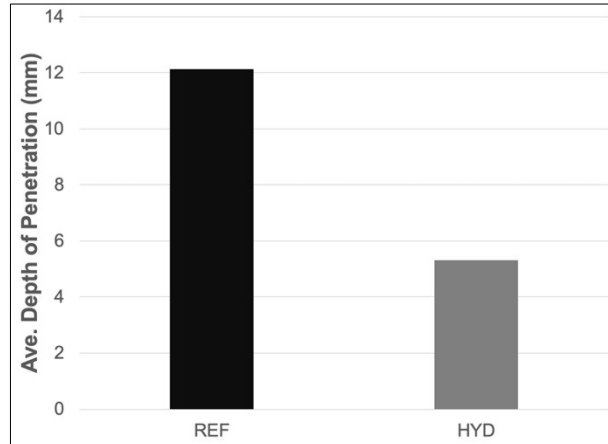
TESTS AND RESULTS



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BS 12930-8 Testing hardened concrete depth of penetration of water under pressure

- The application of the hydrogel technology (HYD) resulted in an average water depth reduction of over 50% when compared to the reference (REF).

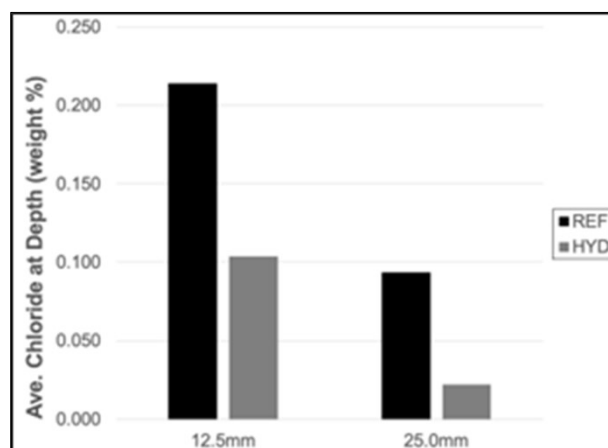


Averaged 12930-8 data set from REF and HYD Samples

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AASHTO T 259 Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration

- At both depths the hydrogel technology (HYD) reduced the chloride concentration by more than 50% compared to the reference (REF).



Averaged T 259 data set from REF and HYD Samples

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Summary

CONCLUSION



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CONCRETE HYDROGELS

CAN HYDROGEL TECHNOLOGY EXTEND MARINE STRUCTURES' SERVICE LIFE?

- Concrete's susceptibility to water and chloride ingress leads to corrosion of the concrete and reinforcing steel, which is the number one cause for premature concrete failure.
- This research establishes the efficacy of the hydrogel technology to reduce water penetration, thus impeding the damage inducing chemicals and other elements from entering the concrete and reaching the steel reinforcement. The hardened, less permeable concrete that results from the application of these hydrogels protects the marine structure from further physical and chemical attack.
- **If utilized proactively, these hydrogels can extend the service life of marine structures.**



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