Resisting Corrosion to Extend Service Life of Port Infrastructure

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Corrosion

- Corrosion damage costs waterways and ports over $300,000,000 USD each year.
How do we protect infrastructure from corrosion?

• Barriers
  • Coatings
  • Concrete
• Cathodic protection
  • Galvanic and impressed current
• Corrosion resistant construction materials
  • Improved steel grades or composite materials
• Reduce exposure to contaminants
• Regular maintenance
Environment

• Most severe environment for ports?
  • **Tidal splash zone**
  • Repeated wet/drying cycles
  • High oxygen availability
  • Exposure to chlorides in salt and brackish water ways

What do we typically see in the tidal/splash zone of Ports?
Steel
Steel
Coatings don’t last for ever
Why are we putting our most corrosion susceptible material in the most severe environment using a short term barrier for protection?

Design decisions have a significant impact on the future of a structure.
Most common question I get as a corrosion engineer

• What can you do to protect my exposed steel sheet pile wall from continued corrosion in the tidal/splash zone?
  • Coat it...
  • More importantly Keep up with the coating...
  • Encase it in concrete.....

• Cathodic protection will not work above the water line
  • Unless its encased in concrete
Barriers

• Coatings
  • Provides barrier to contamination
  • Surface prep, surface prep, surface prep
    • Can’t say it enough!!

• Concrete
  • Provides a high pH barrier for steel
  • High pH passivates steel
  • Must control cracking
Cathodic Protection

• Will work on steel
  • Submerged in Water
  • Embedded in Soil and
  • Embedded in Concrete

• Galvanic
  • Set and “forget”
    • Don’t really forget about them!
  • Typically more durably
  • Typically higher cost
Cathodic Protection

• Impressed current
  • Typically cheaper to install
  • More control over protective current
  • Requires maintenance and monitoring to be effective over long term
Better Construction Materials

• Steel structures
  • Higher grade alloys
  • Can be extremely expensive

• Concrete structures
  • Corrosion resistant reinforcing becoming more available
  • Stainless, galvanized, stainless clad, GFRP, Carbon Fiber, MMFX and others
  • More expensive than conventional reinforced concrete
    • But much more cost effective to implement than a high grade steel structure
Asset Management

• Key to the effective service life of any infrastructure
  • Regular inspections
  • Effective maintenance with standardized high-quality repair procedures and materials
  • Transfer knowledge
Design Phase

• Have a material engineer perform a durability review
  • Can have a long lasting impact on structure’s service life
  • How can we design a concrete mix to limit cracking and chloride ingress?
  • Where are the best places for steel structures verses concrete?
  • How can we limit construction defects in barrier coatings?
Thank you!

Questions?