Ductile Iron Pipe Corrosion Control

By: Jeff Mason, PE
Corrosion Overview
Corrosion in Hawaii
Ductile Iron Pipe & Corrosion
Designing for Corrosion
Polywrap
Zinc
Bonded Coatings
Joint Bonding
600 munis in service after 100 years –
23 systems over 150 years old -

WITHOUT corrosion protection
Corrosion Overview

Corrosion in Hawaii

Ductile Iron Pipe & Corrosion

Designing for Corrosion

Polywrap

Zinc

Bonded Coatings
Resistivity
pH
Redox
Moisture Content
Ground Water Influence
Sulfides
Bi-metallic connections
Stray Current
Known Corrosive Environments
KNOWN CORROSIVE ENVIRONMENTS

- Coals
- Cinders
- Expansive Clays
- Mine Wastes
- Swamps
- Peat Bogs
- Mine Wastes
- Landfill Areas
- Alkali Soils
Corrosion Overview

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Known Conditions of Hawaii

Non Homogenous Soils
Low Resistivity
Salts
Acidic Soils
Tidal Influence
High Moisture Content
# HBWS Corrosion Ratings

(ohm-cm)

<table>
<thead>
<tr>
<th>Corrosion Type</th>
<th>HBWS Standard</th>
<th>DIP Standard</th>
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<tbody>
<tr>
<td>Extremely Corrosive</td>
<td>0-1,000</td>
<td>0-1,000</td>
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<tr>
<td>Very Corrosive</td>
<td>1,001-3,000</td>
<td>1,001-1,500</td>
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<tr>
<td>Corrosive</td>
<td>3,001-5,000</td>
<td>1,501-2,100</td>
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<td>Moderately Corrosive</td>
<td>5,001-10,000</td>
<td>2,101-2,500</td>
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<tr>
<td>Mildly Corrosive</td>
<td>Over 10,000</td>
<td>2,501-3,000</td>
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<tr>
<td>No Corrosion Protection</td>
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<td>3,000+</td>
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<tr>
<td>Protection Necessary</td>
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HBWS Oahu
Soil Test Results – 688 samples

Extremely Corrosive
Very Corrosive
Corrosive
Moderately corrosive
Mildly corrosive
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STEEL PIPE MANUFACTURING
DIFFERENCES IN DUCTILE IRON PIPE
ANNEALING:

135 \mu m \quad 143 \mu m

50 \mu m
ANNEALING:
Corrosion Overview
Corrosion in Hawaii
Ductile Iron Pipe & Corrosion

**Designing for Corrosion**

Polywrap
Zinc

Bonded Coatings
unplug corrosion

- anode
- electrolyte
- return path
- cathode
unplug corrosion

electrolyte

anode ← return path → cathode
ADVANCEMENTS IN PIPE LONGEVITY:

The Design Decision Model

Better Together!
Corrpro and DIPRA Share Technical Resources for Corrosion Control

Learn more at www.dipra.org
<table>
<thead>
<tr>
<th>Consequence</th>
<th>Likelihood</th>
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<tr>
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POLYETHYLENE ENCASEMENT

- Oxygen Deficient Water
- Cinder
SOIL VERSUS

Both Probes in Soil
Depleted < 300 Days

POLY ENCASEMENT
**Outer Layer:** Linear Low Density Polyethylene (LLDPE) - Light color for UV resistance

**Intermediate Layer:** Thick, impermeable middle layer for toughness and enhancement of inner biocide layer

**Inner Layer:** LLDPE
Enhanced with a Corrosion Inhibitor and a Biocide to Address Anaerobic Bacteria Associated with MIC, Microbiologically Influenced Corrosion.

Advanced Active Corrosion Control Technology begins where Conventional Passive Polywrap Systems End.
Volatile Corrosion Inhibitor
microbiological induced corrosion
biocide
Salt Water Test – 12 Years

V-bio
Polywrap
Bare Iron
Corrosion Rate - Polyethylene

Everglades, FL

Probe Location

Graph showing the corrosion rate over time for polyethylene in Everglades, FL.
Corrosion Rate – Vbio Polywrap

Everglades, FL

CORROSION RATE (MPY)

PROBE LOCATION

DAYS

10 YEARS
The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be *infused with a blend of an antimicrobial* to mitigate microbiologically influenced corrosion and a *volatile corrosion inhibitor* to control galvanic corrosion.
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ZINC APPLICATION
ZINC COATING

Zn$^{+2}$

COATING
ZINC

SELF HEALING
Repair Methods
When NOT to use Zn Only

- soil pH below 4.5
- Soil pH greater than 9
- areas of stray DC currents
- extremely corrosive soils (i.e. < 1,500 ohm-cm)
- for areas of flowing water

...install WITH polywrap
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Polywrap
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peen pattern

annealing oxide

ejoint assembly
Ceramawrap Epoxy
Ceramawrap Epoxy

Designed SPECIFICALLY for Ductile Iron Pipe

99% Solids Ceramic Epoxy-

Barrel Thickness: Applied at 20-25 mils-

Spigot Thickness: 6-10 mils-

High Impact Resistance-
Application

ONLY applied by Induron Approved Applicators

Pipe Delivered Bare

Abrasive Blast Entire Surface

Applicator assumes liability for coating
Applicator Locations

Price Estimate = 20-30% adder per foot
Repair Methods

Repair kits available

General surface prep, dry surface

2 part epoxy, 15 minute pot life

Brush on

Dry time - 3 hours
Field Cuts

Spigot must be sanded down to 10 mils (0.01"")

Accuracy is challenging

Required for MJ Connections as well
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