Zinc Coated Ductile Iron Pipe

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Presentation Agenda:

• Application
• DIP Manufacturing
• Brief History of Zinc Coatings on Ductile Iron (DI) Pipe
• Application Process of Metallic Zinc Coating
• How Zinc protects DI Pipe
• Introducing Zinc Coating on DI Pipe
• Testing Data in highly corrosive soils
• VBIO Polywrap and Zinc Coating Combination
Applications

- Transmission & Distribution Lines
Applications

• Bridge Crossings
Applications

- Trenchless
Applications

- River Crossings
Applications

- Other Applications
  - Treatment plant piping
  - Power Plant Piping
    - Make-up water lines
    - Cooling water lines
  - Pump Station Piping
How it’s Made
## Pressure Class vs. Thickness Class

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Class 350</th>
<th>Class 52</th>
<th>Class 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>6”</td>
<td>0.25”</td>
<td>0.31”</td>
<td>0.43”</td>
</tr>
<tr>
<td>8”</td>
<td>0.25”</td>
<td>0.33”</td>
<td>0.45”</td>
</tr>
<tr>
<td>12”</td>
<td>0.28”</td>
<td>0.37”</td>
<td>0.49”</td>
</tr>
<tr>
<td>36”</td>
<td>0.56”</td>
<td>0.53”</td>
<td>0.73”</td>
</tr>
</tbody>
</table>
Recycling

- More than 93% recycled material
- Content from cars, structures, etc.
- SMaRT Certified
Melting

- Uses Cupola or Contiarc
  - Recycled steel
  - Limestone
  - Silicon Ferrite
  - Pig iron
  - Coke or coal

- Sample button
  - Sent to Quality Assurance
  - Gas spectrometer
  - Guarantees all elements are within acceptable limits
Mixing

- **Induction Mixer**
  - 1,100 ton and 1,300 ton capacity
  - Assures consistent and uniform ductile iron metallurgy
Conversion to Ductile Iron

- Inoculation in a pressure ladle
  - Magnesium added under pressure
  - Changes graphite from flake to spherical form
- Imparts 60 - 42 - 10 physical properties
Casting

- Centrifugally cast
  - Steel mold
  - Sand and Resin Head core
  - RPM ranges from 300-1,200
Annealing

- Relieves residual casting stresses
- Releases internal gases
- Softens the metal
- Increases ductility
- Metallurgical homogeneity
Hydrostatic Test

- Pressure test every pipe to at least 500 psi
- Unique to iron pipe - IMPORTANT!
- Confirms structural integrity of the pipe
Linings and Coatings

- Application-dependent linings
  - Cement lining pioneered
  - Protecto 401; Tnemec 431 lining
  - Glass lined

- Application-dependent coatings
  - Zinc
  - Various Primers
Extending the Life of your System

- Zinc coated ductile iron pipe
- V-Bio Polywrap
Corrosion

- Important to understand what causes corrosion
- Electrochemical process involving chemical reaction and electron transfer
- Dissimilar metals in water system. Less noble is anode and gives up electron and is area which corrosion is most evident
- Rate of corrosion depends on:
  - Degree of metallic dissimilarity
  - Conductivity of soil
- Want to protect system and extend life
Why Zinc?

- Among non ferrous anodic metals, most readily available and least expensive.
- Over 60 year history of external corrosion control of iron pipe.
- Light weight, self healing nature of zinc.
Brief History of Zinc Coatings

- 1984 - UK supplying all new DI Pipe (80-800mm) with a zinc coating
- 1984 - Zinc spray of 130 g/m² w/bitumen topcoat is common in Europe
- 1985 - International Standard Organization (ISO) 8179 standard created
- 1995 - Zinc spray of 200 g/m² w/bitumen topcoat is common in Europe.
- 2015 - Zinc Coating to USA market
Application of Zinc Coating

- Pipe surface cleaned and preheated
- High Purity Zinc Wire is atomized into metallic droplets
- Arc Spray Process or Flame Spray
- Clean Compressed Air propels onto rotating surface
How It’s Applied
How Zinc Protects DI Pipe

• Zinc bonds exceptionally well to the annealing oxide layer (13-14 mils)
• Annealing oxide layer itself reduces rate of corrosion by Factor of 10
• Zinc is Anodic to Iron (200 g/m²) forms galvanic couple between Zn and Fe and acts like an anode by sacrificing itself
• Bituminous Asphalt Topcoat (1-2 mils) protects the Zinc and controls the expenditure
• Zinc sacrifices itself to form Zinc Carbonate and other protective compounds
Introducing Zinc Coated Ductile Iron Pipe

- Zinc coated layer with mass of 200 g/m² of pipe surface area
- Exceeds ISO 8179 Standard of 130 g/m²
- Bituminous Asphalitic topcoat (1-2 mils)
- NSF 61 approved for potable water contact
- Cost effective life extension measure
• Soil Category (<10 Points on DIPRA Scale)
  • Asphalt Coated – 0.000667” per year (373 year life)
  • Asphalt + Polywrap – 0.000 per year (infinite life)

• Soil Category (≥ 10 Points on DIPRA Scale)
  • Asphalt Coated – 0.0105” per year (24 yr life)
  • Asphalt + Polywrap – 0.000453” per year (550+ estimated yr life)

• Soil Category (Uniquely Severe)
  • Asphalt Coated – 0.0287” per year (9 estimated yr life)
  • Asphalt + Polywrap – 0.0068 per year (37 estimated yr life)
Testing Data

- DIPRA Test Environments
  - Uniquely Severe Example
  - Everglades, FL
    - Resistivity = 110-200 Ohm-cm
    - Fluctuating tidal brackish waters
    - Anaerobic Conditions (sulfate reducing bacteria)
    - Wet, highly corrosive muck
    - Redox Potential = -100mV
    - Sulfides - Positive
    - DIPRA 10 Point Evaluation = 23.5 Pts
1991 Installation

- Asphalt Coating (PW)
  - 10.7 Years (0.0068” per/yr), 37 yr estimated life

- Zinc (200 g/m²) + Asphalt (Damaged PW)
  - 10.7 years (0.00252” per year at damage), 100 yr estimated life

- Zinc (200 g/m²) + Asphalt (PW)
  - 10.7 years (Zero Corrosion), Life > 100 years
VBio Polywrap and Zinc Coating

• Polywrap isolates iron from fresh supply of oxygen thus inhibiting corrosion.

• Zinc coating can be a secondary sacrificial protection in areas of damaged encasement

• Very powerful, cost effective combination for aggressive soil conditions
Common Questions about Zinc on DIP

• Can Megalugs be used on zinc coated pipe? YES

• Can Fast Grip RJ gaskets be used on zinc coated pipe? YES

• Can cathodic protection be added on zinc coated pipe? YES

• How much life expectancy does zinc add to the pipe? VBio + Zinc =250 yrs Plus

• Which manufacturers can supply zinc coating? American and US Pipe

• Is Zinc Coating system NSF 61 approved? YES

• Why is there a topcoat? It traps the zinc oxides after the zinc does its job and forms a passivating layer of protection

• Why is zinc coated ductile just now being introduced domestically? Now cost effective domestically