GROUNDLINE CORROSION PROTECTION

- presented by -

Howard Kennedy
hkennedy@madisonchemical.com
905 878 8863 (ph) 905 878 1449(fx)
Madison Chemical Industries Inc.
Goal

- Provide a basic understanding of corrosion and the polyurethane technology used to combat it.
Topics

- What is Corrosion?
- How to Stop Corrosion?
- What is Polyurethane?
- Application
- Safety & Environmental
- Performance
- Case Histories
Howard Kennedy

- 13 years in polyurethane
- farmer by training
- coated first power pole in 1990
- Manager, Special Projects
- Madison Chemical Industries
- primary supplier of groundline protection
What is Corrosion?

- Transfer of electrons between two dissimilar metals through an electrolyte
- ANODE - gives up electrons (corrodes)
- CATHODE - gains electrons
- ELECTROLYTE - passes electrons
Electrochemical Reaction

Cathode  Fe  Zn  Anode
Electrolyte

Electron Flow
Metal Reactivity

More Anodic
- Magnesium
- Zinc
- Chromium
- Iron
- Nickel
- Tin
- Lead
- Gold

More Cathodic
Corrosion Elements

- Anode - steel
- Cathode - steel
- Electrolyte - soil

Steel Pole

Electron Flow

Soil
How Much Corrosion?

- Depends on...
  - Soil type
  - soil contaminants
  - moisture content
  - salt level
  - bacteria
  - etc., etc.
Steel Rusts!!
THE GOOD NEWS

We know how to stop it!!
Corrosion Prevention Methods

- Select materials that do not corrode
  - may lead to other problems
  - cost
- Remove the electrolyte
  - may not be practical
  - expensive
Corrosion Prevention Methods

- Cathodic protection
  - zinc, galvanizing
- Di-electric coating
  - polyurethane
- Cathodic Protection and Di-electric Coating
  - zinc + polyurethane
Corrosion Protection

- Polyurethane Di-electric Coating
- Sacrificial Zinc Coating
- Steel Pole
- Ground Line
- Corrosion Zone
- Soil
WHAT IS A POLYURETHANE?

ASTM Definition

Urethane based upon vehicles containing a minimum of 10 percent by weight (nonvolatile vehicle basis) of a polyisocyanate monomer reacted in such a manner as to yield polymers containing any ration, proportion or combination of urethane linkages, active isocyanate groups, or polyisocyanate monomer. The reaction products may contain excess isocyanate groups available for further reaction at time of application or may contain essentially no free isocyanate as supplied.
POLYURETHANE EQUATION

iso + polyol = polyurethane

R-NCO + R’-OH = R-NH-COOR’
POLYURETHANE YOU OWN:

“the average family owns 25 to 100 lbs of polyurethane”

Buist, J.M., Developments in Polyurethanes, 1986
Polyurethane
You Own

“Varnished” wood
Foam insulation
-refrigerators, freezers
Flexible foam seating
-cushions, seats
Automotive paint
Fenders
Bumper covers
Running shoe soles
Roller blade wheels
Glue, sealant
Bowling balls
Artificial Heart valves
equal, etc., etc., etc.
UTILITY POLE  POLYURETHANE

- ASTM Type V
- thermoset plastic
- 100% solids / Zero VOC’s
- 1:1 ratio
- aromatic iso
- rigid
- fast cure
Dog & Pony
Application Advantages

- Fast Cure
  - 10 minutes to handle
- 1 Coat (multi-pass)
- Unlimited film build
- Cure down to minus 40
- Lower total applied cost
Application Equipment

Drums of Coating

- Hoses
- Plural Comp. Airless Pump
- Heated Hoses
- Spray Gun
2 Component Spray Machine
Manual Application
Automatic Application
• NO Coal Tar
• NO Amines
• NO monomeric isocyanate
• NO solvents
• NO flammability
• “early warning”
GREEN TECHNOLOGY

- no VOC’s
- no solvents
- no coal tar
- no leachate
  - EPA TCPL Testing
HOW LONG DOES THIS STUFF LAST???
“Madison polyurethane coatings will typically outlast conventional coating technologies by at least 30 to 50% based on lab performance testing and case histories”
PERFORMANCE TESTING

- Toughness
- Corrosion Resistance
PERFORMANCE TESTING

- TOUGHNESS
  - Flexibility (ASTM D522)
  - Impact resistance (ASTM D2794)
  - Abrasion resistance (ASTM D4060)
PERFORMANCE TESTING

- CORROSION RESISTANCE
  - Adhesion (ASTM D4541)
  - Cathodic disbondment (ASTM G8)
  - Chemical resistance (ASTM D714)
  - Salt spray resistance (ASTM B117)
  - Water absorption (ASTM D570)
## Polyurethane vs. Epoxy

<table>
<thead>
<tr>
<th>TEST</th>
<th>CORROCOTE II CLASSIC</th>
<th>EPOXY</th>
<th>BETTER</th>
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</thead>
<tbody>
<tr>
<td>Impact</td>
<td>40 in. lbs</td>
<td>16 in. lbs</td>
<td>Higher</td>
</tr>
<tr>
<td>Flexibility</td>
<td>1” mandrel</td>
<td>2” mandrel</td>
<td>Lower</td>
</tr>
<tr>
<td>Abrasion</td>
<td>80 mg loss</td>
<td>120 mg loss</td>
<td>Lower</td>
</tr>
<tr>
<td>CD Resistance</td>
<td>0.5 in.²</td>
<td>1.5 in.²</td>
<td>Lower</td>
</tr>
<tr>
<td>Adhesion</td>
<td>&gt;2000 PSI</td>
<td>1000 PSI</td>
<td>Higher</td>
</tr>
<tr>
<td>Permeability</td>
<td>0.002 perm in.</td>
<td>0.002 perm in</td>
<td>Lower</td>
</tr>
</tbody>
</table>
POLYURETHANE PROPERTIES

- Very Tough and Durable
- Extremely Corrosion Resistant
300,000 Tanks - Zero Failures

Underground Fuel Storage Tanks

American Iron and Steel Institute
Steel Transmission Poles
111 Year Life Expectancy

Wastewater Pipe, San Diego, CA

American Iron and Steel Institute
World Record Directional Drill

Corpus Christi River Crossing
SUMMARY

- Steel rusts but we know how to stop it
- Polyurethane Technology
- Fast to Apply (cost efficient)
- Environmentally Friendly
- Tough & Durable
- Excellent Longevity