Learning Objectives

➢ Examine the challenges facing the North American pipeline rehabilitation market

➢ Discuss advancements in Cured-In-Place Pipe (CIPP) and reinstatement of service connections

➢ Review a recent pilot project
North American Pipeline Rehabilitation Market
Potable Water Infrastructure Condition

According to Bluefield Research:

• The estimated average age of water pipelines across the nation has climbed from 25 years in 1970 to 45 years in 2020 — largely because of underinvestment.

• U.S. utilities lose nearly two trillion gallons of water — 15% of the total drinking water treated nationwide — to leaks each year.

• Municipal non-revenue water losses — real losses, apparent losses, unbilled consumption — run as high as 43% in major U.S. cities and exceed 85% in some smaller rural communities.

According to the American Society of Civil Engineering (ASCE) 2021 Report Card for America’s Infrastructure:

• Our nation’s drinking water infrastructure system received a “C-” grade.

• A recent survey found that 47% of the maintenance work undertaken by utilities is reactive and done as systems fail.

• Our nation’s drinking water infrastructure is composed of 2.2 million miles of pipe. By 2019, utilities were replacing between 1% and 4.8% of their pipelines per year on average.
North American Pipeline Rehabilitation Market

- U.S. & Canada – Water/Wastewater Networks – Water Pipeline Rehabilitation: $3.8 billion

<table>
<thead>
<tr>
<th>Water Pipeline Rehab - Sub-Categories</th>
<th>% Spend</th>
<th>Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Burst</td>
<td>11%</td>
<td>$432</td>
</tr>
<tr>
<td>Cured-in-place Pipe</td>
<td>7%</td>
<td>265</td>
</tr>
<tr>
<td>Slipline</td>
<td>6%</td>
<td>243</td>
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<tr>
<td>Epoxy Lining</td>
<td>3%</td>
<td>121</td>
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<tr>
<td>Cement Mortar Lining</td>
<td>5%</td>
<td>197</td>
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<tr>
<td>Dig and Replace</td>
<td>49%</td>
<td>1,855</td>
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<tr>
<td>HDD</td>
<td>7%</td>
<td>273</td>
</tr>
<tr>
<td>Other</td>
<td>11%</td>
<td>403</td>
</tr>
</tbody>
</table>

Total Addressable Market - Pressure Pipe Solutions: $1,290

Pressure pipeline agencies are less inclined to use trenchless technology compared to gravity pipeline agencies, primarily due to additional access requirements and unfamiliarity.
Cured-in-Place Pipe (CIPP)
What is Cured-in-Place Pipe (CIPP)?

• Developed in 1971, Cured-in-Place Pipe (CIPP) is a trenchless technology:
  • Initially used in sewers (~30,000 miles)
  • Full length, jointless, “pipe-within-a-pipe”
  • Minimally disruptive installation methods

• Market needs later led to development of a pressure-capable CIPP product:
  • Uses reinforcing materials and advanced resins to meet environmental and physical properties demanded by pressurized systems
  • Certified to NSF/ANSI 61 standards
  • 50+ year engineered design
  • Utilizes multiple curing methodologies
    • Steam, hot water, UV light
Pressure CIPP Glass Composite Structure

**Epoxy/polyester felt structure**
- Provides for external load capacity
- Layer thickness can be varied depending on loading conditions
- Utilizes epoxy resin system instead of polyester resin (drinking water safe)

**PP/TPU coating**
- Water contact surface
- Coating also provides water barrier for installation processes & handling

**Epoxy/fiberglass structure**
- Provides high tensile/hoop strength
- Number of layers varies depending on diameter and internal pressure

**Hazen-Williams Coefficient**
- $C=140$
Pressure CIPP Technical Envelope

Potable water

Raw water

Reclaimed water

Sanitary water

Industrial (Fire & Process Water)

Technical Envelope

- Diameter = 6” to 96”
- Max. Operating Pressure = 250 psi
- Bends = up to 45°
- Access Pits Required for Installation
- Internal Reinstatement of Service Connections
CIPP Design Parameters

Gravity CIPP
• Meet the design intent of:
  • ASTM F1216 / AWWA M28
• External design:
  • Soil, groundwater, traffic, and other live loads

Pressure CIPP
• Internal design:
  • Operating, transient and vacuum pressures
• Other factors:
  • End fittings, bends and services
Potential Leak Locations:

- End terminations
  - Vary by product and installer
  - Adhesion, mechanical or combination
- Service connections
  - Excavated, adhesion or mechanical
Mechanical Reinstatement of Service Connections
Historical Service Reinstatement Options

Excavated Mechanical Reconnections:
• Involves open-cut excavation installation of new mechanical connections at each service

Adhesive Reconnections:
• “Plug and drill” method whereby liner adheres to host pipe and service corporation valve
Adhesion or Bond Reliance Summary

- Commercially implemented and cost effective
- Key to bond strength is surface preparation
  - Testing has proved that suitable bond can be achieved
  - Achieving bond is not a localized process
  - Different levels of effort provide varying results
- Long term effectiveness currently not characterized
- No governing standard for bond requirement
- Difficult to measure effectiveness
All reinstatement systems have common requirements/processes – bond reliant to date

1. Prepare internal surface
   – No specification, installer’s requirements

2. Plug existing corporation valves – system specific
   – Direct tapped
   – Saddle tapped – no protruding corporation valve threads

3. Install CIPP pressure pipe liner

4. Terminate/cut liner at ends of lined pipe
   – Processes and effectiveness to provide a leak tight seal at terminations vary

5. Locate service under liner

6. Open service by drilling out plug

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Traditional Internal Reinstatement
Mechanical Service Reinstatement

- First-generation mechanical service reinstatement system introduced in 2009
  - Plastic expandable plug
  - Hollow T-nut inserted and screwed in
- Technically successful but not cost-effective
  - Single process installation per pipe entry (plug and T-nut)
- No reliance on bond or integrity of the host pipe
Mechanical Service Reinstatement

- Current-generation mechanical service reinstatement system recently introduced
- Cork plug with magnetic studs
- Hollow stainless-steel fitting
- Push in installation process
- ½-inch, ⅝-inch, ¾-inch and 1-inch sizes
Mechanical Fitting System Components

**Measurement probe**
Consists of laser sensors and inspection camera

**Self-locating plug**
Installed prior to lining to prevent resin migration

**Drilling tool**
Detects exact location of plug prior to drilling

**Mechanical fittings**
Utilizes a patented push-in-place “Corpbite” system that maximizes pull-out force

**Cartridge loading system**
Holds up to 8 plugs/mechanical fittings to maximize production

**Interface software**
Provides operator with easy-to-use interface for reinstating connections
Mechanical Fitting System Review
Mechanical Reinstatement Pilot Project
Pleasant Grove, UT
Mechanical Reinstatement Pilot Project – Pleasant Grove, UT
Project Description

- Owner: Pleasant Grove City, UT
- Pipe Material: Ductile Iron
- Diameter: 8-inch (measured ID varied from 8-⅛ to 8-⅜ inch)
- Length: 540 LF
- Pressure: 120 psi
- Type: Potable water
- Services: Ten one-inch service connections
- Problem Statement: Historical breaks and leaks
- Other: Pipe sloped downhill to from Pit 1 to Pit 3
Potable Water Bypass
Plug/Fitting Installation Unit
Milling of Direct Tap Corporation Valves
Service Plug Location and Removal
Mechanical Fitting Installation
Thank You for Joining Me Today!

Feel free to reach out with any questions:

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