Overview

• Introduction

• Pipe Condition Assessment
  • The Problem
  • Condition Assessment Alternatives
  • Acoustic Condition Assessment
  • Case Study
  • Summary
  • Questions

• Pipe Rehabilitation
  • Current Problems
  • Pipe Rehabilitation
  • 100% Solid Epoxy SIPP
  • Epoxy SIPP In Practice
  • Questions
Who is SUEZ?

Our History: The SUEZ Canal Company

• **SUEZ Canal Company** formed in 1858
• Used **innovative coal and steam-powered technology** to build canal
• **SUEZ Canal** opened in 1869

**Today:**
• Present in 70 countries
• 80,990 employees
• 323,000 Municipal and Industrial customers
• $18+ billion revenue annually
SUEZ’ HISTORY IN NORTH AMERICA

1869 - Founded as Hackensack Water Company

1974 - Integration of Infilco by Degremont

2000 - Integration of United Water

2008 - Integration of Utility Service Group

2011 - Integration of SENA Waste Services

2017 - Acquisition of GE Water & Process Technologies
SUEZ’ HISTORY IN NORTH AMERICA
SUEZ Advanced Solutions:

**Infrastructure Rehabilitation & Maintenance**
- Rehabilitate
- Maintain
- Back-up short-staffed internal teams

**New Technologies**
- Do more with existing assets to meet new regulations

**Complete Integrated Package**

**Smart Asset Management**
- Increased efficiency
- Optimized operations

SUEZ can provide water utilities with an integrated solution.
Suez Advanced Solutions

Water Wells
- Condition assessment
- Maintenance program
- Pumps services
- Rehabilitation
- Drilling

Water Quality
- Asset chemical cleaning
- Mixers
- THM removal
- Ice Pigging
- Filter media replacement

Steel Water Tanks
- Condition assessment
- Maintenance program
- Rehabilitation
- Drone inspections

Concrete Structures
- Condition assessment
- Maintenance program
- Rehabilitation
- Water, wastewater and storm water assets

Network assets & Meters
- Maintenance program with AMI
- Advanced Network management (Aquadvanced)
- Network condition assessment and rehabilitation
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The Problem

Pipe Age:

Estimated Aggregate Investment in US Water Mains (in millions of 2010 $s)

- 70 years
The Investment Bubble

- AWWA Buried, No Longer Confronting America’s Infrastructure Challenge - $1 Trillion Need
- American Society of Civil Engineers gives drinking water systems a D- Grade
- America’s drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities

USEPA Drinking Water Needs Survey
The Problem

Municipal infrastructure is decaying faster than it is being renewed:

- Pipes are surpassing useful life

<table>
<thead>
<tr>
<th>PIPE TYPE</th>
<th>LIFESPAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron (Pit Cast)</td>
<td>Pre 1850s - 1910</td>
</tr>
<tr>
<td></td>
<td>@120 Years Live</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>1910 – 1970</td>
</tr>
<tr>
<td></td>
<td>@80 - 120 Years</td>
</tr>
<tr>
<td>Concrete/ AC/ Steel</td>
<td>1945 – 2000s</td>
</tr>
<tr>
<td></td>
<td>@75 - 105 Years</td>
</tr>
<tr>
<td>Ductile Iron</td>
<td>1965 – 2010s</td>
</tr>
<tr>
<td></td>
<td>@50 - 110 Years</td>
</tr>
<tr>
<td>PVC</td>
<td>1975 – Now</td>
</tr>
<tr>
<td></td>
<td>@55 - 100 Years</td>
</tr>
</tbody>
</table>
Pipes are surpassing useful life due to:

- Internal Corrosion
- Tuberculation build up
- Loosing wall thickness
- Main breaks

Example of concrete water pipe failure

Example of Cast Iron Pipe Corrosion
The Problem

Underground environment creates a situation for stress cracking and seal leaks.

By design, these systems are subject to initial and subsequent differential settlement

Out of sight, out of mind… until it leaks!
Run To Failure Approach

Consequences on water distribution:
- Loss of hydraulic capacity
- Water loss
- Degradation of water quality / Poisoning
- Collapses

Consequences on collection systems:
- Contamination due to Overflows, Violations
- Inflow & Infiltration / Pumping & treatment cost
- Collapses

14th Street, Atlanta
The Solution

- PIPE REPLACEMENT
- CATASTROPHIC BREAKDOWN
- SERVICE CALLS
- PM PROGRAM

The Best Way to Deal with a Problem is to Prevent it

COSTS

A customized PM Program pays for itself
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Traditional Approach

Due to the difficulties to inspect pressurized pipes, pipe rehabilitation in distribution systems is prioritize based on pipe age and material:

- **Cast Iron (Pit Cast)**
  - Pre 1850s - 1910
  - @120 Years Live

- **Cast Iron**
  - 1910 – 1970
  - @80 - 120 Years

- **Concrete/ AC/ Steel**
  - 1945 – 2000s
  - @75 - 105 Years

- **Ductile Iron**
  - 1965 – 2010s
  - @50 - 110 Years

- **PVC**
  - 1975 – Now
  - @55 - 100 Years
Traditional Approach: The Problem

Two Pipelines Sound The Same

<table>
<thead>
<tr>
<th>Pipeline 1</th>
<th>Pipeline 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed 1860</td>
<td>Installed 1860</td>
</tr>
<tr>
<td>Brown sandy soil</td>
<td>Brown clay soil</td>
</tr>
<tr>
<td>Moderate soil corrosivity</td>
<td>Moderate soil corrosivity</td>
</tr>
</tbody>
</table>
## The Problem

### But Look Very Different

<table>
<thead>
<tr>
<th></th>
<th>Pipeline 1</th>
<th>Pipeline 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed</td>
<td>Installed 1860</td>
<td>Installed 1860</td>
</tr>
<tr>
<td>Soil Type</td>
<td>Brown sandy soil</td>
<td>Brown clay soil</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>Moderate soil</td>
<td>Moderate soil</td>
</tr>
<tr>
<td>Results</td>
<td>31% degraded</td>
<td>1% degraded</td>
</tr>
<tr>
<td>Condition</td>
<td>Poor</td>
<td>Good</td>
</tr>
</tbody>
</table>

![Image of degraded pipe](image1.png)

![Image of good condition pipe](image2.png)
Condition Assessment Alternatives

What is Available?

• Non Pressurized (Sewers)
  o Pole Cameras
  o CCTV inspection
  o Advanced Pipe Condition Assessment Systems (Redzone, Cleanflow, PPR, etc.)
  o Manual and Entry Inspection Methods

• Pressurized system (Drinking Water)
  o Desktop Studies
  o Sahara (Online / Intrusive)
  o Smart Ball (Online / Intrusive)
  o Hydrant Camera / JD7 (Online / Intrusive)
  o Acoustic (Online / Non intrusive)

These methods require to take pipes out of service in potable water

Require insertion of devices in the potable water (Intrusive)
Alternatives: Traditional Approach

More sophisticated engineering studies include additional data to estimate the pipe condition:

- Pipe Material
- Size
- Age
- Soil Type
- History of leaks / main breaks
- Other indirect data

- Over 30 Pipe Classes Identified:
  - Material, Size, and Installation Era
- Pipe Effective Service Life:
  - Estimated based on break rate targets and system wide impacts
Alternatives: Traditional Approach

Desktop Study Alone:

- Over 30 Pipe Classes Identified:
  - Material, Size, and Installation Era
- Pipe Effective Service Life:
  - Estimated based on break rate targets and system wide impacts

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Desktop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop Study</td>
<td>$0.05 / ft</td>
</tr>
<tr>
<td>Error Rate</td>
<td>50%</td>
</tr>
<tr>
<td>Replacement Cost</td>
<td>$200 / ft</td>
</tr>
<tr>
<td>Error Risk</td>
<td>$100 / ft</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$100.05 / ft</td>
</tr>
</tbody>
</table>

The actual cost of a desktop Study can be high when considering the cost to rehabilitate the wrong pipes.
Alternatives: Invasive Condition Assessment

Disruptive Condition Assessment: Smart pigs

Benefits:
- Very accurate

Main Drawbacks:
- Cost / Availability
- Application constraints
  - Pipe diameter
  - Velocity
  - Pressure
  - Geometry
  - Deployment
Alternatives: Invasive Condition Assessment

Disruptive Condition Assessment:

<table>
<thead>
<tr>
<th>Scenario:</th>
<th>Disruptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation Cost</td>
<td>$40 / ft</td>
</tr>
<tr>
<td>Inspection Cost</td>
<td>$10 / ft</td>
</tr>
<tr>
<td>Error Rate</td>
<td>5%</td>
</tr>
<tr>
<td>Replacement Cost</td>
<td>$200 / ft</td>
</tr>
<tr>
<td>Error Risk</td>
<td>$10 / ft</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$60 / ft</strong></td>
</tr>
</tbody>
</table>
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Acoustic Condition Assessment: How Does it work?

Equipment Measures Average Wall Thickness Over Intervals

300 ft to 650 ft
Acoustic Condition Assessment: How Does it work?

Sensors to be placed on Hydrants, valves or directly on top of the main
Acoustic Condition Assessment: How Does it work?

Testing results match best with the thinnest point around the circumference, averaged over test interval

Tuberculation and graphitized material do not contribute to structural thickness

This is the remaining structural thickness!
Acoustic Condition Assessment:
Method Summary

Method Requirements

• Pressure >15 psi
• No air in pipe
• Contact points every 100m to 200m
• Diameter : Thickness ratio of 30:1 or less
• Pipe information (maps, as-builts, repair sections, etc.)

Deliverables For Each Test Segment

• Average structural wall thickness
• Percentage loss
• Qualitative condition
• Leak locations and estimated sizes
• Remaining service live also available for AC and iron mains
Acoustic Condition Assessment: Features and Benefits

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test from outside the main</td>
<td>No operational disruptions</td>
<td>Lower preparation costs. Water never contaminated. Sediment undisturbed.</td>
</tr>
<tr>
<td>Works with all appurtenances</td>
<td>No need to dig up the main or install new ports</td>
<td>Lower total project costs. Minimal traffic disruptions.</td>
</tr>
<tr>
<td>Field tests fast, non-disruptive</td>
<td>Test 1 km / team / day with minimal support</td>
<td>Scalable to large portions of a network</td>
</tr>
<tr>
<td>Report current wall thickness</td>
<td>Easily predict remaining useful life</td>
<td>Allows clear decisions about replacement or rehabilitation.</td>
</tr>
<tr>
<td>Verified and proven</td>
<td>Dozens of utilities have verified our results</td>
<td>Utilities can act with confidence in the information provided</td>
</tr>
</tbody>
</table>

The low cost and minimal support required for Acoustic Condition Assessment make it easy to scale to large portions of a network.
Alternatives: Acoustic

Non-Disruptive Condition Assessment:

Measures Average Wall Thickness Over Intervals

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Non-Disruptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation Cost</td>
<td>$3.50 / ft</td>
</tr>
<tr>
<td>Inspection Cost</td>
<td>$1.50 / ft</td>
</tr>
<tr>
<td>Error Rate</td>
<td>10%</td>
</tr>
<tr>
<td>Replacement Cost</td>
<td>$200 / ft</td>
</tr>
<tr>
<td>Error Risk</td>
<td>$20 / ft</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$25 / ft</td>
</tr>
</tbody>
</table>

Acoustic Condition Assessment provides savings by making sure the pipes in worst conditions are selected:
Acoustic Condition Assessment provides savings in a rehabilitation program, making sure the pipes in worst conditions are selected:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Desktop</th>
<th>Invasive</th>
<th>Acoustic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation Cost</td>
<td>$0 / ft</td>
<td>$40 / ft</td>
<td>$3.50 / ft</td>
</tr>
<tr>
<td>Inspection Cost</td>
<td>$0.05 / ft</td>
<td>$10 / ft</td>
<td>$1.50 / ft</td>
</tr>
<tr>
<td>Error Rate</td>
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<td>5%</td>
<td>10%</td>
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<tr>
<td>Error Risk</td>
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<td>$10 / ft</td>
<td>$20 / ft</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$100.05 / ft</strong></td>
<td><strong>$60 / ft</strong></td>
<td><strong>$25 / ft</strong></td>
</tr>
</tbody>
</table>
Value Proposition

Provides Up to 50% savings by implementing a systematic Asset Management approach including verification (condition assessment) after a traditional engineering study:

- Acoustic Condition Assessment (Distribution water pipes) is the most efficient solution
  - Non-Invasive
    - No service interruption
    - No Risk
  - Most Cost Efficient
  - Quick
    - Minimum preparation required
    - Usually no site preparation / construction needed
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Case Study: Washington DC

Traditional Desktop Study:

- Pipes selected by a computer model considering age, material, soil, break history, and other factors
- Replacing 55 miles of pipe per year to reduce burst rate
Case Study: Washington DC

Traditional Desktop Study:

• After digging up pipes selected for replacement, found that more than 50% were still in good condition.

• Decided to run a pilot program using Acoustic to check the condition of the selected pipes before replacing them.

Project Details

• 43 miles of Acoustic testing
• < $1M invested in Condition Assessment
• 10 weeks of testing
• 0 excavations / 0 disruptions
Case Study: Washington DC

Condition Assessment results:

Project Details
- 43 miles of Acoustic testing
- < $1M invested in Condition Assessment
- 10 weeks of testing
- 0 excavations / 0 disruptions

Results
- 20 miles of good pipe found
- $14M saved (46%)
- $117k worth of leaks found
- Budget redirected from pipes actually in good shape
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The solution: Pyramid Model

The best approach is:
1. Use a desktop study to prioritize where to perform annual acoustic surveys
2. Use acoustic surveys to prioritize pipes for rehabilitation
3. Use invasive inspections if needed for spot investigations
Key Questions:

• Do any of your pipes keep you up at night?
  o Condition Assessments can help you understand that pipe’s condition

• Do you have an annual budget for replacing mains?
  o Condition Assessments can let you be sure you are replacing the right ones

• Are you happy with how your pipe replacement choices are being made?
  o Condition Assessments lets you make decisions based on actual condition

• Have you ever replaced pipes and then discovered they were still in good shape?
  o Condition Assessments can help you avoid wasting this money

• Is your existing condition assessment program too costly?
  o Condition Assessments offers the lowest total project cost on the market
Questions?
Pipe Rehabilitation
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Market Overview
Actual annual expense


Construction/Rehab Spending

<table>
<thead>
<tr>
<th>Year</th>
<th>Rehabilitation</th>
<th>New Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>780 million</td>
<td>3.58</td>
</tr>
<tr>
<td>2013</td>
<td>1.0</td>
<td>3.8</td>
</tr>
<tr>
<td>2014</td>
<td>1.9</td>
<td>4.3</td>
</tr>
<tr>
<td>2015</td>
<td>2.1</td>
<td>4.7</td>
</tr>
<tr>
<td>2016</td>
<td>2.2</td>
<td>5.0</td>
</tr>
<tr>
<td>2012</td>
<td>817 million</td>
<td>4.3</td>
</tr>
<tr>
<td>2013</td>
<td>3.2</td>
<td>4.3</td>
</tr>
<tr>
<td>2014</td>
<td>3.6</td>
<td>4.8</td>
</tr>
<tr>
<td>2015</td>
<td>1.3</td>
<td>5.0</td>
</tr>
<tr>
<td>2016</td>
<td>1.5</td>
<td>5.5</td>
</tr>
<tr>
<td>2016</td>
<td>1.8</td>
<td>4.1</td>
</tr>
</tbody>
</table>

7.3% Needs ($40B)
3.5% Needs ($89B)
8.7% Needs ($116B)
**Cured in Place Pipe**

- Fabric tube impregnated with thermosetting resin
- **Inserted in host pipe and heat cured** – 2 Methods
  - Pulled into host pipe and expanded by water pressure
  - Liner turned inside out (Inversion)

**Advantages:**
- Service connections can be reinstated by robotic cutters

**Disadvantage:**
- Requires extensive pre-investigation
Spray in Place Pipe

- Thorough cleaning of host pipe
- Spray host pipe with a thin lining of resin (typically 1mm thick)

Advantages:
- Minimal excavation

Disadvantage:
- Requires a completely clean and dry host pipe
- Traditionally not providing structural rehabilitation (WQ)
Sliplining

- HPPE pipe is pulled into host pipe

**Advantages:**
- Not reliant on integrity of host pipe

**Disadvantages:**
- Reduction in pipe diameter (but maybe not in capacity)
Close Fit Sliplining – Diameter Reduction

- New pipe temporarily deformed
- Two methods
  - Swaging
  - Compression Rollers

Advantages:
- Limited loss of pipe diameter

Disadvantage:
- Difficult to install if irregularities in host pipe
Close Fit Sliplining – Rolldown

- Liner is heated and folded
- Liner is winched into host pipe and reshaped by heat and pressure

**Advantages:**
- Limited loss of pipe diameter and accommodates bends

**Disadvantage:**
- Reversion process may be difficult
Pipe Bursting/Pipe Splitting

- HPPE pipe is attached to bursting head
- Break and displace host pipe
- Pull replacement pipe into the void

Advantages:
  - No cleaning required; facilitates upsizing

Disadvantage:
  - Difficult in some situations; not suitable for Asbestos Cement mains
Pipe Bursting - Execution

Distance between pits: approximately 100 metres
Horizontal Directional Drilling

- Pilot bore to line and grade
- Reamer and new HPPE pipe pulled through in reverse direction

Advantages:
- Less disruption compared to open cut; existing supplies not cut-off

Disadvantage:
- Depends on suitable soil conditions and corridor free from existing services
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100% Solids Epoxy

- Structural Epoxy Spray Lining
- Rapid cure (< 2 hr)
- Moisture tolerant (i.e. surfaces don’t have to be 100% dry)
- Single coat monolithic coating (i.e. no multiple coats)
- NSF approved and Bisphenol free
- Less downtime and significant savings
Coating Specification Details

<table>
<thead>
<tr>
<th>Coatings Specification Details</th>
<th>ASTM F-1743</th>
<th>100% Solid Epoxy</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>3,000</td>
<td>7,000</td>
<td>233%</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>4,500</td>
<td>11,000</td>
<td>244%</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>Not Listed</td>
<td>12,000</td>
<td>--</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>250,000</td>
<td>500,000</td>
<td>200%</td>
</tr>
</tbody>
</table>

AWWA M-28 Standards for rehabilitation of water mains. This specifies ASTM F-1743 as the class 4 Structural lining standard.

ASME PCC-2 Design considerations for buried pipe test standards were utilized and documented by Madero Engineering, Houston, TX. Certified wall thickness for our lining material for partially deteriorated pipe to resist both internal and external loads.

ASTM F1216 Standard practice for rehabilitation of existing pipeline standards were utilized and documented by Madero Engineering, Houston, TX. Certified wall thickness of our material comply with this standard.

"the ultimate capacity of all specimens exceeds 400 psi hydrostatic pressure”

– Kent Harries, Ph.D., FACI, P.Eng.

Associate Professor of Structural Engineering and Mechanics University of Pittsburgh.
Coating Specification Details

• Coatings are able to withstand prolonged exposure to heat, chemical and aggregate

• Other situational applicable coatings include:
  • HVAC
  • Sewer
  • High Temperatures
  • Cooling Tower
  • Fire hydrant lines / stand pipe
  • Steam vaults
  • Steam condensate lines
  • Cogeneration
  • Domestic Water
Structurally Enhance & Reinforce

State of the art robotic spray application
  • Computer-controlled for more refined application and curing.

Material bonds to your piping system–
  • Preventing and sealing cracks
  • moves with the structure, abating leaks caused by settlement.
## Spray-In-Place Pipelining Process

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Map system</td>
<td>• Repair or replace damaged pipe sections</td>
<td>• Abrasive cleaning with conical spray head to near-white metal finish <em>(as specified by manufacturer)</em></td>
<td>• Pipe’s state of good repair enhanced with epoxy lining</td>
<td>• TV inspection</td>
</tr>
<tr>
<td>• Utilize computerized pipe video surveillance to inspect and digitally record findings</td>
<td>• Flushing &amp; drying</td>
<td>• and need for coating repair</td>
<td>• Extends life of repaired or replaced pipe</td>
<td>• Epoxy inspection of pipe lining for thickness</td>
</tr>
<tr>
<td>• Review findings with property management</td>
<td>• Tuberculation removal</td>
<td>• Prevents corrosion and biological buildup</td>
<td>• Grit blasting</td>
<td>• Hydrostatic pressure testing</td>
</tr>
<tr>
<td>• Diagnose and identify restoration plan</td>
<td>• Grit blasting</td>
<td>• Enhances flow capacity</td>
<td></td>
<td>• Leakage pressure testing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dampens vibration</td>
<td></td>
<td>• Bacteriological disinfection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Leaching test</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Restoration of system</td>
</tr>
</tbody>
</table>
The Process

SIPP Demo
### Benefits Technology Benchmarking

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Excavation in sewer</td>
<td>✔</td>
</tr>
<tr>
<td>Minimal Excavation in water</td>
<td>✔</td>
</tr>
<tr>
<td>Structural Rehabilitation</td>
<td>✔</td>
</tr>
<tr>
<td>Stronger than the host pipe</td>
<td>✔</td>
</tr>
<tr>
<td>Not exhaust cleaning</td>
<td>✔</td>
</tr>
<tr>
<td>Moisture tolerant</td>
<td>✔</td>
</tr>
<tr>
<td>Keeps Connections</td>
<td>✔</td>
</tr>
<tr>
<td>Suitable for angles, turns, elbows</td>
<td>✔</td>
</tr>
<tr>
<td>Less downtime and significant savings</td>
<td>✔</td>
</tr>
<tr>
<td>No significant pipe diameter loss</td>
<td>✔</td>
</tr>
<tr>
<td>No depends on soil conditions</td>
<td>✔</td>
</tr>
<tr>
<td>NSF approved Rapid cure coating</td>
<td>✔</td>
</tr>
<tr>
<td>Suitable for all materials</td>
<td>✔</td>
</tr>
<tr>
<td>No limitations in small diameter pipes</td>
<td>✔</td>
</tr>
</tbody>
</table>
# Epoxy vs Polyurea

<table>
<thead>
<tr>
<th></th>
<th>Epoxy</th>
<th>Polyurea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tensile Strength</strong></td>
<td>48 MPa</td>
<td>26 MPa</td>
</tr>
<tr>
<td><strong>Flexural Strength</strong></td>
<td>75 MPa</td>
<td>45 MPa</td>
</tr>
<tr>
<td><strong>Flexural Modulus</strong></td>
<td>3.4 GPa</td>
<td>2.8 GPa</td>
</tr>
<tr>
<td><strong>Size Of Pipe</strong></td>
<td>1¼ - 72 inches</td>
<td>4 - 24 inches</td>
</tr>
<tr>
<td><strong>Coating Thickness</strong></td>
<td>Up to 6mm in one run</td>
<td>Requires 3+ runs</td>
</tr>
<tr>
<td><strong>Product Lifetime</strong></td>
<td>Indefinite</td>
<td>Degrades in a few years</td>
</tr>
<tr>
<td><strong>Cure Time</strong></td>
<td>Allows for margin of error</td>
<td>No margin of error</td>
</tr>
</tbody>
</table>
# Epoxy vs Polyurea

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Cures At Low Temperature</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
<tr>
<td><strong>Cures At High Humidity</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
<tr>
<td><strong>Withstand Frost</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
<tr>
<td><strong>Withstand Heat</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
<tr>
<td><strong>Withstand Chemicals</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
<tr>
<td><strong>Withstand Aggregate</strong></td>
<td>✔</td>
<td>✘</td>
</tr>
</tbody>
</table>
# Technology Summary

<table>
<thead>
<tr>
<th></th>
<th>Spray Lining (New)</th>
<th>Spray Lining (Old)</th>
<th>Cement Mortar Lining</th>
<th>Sliplining</th>
<th>CIPP</th>
<th>Pipe Bursting</th>
<th>HDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Excavation in sewer</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>Requires extensive pre-investigation</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Rapid Cure</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<td>☑</td>
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Benefits of Protective Coatings to Consumer

- Protects against future corrosion & degradation
- Extends service life of system piping & components
- Significantly enhances water and air quality
- Reduces frequency of maintenance and decreases costs and system down-time
- Eliminates the leaching of lead from the soldered joints, and the corrosion of copper and steel pipe
- Enhances flow capacity and system efficiency
Overview

• Introduction
• Pipe Condition Assessment
  • The Problem
  • Condition Assessment Alternatives
  • Acoustic Condition Assessment
  • Case Study
  • Summary
  • Questions
• Pipe Rehabilitation
  • Current Problems
  • Pipe Rehabilitation
  • 100% Solid Epoxy SIPP
  • Epoxy SIPP In Practice
  • Questions
100% Solid Epoxy In Practice
Feature Project
Merrick Road – New York American Water Works

- Restored a 100-year-old water main with a history of leaks, severe corrosion and poor water quality in Massapequa, NY

- Successfully lined over a 2 month period in Spring 2016

- Using our proprietary SIPP process, a structural 3 mil (1/8th”) epoxy coating was evenly applied through the entire length of 2 miles of 12” cast iron domestic water pipe under strict zero-VOC policy

- Developed logistics to minimize disruption to 4-lane highway, despite multiple adverse conditions, such as multiple trapezoid sweeps, including underneath small rivers and other utility services
Feature Project
Jersey Shore Pennsylvania Domestic Water Lining Project

- Rural town of Jersey Shore, Pennsylvania, has a gravity fed domestic water distribution system.
- Successfully lined two miles of pipe on time and on budget.
- Base infrastructure 16” and 12” cast iron mains originally installed in the 1890s, to supply steam locomotive station
- System’s lead sealed joints had tuberculation levels as high as 50%
- Bypass system for approximately 150 residences installed and successfully maintained Several trapezoidal pipe layouts under streams and rivers were successfully lined in place.
- This was a turn key project: attended to all site safety, excavation, mechanical and road restoration.
## Marymont Drive – Piqua, Ohio

<table>
<thead>
<tr>
<th>Epoxy Cleaning and Lining</th>
<th>Traditional Pipe Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Required</strong></td>
<td></td>
</tr>
<tr>
<td>3-5 days</td>
<td>4-6 weeks</td>
</tr>
<tr>
<td><strong>Access Requirements</strong></td>
<td></td>
</tr>
<tr>
<td>4 access points</td>
<td>Trench the entire street causing severe and long traffic disruptions</td>
</tr>
<tr>
<td>needing just 3 feet of pipe access</td>
<td></td>
</tr>
</tbody>
</table>
Rte. 42 bridge – Woodstock, Virginia

Epoxy Cleaning and Lining

- **Time Required**: 2-3 days
- **Access Requirements**: 2 access points needing just 3 feet of pipe access

Traditional Pipe Replacement

- **Time Required**: 2-4 weeks
- **Access Requirements**: Close half of the bridge down causing severe and long traffic disruptions
Franklin Avenue - Salem, Ohio

<table>
<thead>
<tr>
<th>Time Required</th>
<th>SUEZ Epoxy Cleaning and Lining</th>
<th>Traditional Pipe Replacement</th>
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</thead>
<tbody>
<tr>
<td>3-5 days</td>
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<td></td>
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</tbody>
</table>

Access Requirements

- 4 access points needing just 3 feet of pipe access
- Trench the entire street causing severe and long traffic disruptions
Past Performance Examples

Kent County Courthouse
Dover, DE

U.S. Government GSA
Washington, D.C.

Indian Head Naval Base
Indian Head, MD

Bechtel
San Francisco, CA

DuPont Facility
Wilmington, DE

Horizon House
Naples, FL

JFK Airport
New York, NY

Saks 5th Ave
New York, NY

WTC Tower 4
New York, NY

299 Park Ave
New York, NY

Christie Street
New York, NY

The Prince
Marco Island, FL
Spray-In-Place Pipelining Process – Summary

- Extends asset life
- Eliminate corrosion and WQ issues
- Recover capacity
- Provides thermal isolation
- Rapid cure and Minimal disruption
- Withstanding prolonged exposure to heat, chemical and aggregate
- Suitable for small diameters, turns and bends (1¼ to 72 inches)
Questions?

For Additional information:

Jeff Austin
503-713-8823
jaustin@utilityservice.com
www.utilityservice.com