Progressive Environmental Services

Protecting What's Been Built, Restoring What's Been Broken

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Progressive

Descaling, Disinfection, Rebuilding, Preservation.

Healthier Water.
A cleaner and safer Environment.
Minimal disruption to life & the economy.
A Successful Chemical Cleaning of Struvite Scale Prolongs the Life Span of Sludge Exporting Pipeline

WEFTEC Los Angeles
Session 9 – Monday, October 17, 2011
3:30-4:00 pm

Steven Carl, I.T. Lemma, D. Montenegro, M. Sinaki,
Introduction
Clogging Mechanisms

- Sedimentation
- Thermodynamically Favored Precipitation
- Biologically Induced Precipitation
Clogging Mechanisms

- Sedimentation
  - Straining
  - Interception
Characteristics of Leachate and Precipitate

- Leachate Analysis
- Precipitate X-Ray Diffraction
- Biological Activity Reaction Tests (BART)
Precipitate Analysis - XRD

Calcium Carbonate
Precipitate Analysis – XRD

Brushite
Calcium Carbonate
Gypsum
Biological Activity Reaction Tests (BART)

- MSW/Ash leachate showed high IRB/SRB Populations
  => Biologically induced CaCO₃ and FeS precipitation
Characteristics of Leachate and Precipitate

- Leachate analysis and geochemical modeling showed thermodynamically favored precipitation of hydroxyapatite and calcite.

- BART showed high populations of SRB and IRB.

- XRD of precipitate showed presence of calcium carbonate, brushite, and gypsum.
Cleaning Technologies

- Mechanical Methods
  - High-Pressure Water Jetting (4,000 and 10,000 psi)
    - Equally Distributed
    - Point-Focus
    - Rotating
    - Flushing
Cleaning Technologies

- Mechanical Methods
  - Cutters and Milling Machines
    - Water pressure driven
    - Designed to align within pipe
    - Potential for damage to pipe
      - Transitions
      - Changes in pipe material
      - Welds within HDPE piping.
  - Explosion potential
    - Landfill Gas
Cleaning Technologies

- Chemical Cleaning
  - Recirculation and/or resurgance of chemical solution
    - Certified biodegradable acid solution
      - Hydrochloric acid, carboxylic acid, alkanolamine, and sodium alkylsulfonate
    - Catalysts
    - Dispersants
    - Inhibitors for base metal protection
Cleaning Demonstrations
Cleaning Demonstrations

- High-pressure water jetting
  - Successful at removing large, intact pieces of precipitate
    - Difficulty flushing large pieces
  - Slow, staged cleaning approach required
    - Increased time and cost
  - Requires access for removal of debris

- Chemical Cleaning
  - Successful in cleaning:
    - Non-perforated LCS piping
    - Perforated LCS pipe with multiple access points
    - 100 - 150 feet of single access perforated LCS piping
  - Requires large chemical volumes
Cleaning Demonstrations

- **High-pressure water jetting**
  - Up to 1,500 feet per week, depending on:
    - Amount of precipitate and
    - Access/removal
  - $10 to $60 per foot

- **Chemical cleaning**
  - Over 2,000 feet per week
  - $20 to $40 per foot

- Chemical cleaning determined to be the best technology for removing heavy precipitate buildup
Combined Chemical-Jetting Technology
- Thrust of the jet for transport
- Jet nozzle with “blow out” disk
- Gravity flow back to manhole
- Chemical solution collected at manhole and pumped back

- Cleaned single-access perforated pipe at lengths greater than 150 feet

Full Scale Chemical Cleaning
Full Scale Chemical Cleaning

- Successful in removing precipitate from:
  - Over 10,000 feet of perforated laterals
  - 4,000 feet of perforated headers
  - 4,000 feet of gravity mains

- Restored flow in areas that appeared stagnant

- Reduced leachate head and liner leakage
Leak Detection Flow Rates

Gallons per month

Completed Chemical Cleaning

01-Oct-10
01-Nov-10
01-Dec-10
01-Jan-11
01-Feb-11
01-Mar-11
01-Apr-11
01-May-11
01-Jun-11
01-Jul-11
01-Aug-11
01-Sep-11
01-Oct-11
01-Nov-11
01-Dec-11
01-Jan-12
01-Feb-12
01-Mar-12
01-Apr-12
01-May-12
01-Jun-12
Products and Services for Water and Waste Water Systems

- Chemical Cleaning
- Structural Epoxy Rehabilitation
**Business Activity**

- Chemical Formulas for cleaning, maintaining and improving Water and Waste Water Systems

- Application of Formulas in Marine, Municipal, Industrial and Fire Protection (including):
  - Sewer Systems Plants & Ships: Struvite cleaning, Scale Removal
    - Over 500 cleaning jobs for Navy and Municipal
  - Waste Collection Systems: Landfills
  - Fire Sprinkler Systems
  - Cooling Towers, Power Generation, Etc.
Chemical Cleaning

Involves Two Major Areas of Consideration

1. Metals, Minerals and Microbes (or Macrobes)
2. People, Equipment, Chemistry and Procedure

Major issues: Time, Money, Safety, Performance and Environmental Impact.
Metals, Minerals & Microbes

- Type of Scale – requires chemical analysis and system history.

- Materials of Construction - one or mixed. Concern for compatibility, plating, reactions, etc.

- Microbes (macrobes) - what’s in the system, how to remove it and how to prevent reoccurrence.
People

- Training
- Experience
- Safety Qualified
- Hazmat Qualified
- NDT Qualified
- Competent Persons
Equipment

- Safety Considerations
- Flow Velocities – Dictated by situation
- Flow Volumes – need to fill the pipe
- Operating Pressures – as low as possible
- Containment – able to hold entire volume
- Onsite Repair Capability
- Minimize Disruption
Places Worked / Kind of Work

- Alameda County, CA: Chemical Feed lines
- New York City, Brooklyn, Struvite cleaning
- Westfield, NY, Water Distribution Piping
- West Palm Beach, FL, Struvite
- US Navy: US bases and outside CONUS, USCG, MSC
- San Jose Water Pollution Control Plant
- DuPont, Cleaning Nomex process lines
- Dole Fruit, Chillers and Heat Exchangers
Chemistries

- Cleaning Chemistry
- Disposal
- Safety
- Base material protection
- Re-oxidation / Passivation
- Protecting Pipe Integrity
- No effect on Coatings
- Foaming, Flow, Jetting
- Markers for completion
Cleaning Chemicals

- *Pipe Renew™* Family
- Organic Acid / Sulfonylamine 1:1 Soap
  - Stoichiometric Chemistry - Neutral
- HCl, NaOH, Other work horses
- Formulas for Potable systems.
- Pipe Renew Soaps accelerate cleaning by up to 15X.
  - Allows for COLD / DILUTE cleaning.
  - Improves safety and disposal
- Biodegradability for disposal and handling.
Cleaning Chemicals Cont’d

- Include inhibitors for base material protection
- Dispersants and Penetrants
- Neutralization Reactants.
- Waste Treatment and/or Recycling
Lab Results of Chemical Analysis

Goal: Match volume & concentration for optimum time

Challenge: How many lbs per foot of scale.
- Time & Concentration to clean 98%
- sufficient residual chemical to continue
- final pH between 0.4-0.8

e.g. Test 1: 25% Concentration required 6 hours for 95% clean with residual pH of >1.0;

Test 2: 33% concentration required 4 hours with pH 0.04 residual
Major Steps in Procedure

- Set up and system inspection (pre video) and test
- Cleaning: Recirculation or Surging
- Video inspection
- Neutralization
- Flushing
- Air Evacuation
- Return to service

Determination of steps is critical to achieve desired end results.
Operational Plan

A. Sectioning pipe for cleaning: Options

B. Stage Pumping Equipment with pump and Frac Tanks at lower end of each section.

C. Recirculate or Surge to Clean, Neutralize to pH 2-4, release to finish or by section.

D. Move Equipment to lower end of next Section

E. Chemical Storage with Berms at each location.
Other Considerations

- Site Specific Safety Training
- Emergency Plan
- Local Emergency List
- Repairs of leaks in the pipe.
- Post Cleaning Strategies
  - Chemical, pH adjustment, dilution
  - Maintenance Strategies:
    - Pigging
    - Routine flushing
    - Treatment
    - Scheduled Chemical Cleaning
Descale, Rebuild, Preserve

- Now its Clean
- Rebuild the Structural Strength
- Minimize Reoccurrence
- Preserve for maximum Life
Specifications
Flame Spread & Toxic Gases In Smoke
(ASTM E-84-97a)   (BSS7239-88)
Epoxy & Grout System
Saves $1.5 Million USD Over 3 Years
As Seen on Our Planet Series
Miami Dade Pump Station and Large Diameter Pipe Rehab
Right The First Time
Hovensa Refinery, St. Croix USV
16 year Inspection New York Aqueduct, May 12th 2010 on Warren Epoxy. Inspection performed by Parsons Brinckerhoff, New York Office. The Single Coat, 40 mil application was in PERFECT CONDITION after 16 years of constant flow.
Experimental Program

- Instrument yoke
- 150 mm
- 450 mm
- Structural Epoxy ¼" (250 Mils)

ASTM C78 and C1018 test specimen
## Average Test Results On Peak Load In FT/LBS

<table>
<thead>
<tr>
<th>6” Test Beam Conditions</th>
<th>Number Tested</th>
<th>Repair Condition</th>
<th>Initial Damage Level</th>
<th>Average Peak Load/Length (lb/linear foot)</th>
<th>Average deflection (in.) at Peak Load</th>
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<tbody>
<tr>
<td>Control</td>
<td>6</td>
<td>Dry</td>
<td>None</td>
<td>5095</td>
<td>0.0175</td>
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<tr>
<td>DHD</td>
<td>4</td>
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<td>Heavy</td>
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<td>Moderate</td>
<td>6286</td>
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</table>
2 Year Inspection 96” Potable Water Main
The coating was applied in two 750 mil lifts
Warren High Build Single Coat Marine Epoxy Moving Forward With PES Supplying the United States Navy
“The Warren Environmental S-301 coating system in this tank, SWB 3-121-1-W, was in excellent condition, with far less than 1/10 of 1% corrosion noted at 15 month inspection.” Direct quote from Navy Inspection Report. US Navy Ship Oakhill
Protecting What's Been Built,
Restoring What's Been Broken

Chemical Rehabilitation Specialists
Warren Structural Epoxy Applicators
Descaling,
Disinfection,
Rebuilding,
Preservation.