Oversized HDPE Liners to Combat Internal Corrosion & Erosion in Mining Industry Pipelines
Agenda

• History of Oversized HDPE (PEAD) Lining
• Benefits of Oversized HDPE Lining
• Design Considerations
• Oversized HDPE Lining Installation Process
• Typical HDPE Lining Concerns and Management
• HDPE Lining Improvements
• Conclusions and Action
History of Oversized HDPE Lining

- Initially used in Oil & Gas applications
- Expanded into smaller slurry pipeline projects
  - Newmont Gold, Kennecott in US
- Escondida in 1994/1995
  - First Long Distance Slurry Pipeline w/ liner
- Additional large projects since then and ahead
  - Antamina, Century Zinc, Collahuasi, Ambatovy, etc.
Oversized HDPE Lining
Oversized HDPE Lining
Benefits of Oversized HDPE Lining

• Escondida makes an excellent case study

• Problems encountered
  – Heavy internal scaling
  – Acid cleaning of pipeline
  – Galvanic corrosion during extended downtime
  – Microbiologically Influenced Corrosion (MIC)
  – Excessive wear (6 O’Clock groove and slack flow)
Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - Chemical Resistance
    - High MW, non-polar, paraffin HC
    - Excellent resistance esp. vs. acids, alkalis, salts
    - Plastics Pipe Institute, Perry’s
  - Biological Resistance
    - HDPE not a nutrient medium
    - New pipeline protection and existing rehabilitation
Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - Abrasion Resistance
    - “3 – 5 times (vs.)…steel pipe” (1984)
    - x10 at 7fps, x4 at 15fps, coarse sand (SRC, 1975)
    - x 4 at 23 fps through bends (Schreiber, 1968)
  - Surface Roughness (“Smoothness”)
    - Extruded HDPE vs. new steel
  - Operating costs
  - Earthquake consequences
Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - International acceptance
  - Fit-and-Forget solution

- HDPE Lining “Never Stops Working For You”
Oversized HDPE Lining Design Considerations

- Outside Diameter
- Wall Thickness
- Installed HDPE Liner Pipeline Length
Oversized HDPE Lining Design Considerations

- Bends and Roto-Lining Solution

- Wear Free Bends (e.g., Vortex-Ell Bend)
Oversized HDPE Lining Installation Process

• Field Installation for Long Distance Slurry Pipeline

• Steel Pipeline Construction
  - Traditional methods
  - Required section lengths
  - HDPE Liner installation in concert with steel
Oversized HDPE Lining Installation Process

- On site HDPE fusion to customized lengths of steel pipe
Oversized HDPE Lining Installation Process

- On site HDPE fusion to customized lengths of steel pipe
Oversized HDPE Lining Installation Process

• Wireline cable, blowdown pig, sizing plate
Oversized HDPE Lining Installation Process

• Customized material and Specialized equipment
Oversized HDPE Lining Installation Process

• During this brief time of reduced diameter, the HDPE liner is quickly installed to line the host pipe
Oversized HDPE Lining Installation Process

- Internal and external clamps are then used to facilitate the installation of the HDPE end connections or “stub-ends” that are custom machined to tightly match the specially machined RFWN steel flanges.
Oversized HDPE Lining Installation Process

- Fusion of stub-end, removal of internal/external weld bead, release of internal clamp
Oversized HDPE Lining Installation Process

- Relaxation/tightening of oversized HDPE liner, air-test, and bolt-up.
Oversized HDPE Lining Installation Process

- Completed connection and installation
External monitoring vent
Typical HDPE Lining Concerns

- Wear

- Permeation/Vacuum and Possible Collapse

- Leaks and Leak Detection

- Flanged Connections
HDPE Lining Improvements

• Wear
  » Modeling
  » Laboratory Analysis
  » Scheduled Inspection
  » Inspection Ports
  » Caliper Pigs
  » RFT
HDPE Lining Improvements: Wear - RFT

RFT information by Russell NDE Systems
HDPE Lining Improvements: Wear - RFT
HDPE Lining Improvements: Wear - RFT

- 8-inch Steel Pipe
- Sour gas transportation
- Age = approx. 5 yrs old
- External concrete jacket
- HDPE lined
- 16.5km x four segments

RFT information by Russell NDE Systems
HDPE Lining Improvements: Wear - RFT

- No major wall loss detected
- Lines are in good condition
- No immediate threat to surroundings
- Findings backed by selective digs
HDPE Lining Improvements

• Permeation/Vacuum and Possible Collapse – Oversize Liner, Design, and Monitoring

• “Hoop-compressive” state

• $P_c \propto E(t/R)^2$
HDPE Lining Improvements

- Leaks and Leak Detection – Monitoring Vents
HDPE Lining Improvements

• Flanged Connections – Welded Connections
  ♦ First subsea installation in 1994
  ♦ Flanges worked. Flanges work.
  ♦ Improvements and insurance desired
  ♦ CRAs used – internal corrosion, not erosion
  ♦ Onshore use possible
Conclusions – Oversized HDPE Liners

• History
• Benefits
• Installation Process
• Typical Concerns
• Addressing, Managing, Resolving Concerns
Action – Oversized HDPE Liners

- Communication
- Identification
- Cooperation
- Corroboration
- Satisfaction
Questions?

Next Steps?
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