REINHOLD ENVIRONMENTAL Ltd.

2012 APC Round Table
& Expo Presentation

July 16-17, 2012, in Baltimore, MD / Hosted by Duke Energy, Entergy, FirstEnergy, Southern Company & TVA

Polymer Lining Protection
For
Duplex 2205 Alloy Absorber Modules

History

- EPA essentially has mandated use of FGD systems to meet emission requirements for:
  - Sulfur dioxide (SO 2)
  - Mercury
- More than 360 FGD systems are in place to meet EPA requirements.
- Due to rising cost of higher nickel alloys, a number of these units were constructed with Duplex 2205.
- Up to 80 units may be at risk.

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History

- FGD Environment very challenging for Duplex 2205 and 255 Alloy.
  - Operating temperature typically 125 F or greater.
  - pH is typically 5.
  - Chlorides of 5000 ppm with some reported at 20,000 ppm, dependent on coal utilized.
- Dissolved fluorides further compound the problem.
- DNV has established that 2205 Alloy does not have sufficient corrosion resistance for this service.

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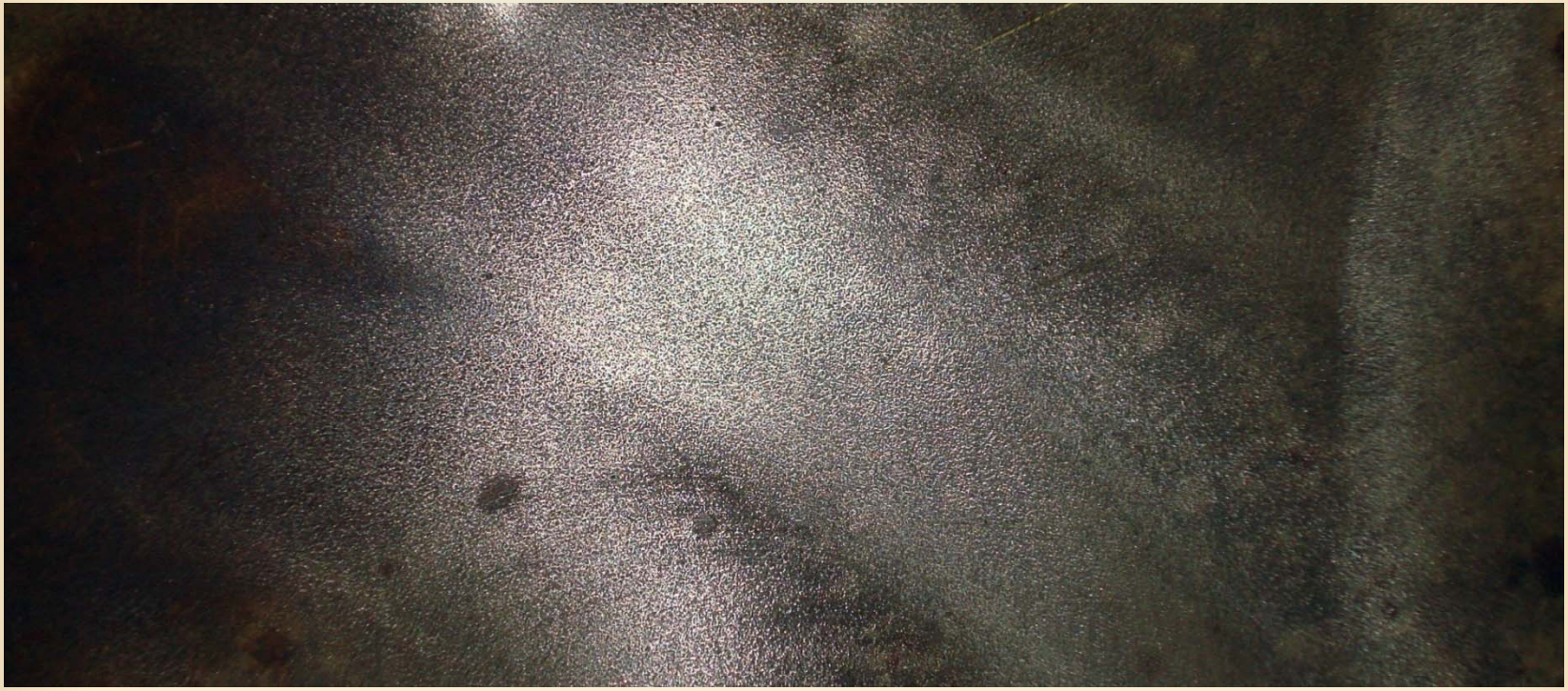
History

Darkened Surface is an Indication of Active Corrosion



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History

Active Pitting Found Under Slurry Buildup

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History

Pitting found in absorber after 12 – 18 months service

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History

- Surfaces are abrasive blasted to clean and determine extent of damage
- Abrasive blasting reveals wormholes in the 2205

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History

Floors With Full Through Corrosion

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Repairing The Module

- Rehabilitation begins by chemical cleaning.
- All surfaces washed with proper cleaning solution to remove and neutralize:
  - Chlorides
  - Nitrates
  - Sulfates

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Repairing The Module

Abrasive Blasting

- Module Surfaces Abrasive Blasted To:
  - Expose Hidden Pitting
  - Expose Hidden Wormholes
  - Impart Proper Anchor Profile
- Abrasive Must:
  - Be Hard Enough To Impart Proper Profile
  - Not Contaminate The Surfaces

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Repairing The Module

Chemical Cleaning Followed by Abrasive Blast

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Repairing The Module

Abrasive Blasting

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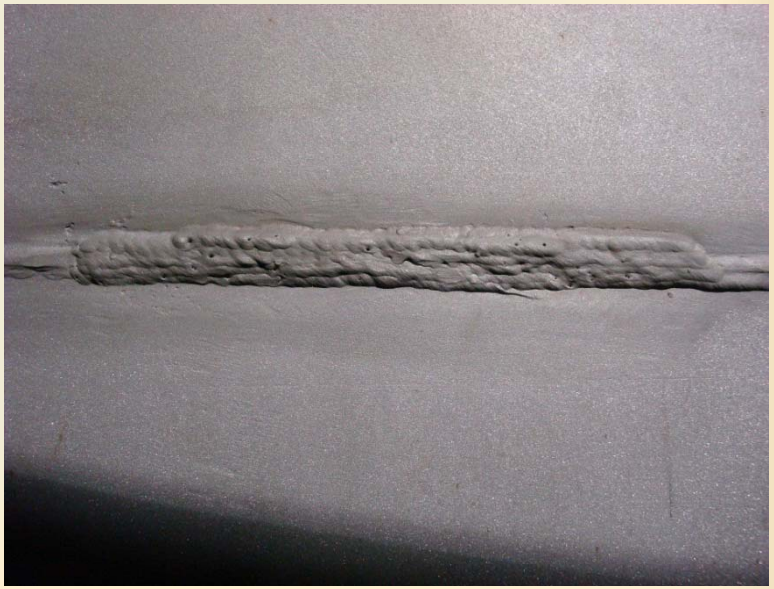
Repairing The Module

- Weld Inspection
  - Welds & HAZ's (heat affected zones) have been found to be very badly damaged.
  - Abrasive blasting is required to clean and open the deteriorated welds.

Repairing The Module

- Weld Overlays
  - Repaired welds must be re-blasted to impart the 3 – 5 mil anchor profile.



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Lining System

- Preferred lining system based on Epoxy Vinyl Ester Technology.
  - Epoxy Vinyl Ester has been utilized in Wet FGD:
    - Absorber modules
    - Slurry piping
    - Ductwork
    - Stack liners
    - Support Tanks
  - Vinyl Ester technology has been used in these services since early 1970's.

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Lining System

- Epoxy Vinyl Ester systems are specially designed to withstand Wet FGD Absorber environments:
  - Low pH
  - Aqueous Chloride
  - Suspended Solids

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Primer

- Prepared surfaces should be primed with High Elongation Epoxy Vinyl Ester Primer
- Flexible Epoxy Vinyl Ester primer:
  - Helps absorb absorber shell vibrations.
  - Helps isolate lining system from shell vibrations
  - Should be applied at 6 – 8 mils dft.

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Primer

High Elongation “Rubberized”

Epoxy Vinyl Ester Primer

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Pit & Void Filler

- Any remaining pits or voids must be filled.
  - In shell walls
  - In floors
  - In welds

Pit & Void Filler

- Stripe all welds with High Bond Vinyl Ester Mortar
  - Provide smooth transition over the weld & weld overlays.
  - Should extend over the weld and 4” either side.

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Base Coat

- Lining system foundation is glass flake filled Epoxy Vinyl Ester.
- Specifier should select:
  - Product utilizing chemically treated, large diameter glass flake as part of the formulation.

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Base Coat

- Proper flake selection and chemical treatment will:
  - Result in maximum integration into the resin mix.
  - Result in flakes aligning themselves like fish scales.
  - Provides dense film resistant to moisture vapor transmission.

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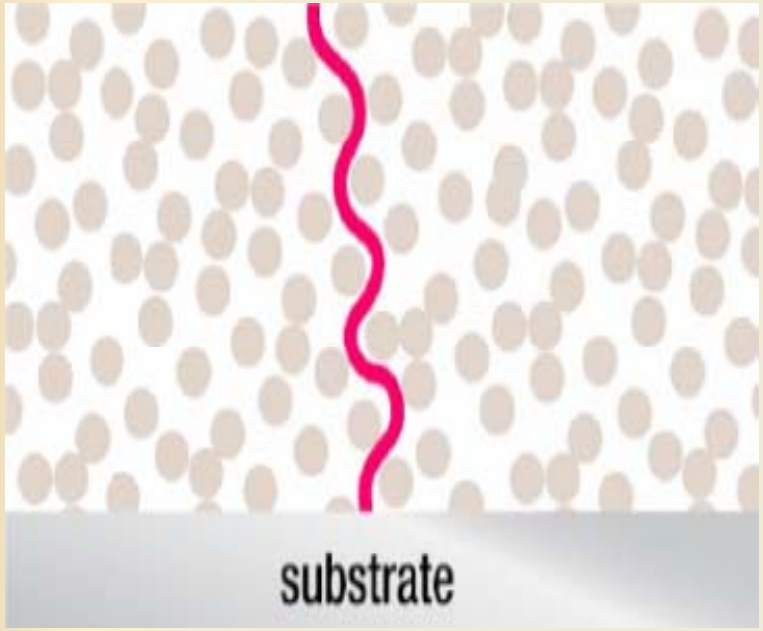
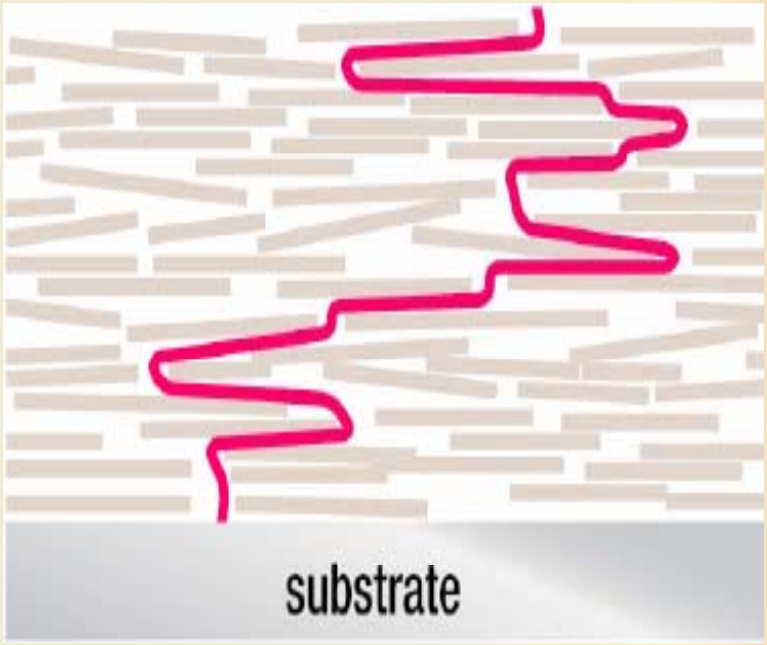
Base Coat

Typical Coating



Properly Formulated Glass Flake Filled Coating



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Base Coat

- Specifier should require:
  - Base coat be applied at 50 – 60 mils.
  - Permeability of Glass Flake Filled Epoxy Vinyl Ester be maximum of 0.0002 inch perms per ASTM E-96

Intermediate & Finishing System

Glass Reinforced, Abrasion-resistant Epoxy Vinyl Ester Lining System

- First Mortar Coat:
  - Shall be trowel applied to Base Coat
  - Shall have proper fillers to allow thickness of 60+ mils to be obtained.

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Intermediate & Finishing System

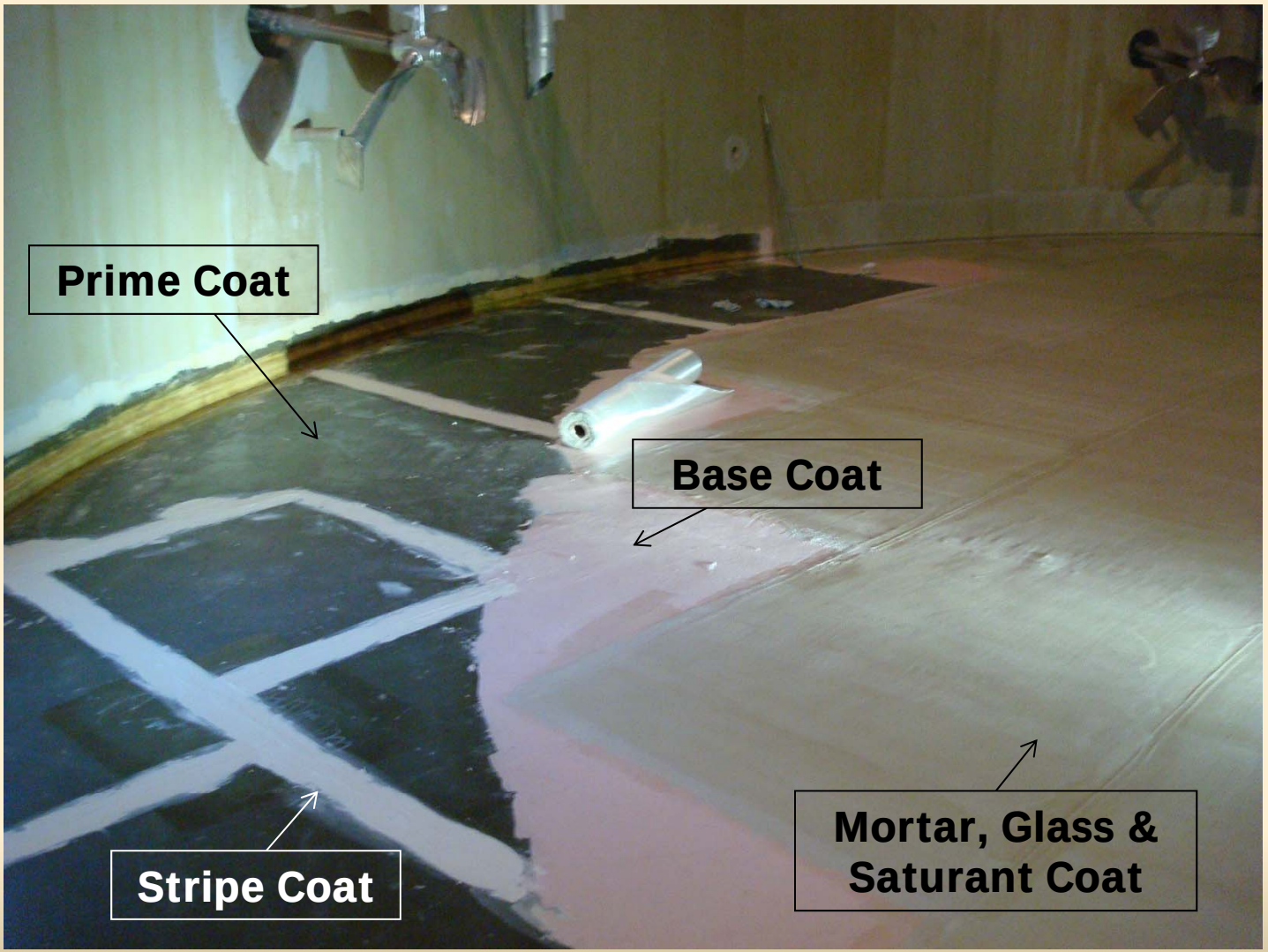
- Woven Roving Glass Reinforcement
  - 10 oz. woven roving glass shall be embedded into wet mortar coat.
  - Use of glass adds physical strength to the entire system.

Intermediate & Finishing System

- Glass Saturant Coat
  - Upon embedding the glass into the uncured Mortar Coat, the glass is saturated with “neat” epoxy vinyl ester resin.
  - Saturation with the resin ensures no dry spots and glass is fully sealed.

Intermediate & Finishing System

- System Photo



Intermediate & Finishing System

- Second Mortar Coat:
  - Should use same vinyl ester resin as the first mortar coat but filler system should be changed.
  - Filler system should be highly abrasion resistant ceramic filler.
  - Specify maximum abrasion resistance of:

    11 mg. loss per ASTM D-4060

    CS17 wheel, 1000g load, 1000 cycles

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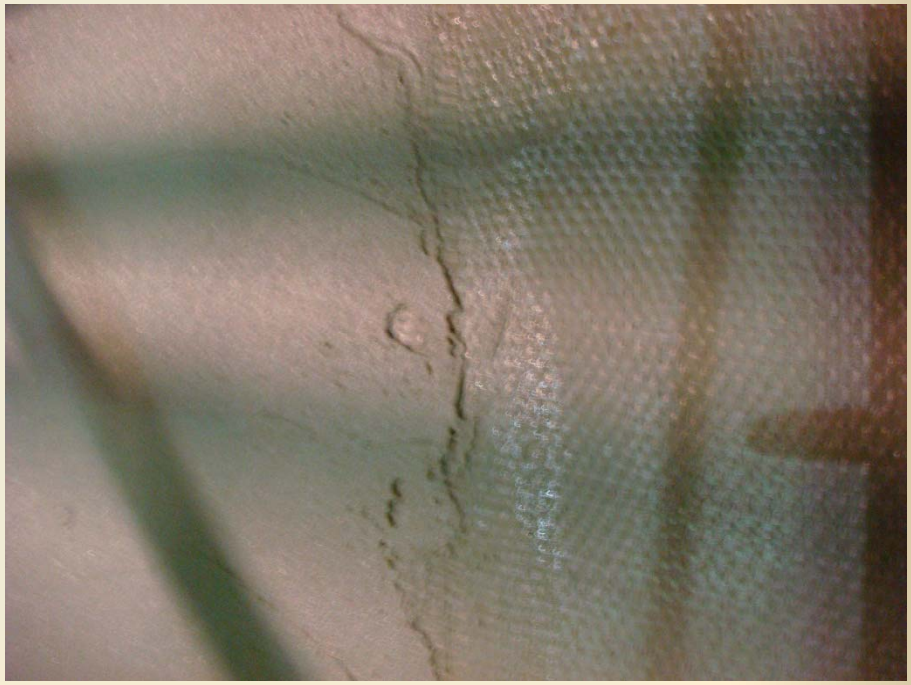
Intermediate & Finishing System

- Second Mortar Coat Application



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Intermediate & Finishing System

- Optional Non-Stick Finish
  - Teflon Filled Vinyl Ester finish coat may be utilized as a final finish coat for the system.
- This type of coating offers:
  - Extremely low surface energy properties.

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Intermediate & Finishing System

- Optional Non-Stick Finish
  - Will reduce sticking and buildup of slurry deposits on the lining system
  - May result in enhanced wear resistance and longer service life due to:
    - Reduced build up
    - Reduced friction

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Case Histories

- To Date, Blome International has completely or partially lined the following duplex 2205 absorbers:
  - 8 Jet Bubble Reactors (JBR's) in the Midwest, completed 2010 - 2011
  - 9 Spray Tower Absorbers
    - 5 in the Eastern US, completed 2011 - 2012
    - 2 in the Midwest, completed 2011
    - 2 in the Southeast, completed 2007

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Case Histories

- Blome Vinyl Ester Technology has been used on these additional absorber projects:
  - Line AL6XN Inserts for 2 concrete, tile lined absorbers in the Gulf Coast. Completed in 2009.
  - Line Duplex 2205 Spray Headers for 1 spray tower in the Midwest. Completed in 2011.

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Conclusion

- Aggressive under deposit corrosion in alarming number of duplex 2205 absorbers.
- Through wall corrosion seen in as little as 3 months.
- Duplex 2205 & 255 deemed unsuitable for this service.

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Conclusion

- Epoxy Vinyl Ester lining systems are an ideal means to repair duplex 2205 FGD scrubbers.
- Epoxy Vinyl Ester lining systems have a proven performance in absorbers fabricated with duplex 2205.
- Specifying a system as described in this presentation will yield a lining service life of 18 – 23 years!

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Questions?

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