The Three Most Common Failure Modes in Coke Drums and What to Do about Them

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Overview

• Bulging-induced shell cracks
• Skirt attachment cracks
• Anchor bolt failures
Why Coke Drums?

• Excessive loads
• Batch process
• Randomness
• Human factors
Bulging-Induced Shell Cracks
Shell Bulging & Cracking

• Major problem for decades.
• Despite design improvements, still a problem—perhaps more severe today.

Courtesy of CB&I
Bulging-Induced Cracks

INTERIOR

EXTERIOR
Bulging Types

- **Uniform**
  - Mechanical
  - Axial thermal
- **Non-uniform**
  - Discontinuity
  - Local PWHT
  - Fabrication process
  - Thermal spot
    - Side inlet
    - Random channeling
    - Top quenching
Assessing Severity
What to do?

Based on severity assessment:

• Weld overlay repair
  – Internal
  – External
  – Sandwich

• Replace
  – Window
  – Can
  – Drum
Skirt Attachment Cracking
Skirt Attachment Cracking

• Very common in conventional welded skirts (almost certain)
• Potential for serious consequences
• Major contributor to drum replacement
Through-wall Crack
Keyhole Cracks
Why?
Severity Assessments
What to do?

Based on severity assessment:

• Replace skirt.
  API 1996: 23% => 45% cracked again
• Grind-and-reweld.
  API 1996: 54% => 50% cracked again
• Retrofit to non-welded design.
• Replace drum.
Anchor-bolt Failures
Bolt Failures

• Failures may show signs of overload, fatigue, and/or corrosion damage.
• Apparently becoming more common.
Contributing Factors

• Cone thermal gradients.
• Unevenness of tabletop.
• Drum vibrations.
• Impact of falling coke boulders on cone.
• Corrosion.
What to do?

• Minimize thermal gradients
• Ensure flatness of tabletop
• Address corrosion
• Replace bolts
• Unconventional anchors
Summary

- Skirt attachment cracking
- Bulge-induced shell cracking
- Anchor bolt failures