An Optimal Inspection Strategy for Coke Drums

Steven A. Garcia
President

American
Testing-Inspection
Overview

• Problem definition
• Acoustic emission testing
• Laser Scanning
• High-resolution imaging
• Optimal strategy
Problem Definition

• Coke Drum Damage Types
  • Bulges
  • Internal shell cracks
  • External shell cracks
  • Skirt attachment cracking
  • Nozzle cracks
  • Blow down line cracks

• Inspection Challenges
  • Shut down equipment to inspect
  • Internal scaffolding
  • Insulation removal
  • Cost
Acoustic Emission Testing (AET)

- In the API Survey of 2013 on coke drums – 76% reported using AET during operation to detect and locate cracking.
- AET is incorporated into several standards, including: ASME, ASTM, API 579, API 572, and many others.
- Can provide source location for active flaws on large structures, to minimize repair efforts.
- One of the many types of NDT methods available and it is complementary to all other NDT methods.
• AET applied to coke drums can be effectively used as a global inspection method without requiring shutdown or insulation removal.
• Sensors can be applied using rope access crews, eliminating the need for scaffolding.
• Normal coking cycles provide the stimulus – typically 3-5 cycles needed for evaluation.
• Modified cycles during testing can improve detection.

Acoustic Emission Testing (AET)
Acoustic Emission Testing (AET)

- Thermocouples placed on the drum shell used to identify cycles and helps correlate AE activity with process.
- For AE data analysis, only look at the data during Heat-Up and Quench cycles.
Map of follow-up areas after AE inspection.
AET is the only inspection method that can:

• Provide a global Inspection of the entire coke drum, including the head, shell, skirt and cone at the same time.
• Detect growing cracks significant to the drum's structural integrity caused by thermal fatigue.
• Be applied in-service during normal coking cycles without insulation removal
• Be remotely monitored to keep non-critical personnel off structure during cycles.
• Guide T/A inspection and repair planning efforts.
Limitations of Acoustic Emission Testing (AET)

• Cannot size defects. Must be used with other NDT methods to give a complete picture of any discovered defects.
• Cannot find inactive flaws (Not growing under normal process conditions or test conditions)
Laser Scanning

- Internal inspection
- Radius measurements
- Bulging profiles
- Sharpness maps
- Leaning/Tilting analysis
• Contour map of radius
Sharpness Maps

• Screening tool for potential areas of concern
• Not a substitute for engineering assessment
Bulge Profiles

Drum Height (inch)

Radius (inch)

- original radius
- 0 degree azimuth
- 90 degree azimuth
- 180 degree azimuth
- 270 degree azimuth
Leaning/Tilting Analysis

Displacement (inch) vs. Height (inch)

- Leaning East
- Leaning South
- Magnitude
High-Resolution Imaging
Optimal Inspection Strategy

- Perform all 3 inspection techniques at same time (only company in the world)
- Same crew
- Performed in parallel
- Comparable costs
Recap

• Problem definition
• Acoustic emission testing
• Laser Scanning
• High-resolution imaging
• Optimal strategy