"Coking.com"

BEST PRACTICES SEMINAR

MAY 15 - 17, 2001

WESTIN GALLERIA HOTEL HOUSTON, TX

CIA INSPECTION (US), INC.

COKE DRUM RELIABILITY
AND MANAGEMENT
THROUGH KNOWLEDGE

www.cia-inspection.com

Today's Presentation

Coke Drum Inspection Service

- Background
- Features of the System
- Benefits

Evolution of the Business Coke Drum Reliability Program Summary

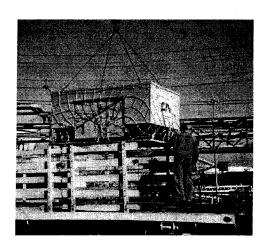
Background on CIA Inspection

- Started scanning delayed cokers in May/93
- On-line inspection technique characterizes internal profile of vessel
- High resolution video inspection of the interior of the vessel
- Complete on-line inspection performed in 4 hour window
- Have performed about 300 inspections throughout the world

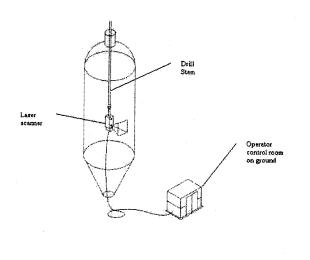
Coke Drum Laser Inspection

- Laser based range imaging system
 - Collects laser distance measurements of entire vertical surface of vessel
 - Color contour map shows bulge profiles and other distortions
 - Allows drum comparison over time
 - Custom designed software "Drumview" interprets the drum scan data

Portable Transportation System



System Overview



Coke Drum Design

- ASME boiler & pressure vessel code section VIII, Division I
- Although fatigue is a factor in coke drum deterioration, vessels are not typically designed with fatigue considerations in mind
- Carbon steel, 1 Cr-1/2 Mo or 1 1/4 Cr-1/2Mo
- Clad with 405 or 410ss
- Typically 3/4" to 1 1/2" thick plate courses
- 18 to 30+ ft. diameter, 60 90 ft. tan to tan height

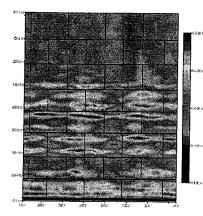
Modern Drum Trends

- New drums are generally chrome-alloy steels
- Trend towards thinner shells higher diameter/thickness ratios
- Shorter cycle times combined with design changes lead to earlier onset of problems
- Modern drums "age" faster
- Shorter cycles more severe service

Why Profile Coke Drums?

- Bulges increase stress concentrations
- Focus inspection activities on failure prone areas
- Extend life through knowledge of drum condition
- Anticipate failures before they happen
- Minimize unplanned outages
- Gauge rate of deterioration

Laser Scan Results

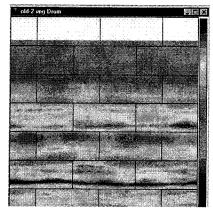


- Color visualization contour map image
- Colors represent distance from center of drum
- Green represents nominal base radius
- Red indicates outward distortions, blue inwards
- Black lines indicate weld seams

Drumview Demonstration

Laser Scan Results

BENCHMARK SCAN



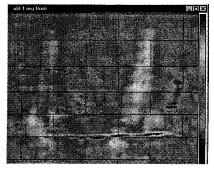
9 MONTHS LATER



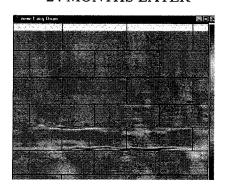
Carbon Steel - Note bulge growth between weld seams

Laser Scan Results

BENCHMARK SCAN

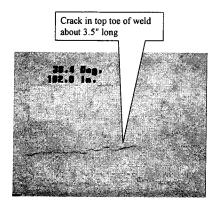


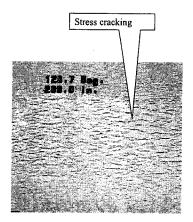
24 MONTHS LATER



ALLOY STEEL - Note bulge growth along weld seam

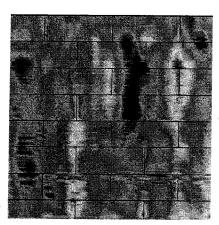
Visual Capabilities





API certified inspector independently reviews and reports on the remote visual inspection

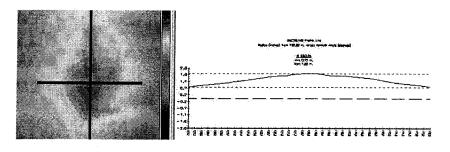
New Drum Fabrication



- Vertical peaking
- Course mis-match
- Ovality

Vertical Peaking

BUILT-IN DEFORMATION IN NEW COKE DRUMS



What CIA Inspection Offers

- History in trending of drums over past 8 years
- Equipment designed to work in a live coke drum
- Combined laser and video scan 1 to 1 registration
- Comfortable, safe, remote control center for inspection personnel
- Ability to link your specific coke drum condition with the rest of the world

New Developments

- Evolution of our business
- Focus on improved reliability through knowledge
- Program approach provides a "one-stopshop" for improved coke drum reliability
- Alliances with:
 - Stress Engineering Services Inc. (SES)
 - Chicago Bridge & Iron Company (CB&I)

New Developments

- Depending on findings from laser & remote visual inspection, additional activities/ approaches can be undertaken
 - Engineering analysis
 - Materials evaluation and testing
 - On-line monitoring of damage
 - Fitness for service
 - Operational control and optimization
 - Recommendations on repair/replace procedures

Follow-up Services

- Additional capabilities include:
 - Maintenance of graphical, CAD based inspection and repair maps of coke drum histories
 - Installation and monitoring of strain gauges and temperature indicators
 - Development of weld repair procedures in advance of failures
 - Recommendations for repair/replace decisions as well as repair options including patch and course replacement sizing

Strain Gauging

- With Stress Engineering:
 - Use laser image dimensions to properly place strain gauges in areas of most stress/strain
 - Data provides complete corrections to strains from temperature-induced error, calculation of bi-axial Principal Stress results, including Stress Intensity
 - Extrapolations made from database to predict remaining useful life of drum

Weld Repair Plan & Procedures

- Develop repair and replace procedures for defective areas of coke drums
- Recommend correct inspection and repair techniques
- Provide on-site consultation and if necessary can provide supervised contract welders to ensure the best possible repair is performed using the correct procedure

Summary

- CIA Inspection is growing in both scope and capability
- Tracking & trending vessel profiles is first step in developing action plan for improved reliability
- Action plan developed which puts your vessels on managed program to improve reliability
- On our way to becoming the "one-stop-shop" for coke drum reliability

Optimization of Coke Quench/ Cut Cycle

- Recommendations to shorten cycle based on analysis of fatigue stresses during quench cycle
- Optimization of the cycle is the key to getting the most out of the vessel
- Periodic monitoring of vessel shape gives feedback on the changes made in the cycle

Dimensional Assessment for Replacement

- With CB&I:
 - In conjunction with laser inspection dimensional data can aid in the correct custom can replacement
 - Drumview "export" feature can help manufacture proper fit-up - bulging and ovality
 - New coke drum inspection to meet code qualifications



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