Coke Drum Workshop

AUT TOFD Inspection of Coke Drums

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Typical Coke Drum, bulges and all, does not restrict our unique TOFD inspection.
Typical TOFD Technique

Transmitter

Lateral wave

Receiver

Upper tip

Lower tip

Back-wall reflection

TOFD A-scan signals

Transmitter

Lateral wave

Receiver

LW

BW

Upper tip

Lower tip
**AUT – Basic TOFD Technique**

- Lateral Wave
- Longitudinal Wave (Clad & I.D. response)
  - Clad interface well defined.
- Mode Converted Energy (Shear)

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**Defect position uncertain with single stroke scan**

Transmitter  
\[ \begin{array}{ccc}
\text{S} & \text{S} & \text{Receiver} \\
\end{array} \]

Constant time locus  
\[ t_1 + t_2 = c' \]

**In practice:**
Maximum error on absolute depth position is within 10%.

Mistakes include NOT doing a multi-pass scan!
Caution for small defects situated at the back-wall or confined to the cladding.
TOFD Technique – Con’t.

TOFD scans primarily D-scans

Deep Cracks in Drum

Moderate Cracking

Typical Coker Calibration Block

Front (O.D.) Surface    Back (I.D.) Surface
Deep crack detected

Perfectly GOOD weld (no cracks) however almost ALL manual UT shearwave attempts will mistake this as a crack!

The above is a previous I.D. repair most likely welded out with stainless or inco.
Even Shallow cracks are detected

Monitoring Exams
A good AUT program is crucial for successful monitoring.
Insulation ring is just barely out of the way.

There is NO problem in scanning the Inco repairs or even detecting new cracking in the inco repairs!

Inco weld repair from O.D. surface.

The image reflects a 100% weld out from O.D with inco.

Scan data of an Inco Repaired Weld after several cycles...2 months.
Cracking detected in INCO weld repairs after 6 months.

Three (3) cracks observed in lower image between 55° – 60° location.

- Crack #5: Start: 660° Stop: 670° Length: 10" RL: 262° CL: +2"
- Crack #6: Start: 696.2° Stop: 702° Length: 5.8" RL: 450° CL: +2"
- Crack #7: Start: 706.4° Stop: 716.6° Length: 10.2" RL: .378° CL: +2"

Cracking can also initiate from the outside surface. However, this is normally the precursor to a thruwall crack.
ACFM – For O.D. Cracking

Cracks are usually monitored until propagation approaches critical flaw depth or next T/A activity.

On-stream Inspection is paramount to the operation & profitability of a Coker unit.

- The AUT examinations can be performed without the usual downtime and between cycles with only minimal support.

COKER 6 DRUM SWITCHING SCHEDULE

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### What is required by you:

1) Access to the welds
   1) Scaffolding
   2) Insulation Removal
2) Surface Preparation
   1) One time power buffing usually lasts for several exams
3) Expectations
   1) What is your repair threshold…i.e. % depth, length into carbon, clad cracking?, etc.
4) Time Windows for Inspections
   1) Typically right after quench, pause for drilling the pilot hole and then during the drill including up to the preheat
5) Permit, 110V Power and Water source
   1) Typically safe work or hot depending on plant.

### What you get!

1) Final Report with FULL details of cracking
   1) 75% confidence in cracking observed in the cladding
   2) 90% confidence in cracking up to .050” into the C/S
   3) 98% confidence in cracking .050”-.100” into the C/S
   4) 100% confidence in cracking >.100” into the C/S.
2) Detailed TOFD Images
   1) TOFD images for ALL scans…not just sample scans
   2) Full crack depth profiles in the images
3) ACAD
   1) ACAD showing scaled locations for all cracks!
4) Comprehensive Crack Table – full details
5) Ability to monitor cracks “on the go”
   1) Minimizing repairs of every superficial crack for a tremendous cost savings.
Details for crack locations transposed onto drum to facilitate repairs.

Any Questions????????????

1. All Coke Drums CRACK…it’s not if, it’s WHEN?
2. Pre T/A inspection minimizes the unknowns
3. Continuous inspections allow for better remaining life assessments.
4. All Drums can be reliably inspected with TOFD.
5. History suggests that O.D. repairs can be used to minimize downtown and eliminate entry – (subject for a different presentation)