A DIFFERENT APPROACH TO ARREST THROUGH WALL CRACKS ON A COKE DRUM USING WELD OVERLAY

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WELD O LATINOAMÉRICA
CONTENT

COKE DRUM SPECIFICATIONS

COKE DRUM BACKGROUND

CASE STUDY

SHORT-TERM PLAN

EXECUTION

DISCUSSION
Base Metal: SA-387 Gr. 11 Cl. 2
Clad: SA – 240 TP.410S
Coking: 95.0 psi → 50 psi (Top) @ 840°F
Quenching: 123 psi → 50 psi (Top) @ 300°F
r = 174 in
Cladding Thickness: 0.11 in

Central Feed
Manual Unheading System
Operating Since 2004
COKE DRUM BACKGROUND

C1
C2
C3
C4
C5
C6
C7
C8

November 2015
CASE STUDY

Bulge Severity Factor = \frac{\sigma_{\text{Computed}}}{\sigma_{\text{Nominal}}}

DRUM 1
Max BSF = 14.5

DRUM 2
Max BSF = 13.6

DRUM 3
Max BSF = 15.3

DRUM 4

<table>
<thead>
<tr>
<th>Location ID</th>
<th>Description</th>
<th>Angle (degrees) 90°±East</th>
<th>Elevation (inches from Bottom Seam)</th>
<th>Axial BSF Value</th>
<th>Width (deg)</th>
<th>Height (inches)</th>
<th>Nearest Circumferential Seam</th>
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<td>771.7</td>
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<td>5.3</td>
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</tr>
</tbody>
</table>

BSF Value: >5.0, 5-6, 7-8, 9-10, >13
CASE STUDY
UT Phased Array Inspection C4 Drum 4

6

June 2016

56 Sectors

DRUM 2

August 2016

Complete cracking
Partially cracking
No cracking

Critical Size 18mm

BSF

mm

0 2 4 6 8 10 12 14 16 18 20

0 5 10 15 20 25 30

6 39 71 103 135 167 199 231 264 296 328 360
CASE STUDY
UT Phased Array
Re-Inspection  C4 Drum 4

Lenght = 500 mm / 19.69 in
Depth = 27 mm / 1.06 in

August 2016
Few days later after Drum´s 2 Failure...

Remaining Thickness = 0.12 in

“Houston, we have a problem!”
SHORT-TERM PLAN

DRUM SHELL

Will it work?

Diameter = 9 in

9 in

9 in

t = 0.47 in

158 in

Weld Overlay
Inconel 625

C1
C2
C3
C4
C5
C6
C7
C8
EXECUTION

✓ Semi Automatic Machines
✓ Certified Welders
✓ ERNiCrMo-3

Scaffolding attached to the structure
**EXECUTION**

<table>
<thead>
<tr>
<th>Step</th>
<th>Time (h)</th>
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<tr>
<td>Steam Preheat</td>
<td>5</td>
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<tr>
<td>Coking</td>
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<tr>
<td>Steam Stripping</td>
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<tr>
<td><strong>Water Quenching</strong></td>
<td><strong>6</strong></td>
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<tr>
<td>Drain</td>
<td>2</td>
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<td>Flange Removal</td>
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<tr>
<td>Decoking</td>
<td>5</td>
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<tr>
<td>Rehead / Steam Purge / Test</td>
<td>1</td>
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<tr>
<td><strong>Total Length Cycle</strong></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>

The Upgrader did not need to shutdown the coke drum.

5h Welding per Quenching

![Graph showing temperature over time]
DISCUSSION

✓ The repair took 1 week during operational windows.

✓ The crack was successfully arrested.

✓ It has been 13 months since the repair and the drum is still operating.

✓ We recommended UT inspection to the upgrader in order to evaluate the crack behavior.

✓ We recommend to repair the cracks the next turnaround and perform weld overlay reinforcement on the areas with high BSF.

✓ Although it was not a repair under code, the main objective was achieved and therefore we highly recommend this approach to arrest cracks.
QUESTIONS?