TROUBLE SHOOTING IN DELAYED COKER UNIT-INSPECTION EXPERIENCE

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TROUBLE SHOOTING IN DELAYED COKER UNIT

CONTENTS

• Introduction

Learning from :
• Coker Heater
• Coker Fractionator
• Coke drum Chute area
• Cutting deck piping & Small bore tapping’s

• Summary and Discussion
MRPL’s DCU DETAILS

- Licensor - M/s Lummus Technology
- PMC - M/s EIL
- Contractor (CDSP) – M/s Punj Lloyd
- Contractor (BOP) – M/s TEIL
- Capacity - 3.0 MMTPA
- Feed - VR formed from distillation of Arab heavy Crude
- On-Stream Factor - 8000 Hrs/yr (333.33 days)
- Turn Down – 50 %
- Through put ratio: 1.10 (This is defined as the ratio of combined heater feed flow rate (including the internal recycle stream from the bottom of wash section) to the DCU fresh feed rate.
- Design feed TAN < 0.5
<table>
<thead>
<tr>
<th>Observations /analysis</th>
<th>Corrective measures</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 02 instances of Bulging and sagging of radiation section tubes</td>
<td>• Replacement of tube sections beyond 5% enlargement in OD.</td>
<td></td>
</tr>
<tr>
<td>• Size: 114.3mm OD X 11.13mm Thk , MOC: 9Cr-1Mo (SA 335 Gr P9)</td>
<td>• RT carried out to check the extent of coke deposition at random locations</td>
<td></td>
</tr>
<tr>
<td>• Dimensional measurement revealed bulging—Photo</td>
<td>• Thickness measurement, Hardness check, visual and dimensional inspection</td>
<td></td>
</tr>
<tr>
<td>• Bulging and sagging due to coking and localised heating.</td>
<td>• Online inspection is limited to Visual inspection</td>
<td></td>
</tr>
<tr>
<td>• Metallurgical analysis of Samples of failed tubes</td>
<td>• Off line inspection includes visual and dimensional check, thickness &amp; hardness</td>
<td></td>
</tr>
<tr>
<td>• Results indicate comparable metallurgical damage in bulged tubes with 5% and more.</td>
<td>measurements and RT for checking coke deposition.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Additional no. of skin thermocouples.</td>
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## Learning from Coker Fractionator

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<tbody>
<tr>
<td>Column opened for internal inspection subsequent to heater charge pump flow</td>
<td>Coke deposits were removed and Strainer assembly was repaired</td>
<td>Damage to Coke strainer caused by damage to overflow down pipes which aggravated</td>
</tr>
<tr>
<td>issue. Blockage suspected. <a href="#">Sketch</a></td>
<td>Overflow down pipes were fixed back as per the modified supporting arrangement</td>
<td>the coke deposition.</td>
</tr>
<tr>
<td>Coke deposits on bottom dish end. Coke strainer observed damaged and partially</td>
<td>Refractory repair work was carried out along with dry out - <a href="#">Photos</a></td>
<td>Also, over flow down pipe damaged due to self weight and insufficient supporting.</td>
</tr>
<tr>
<td>blocked.</td>
<td></td>
<td>Efficient dry out procedures and special castable if any for use during shutdown?</td>
</tr>
<tr>
<td>Overflow down pipes connected to chimney tray #1 sheared and were lying on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the bottom dish end.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refractory damage approx 50% of the area on top of chimney tray #1. KAST-O-LITE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 <a href="#">Photos</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Observations

- Coke drum chute is provided with a 19 mm thk abrasion resistant plate on top of concrete. [Photo](#)
- Failure of Chute plates of 2 nos. drums
- Plate material ABRAZO 400 by TATA Steel UK (Carbon steel with hard facing).

### Corrective measures

- Restoration of damaged chute plates and welding capping with hard facing electrodes.
- Inspection and repair of balance drums Chute plates.

### Analysis/Feedback

- Failure due to Improper welding consumable / procedure
- No hard facing was performed on site fabrication welds.
# Learning from Small bore tapping’s

<table>
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<th>Analysis/Feedback Sort</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Failure in Wet gas compressor 2\textsuperscript{nd} Stage discharge 0.75” PG tapping Photo</td>
<td>• Replacement of the failed assemblies and modification of the existing supporting arrangement.</td>
<td>• Cause of failure is mechanical fatigue due vibration</td>
</tr>
<tr>
<td>• Crack observed near the stiffener support to 0.75” pipe weld upstream of isolation valve. MOC Carbon steel with PWHT</td>
<td>• Hardness values of failed sections were checked and found within acceptable limits.</td>
<td></td>
</tr>
<tr>
<td>(2) Stripper overhead line connected 0.75” PT tapping shear. MOC Carbon steel with PWHT. Photo</td>
<td>• No sign of internal or external corrosion in visual inspection and thickness survey</td>
<td></td>
</tr>
<tr>
<td>• Circumferential through thickness crack all around the periphery resulting in shearing.</td>
<td>• Inspection of balance tappings and corrective action</td>
<td></td>
</tr>
</tbody>
</table>
# Learning from Antifoam lines

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</tr>
</thead>
<tbody>
<tr>
<td>• Repeated failures observed in Antifoam line connected to Coke drum. Line size 3” and MOC 9Cr-1Mo (SA335 Gr P9)</td>
<td>• Replacement of the failed portions of the line. Minor pitting noticed</td>
<td>• Analysis of failed pieces indicate that failures were due to combined effect of corrosion and vibration.</td>
</tr>
<tr>
<td>• Failures were limited to common portion of the line used for supply of Antifoam and top cooling water.</td>
<td>• Hardness check carried out for site welds.</td>
<td>• Corrosion part is being studied further.</td>
</tr>
<tr>
<td>• During hydrotest after repair, leaks detected at multiple locations. All leaks were from cracks in the weld HAZ.</td>
<td>• Radiography &amp; re-PWHT</td>
<td>• Few cases of improper PWHT also contributed to failures in presence of vibration.</td>
</tr>
<tr>
<td>• Higher hardness values were recorded at certain locations</td>
<td>• Re-examination of the joints was carried out after PWHT.</td>
<td>• Modification for providing isolation valves on the drum nozzles for ease of maintenance in case of failure.</td>
</tr>
<tr>
<td>• Normal values also observed for few failed portions. <a href="#">Photo</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Learning from coke drum PSV line

## Observations

- Coke drum connected 24” PSV header has 2 nos. PSV’s mounted for individual drums.
- Crack observed on weld HAZ of Eccentric reducer (10”X12” SA 234 Gr WP9) connected to PSV outlet line.
- Circumferential through thickness crack from 12 O’clock to 1 O’clock position on the 10” side of the reducer in HAZ of the reducer to flange weld.
- No sign of external or internal corrosion. Higher hardness recorded on the reducer and both welds of the reducer - [Photo](#)

## Corrective measures

- Replacement of the failed section of the piping.
- Identification of reducers having similar heat nos.

## Analysis/Feedback Sort

- **Probable cause of failure:**
  - higher hardness of the fitting
  - Higher hardness of weld
  - Vibration related.
- Feedback required on similar issues
Summary & Discussion

• Coker Heater online monitoring techniques and acceptable limits of tube bulging?

• Fractionator refractory repair frequency and dry out procedures?

• Small bore tapping’s Inspection techniques?

• Coke drum connected lines support modification to contain vibration?

• Coke drum Laser Mapping and RVI frequency and any additional techniques used for inspection? [Link]
THANK YOU

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Learning from Coker Heater
Learning from Coker Fractionator

Chimney Tray #1

Over flow down pipe

Coke Strainer

Suction line of GA33402A/B

Part no. 1225 to 1227 are plate stiffeners weld to the over flow pipe (4 nos. 90 deg apart)

Supporting beam

Crossection of the chimney tray#1 at the over flow down pipe section

PIPE 12" (10 THK.)

SECTION F34-F34
Learning from Coker Fractionator
Learning from Coker Fractionator
Learning from drum Chute area
Learning from Antifoam lines
Learning from Small bore tapping’s

Crack noticed near the stiffenner to pipe (nipple) weld
Learning from Small bore tapping’s

Brittle failure

Remaining portion of the failed PT assembly

Back
Learning from coke drum PSV line

Crack on weld HAZ

High Hardness zone

Crack

MOC-9Cr-1Mo (Low alloy steel)

10" Flange

10" X 12" Eccentric reducer

12" Pipe

Failure location
## Coke drum Inspection

### Observations/Future Inspection plans
- Coke Drum 9 Mtr ID and 41 Mtr Height MOC 1.25Cr-0.5Mo Base with SS410 Clad
- LASER Mapping and RVI carried out in September 2014 as a base line measurement for all 4 drums. No major abnormalities noticed.
- Second round of inspection in 2017.
- Inspection of the Key Holes provided in the coke drum skirt to identify cracks is planned during upcoming shutdown.

### Feedback Required
- LASER mapping and RVI frequency for 24 hour cycle time?
- Finite element analysis to study thermal stresses using the temperature data of the drums along with other operational history?
- Any other type of online/shutdown inspection to be performed for checking the integrity of the drums on regular basis?