TROUBLE SHOOTING IN DELAYED COKER UNIT- INSPECTION EXPERIENCE

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TROUBLE SHOOTING IN DELAYED COKER UNIT

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- Coker Heater
- Coker Fractionator
- Coke drum Chute area
- Cutting deck piping & Small bore tapping's

- Summary and Discussion

MRPL's DCU DETAILS

- Licenser - 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

Learning from Coker Heater

Observations /analysis	Corrective measures	Feedback
• 02 instances of Bulging and sagging of radiation section tubes • Size: 114.3mm OD X 11.13mm Thk , MOC: 9Cr-1Mo (SA 335 Gr P9) • Dimensional measurement revealed bulging–Photo • Bulging and sagging due to coking and localised heating . • Metallurgical analysis of Samples of failed tubes • Results indicate comparable metallurgical damage in bulged tubes with 5% and more.	• Replacement of tube sections beyond 5% enlargement in OD. • RT carried out to check the extent of coke deposition at random locations • Thickness measurement, Hardness check, visual and dimensional inspection	• Online inspection is limited to Visual inspection • Off line inspection includes visual and dimensional check, thickness & hardness measurements and RT for checking coke deposition. • Additional no. of skin thermocouples.

Learning from Coker Fractionator

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

Learning from Coke drum Chute area

Observations	Corrective measures	Analysis/Feedback
• 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).	• Restoration of damaged chute plates and welding capping with hard facing electrodes. • Inspection and repair of balance drums Chute plates.	• Failure due to Improper welding consumable / procedure • No hard facing was performed on site fabrication welds.

Learning from Small bore tapping's

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

Learning from Antifoam lines

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

Learning from coke drum PSV line

Observations	Corrective measures	Analysis/Feedback Sort
• 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	• Replacement of the failed section of the piping. • Identification of reducers having similar heat nos.	• 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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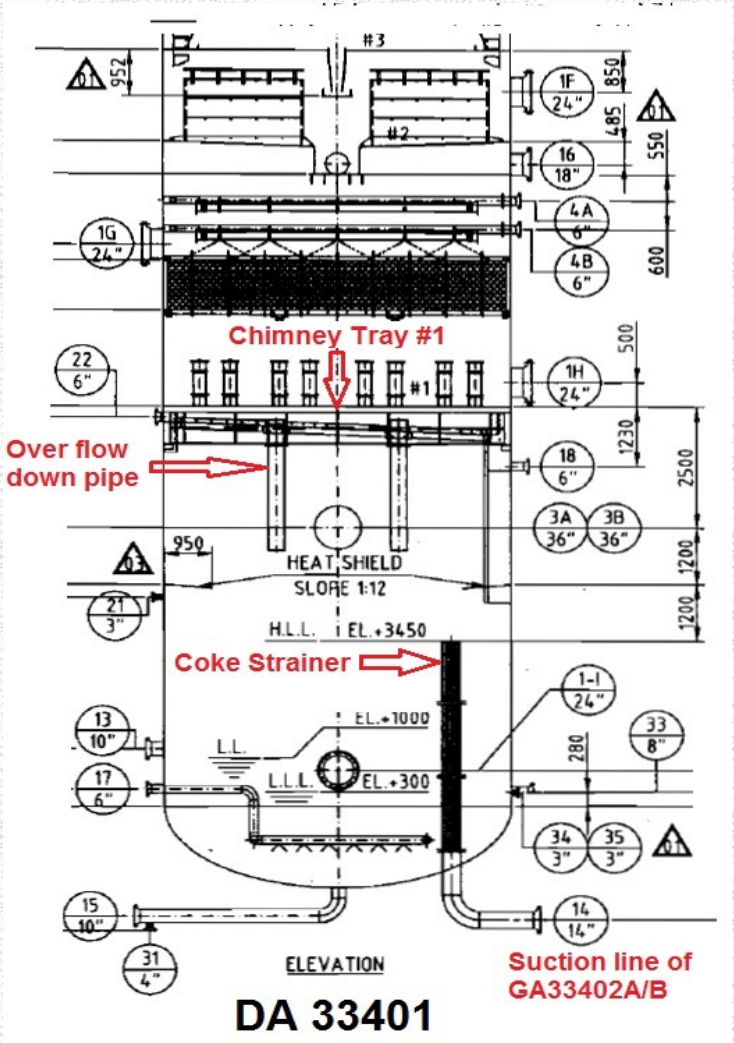
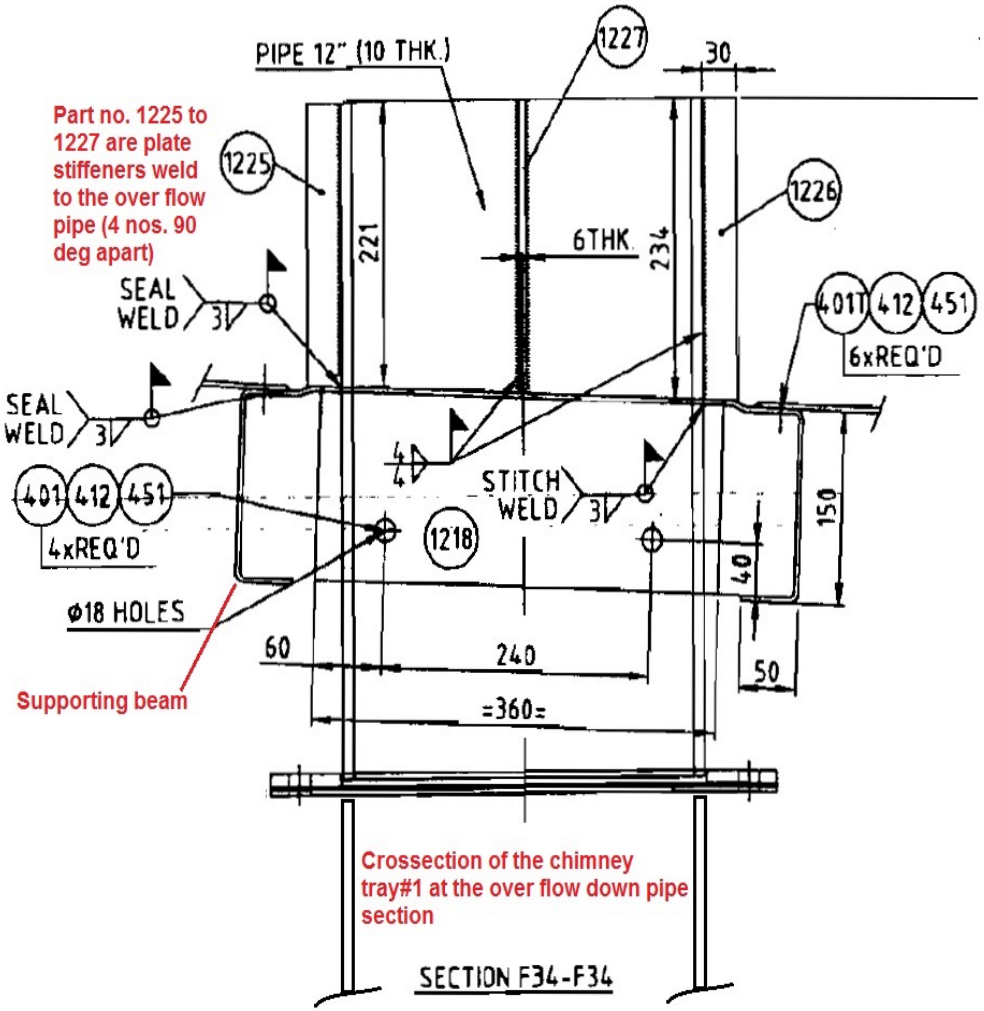
Learning from Coker Fractionator





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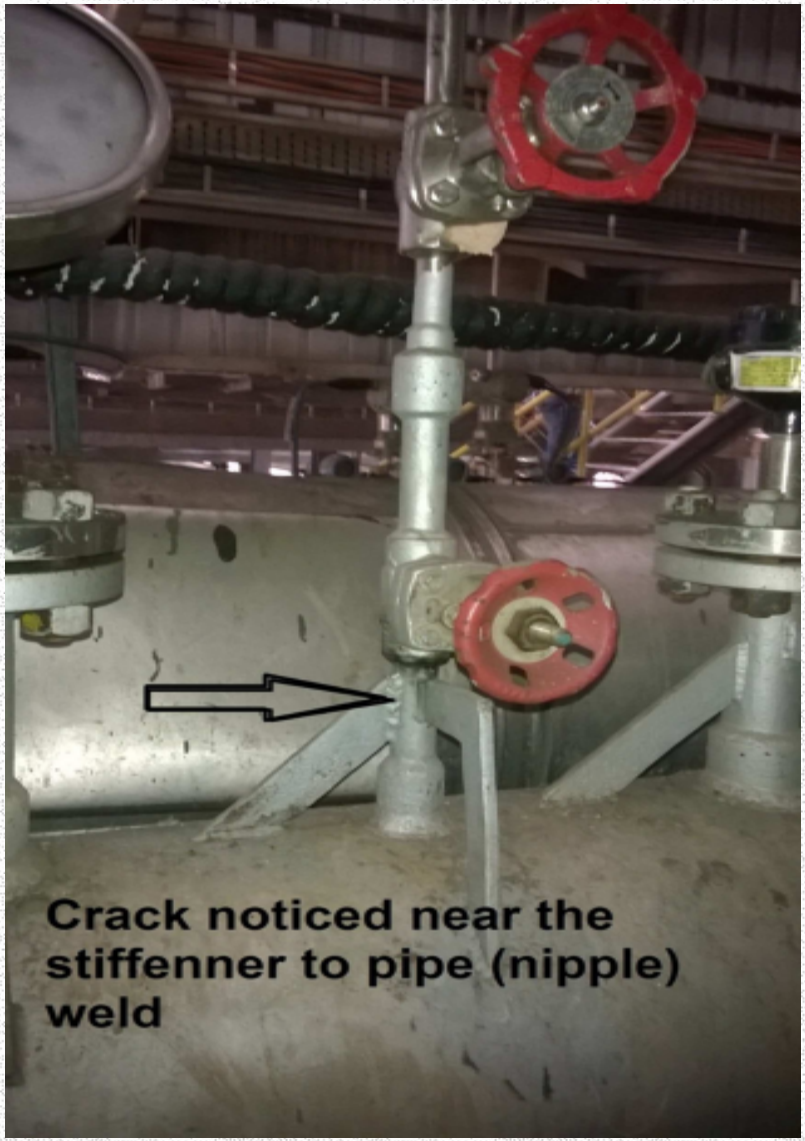

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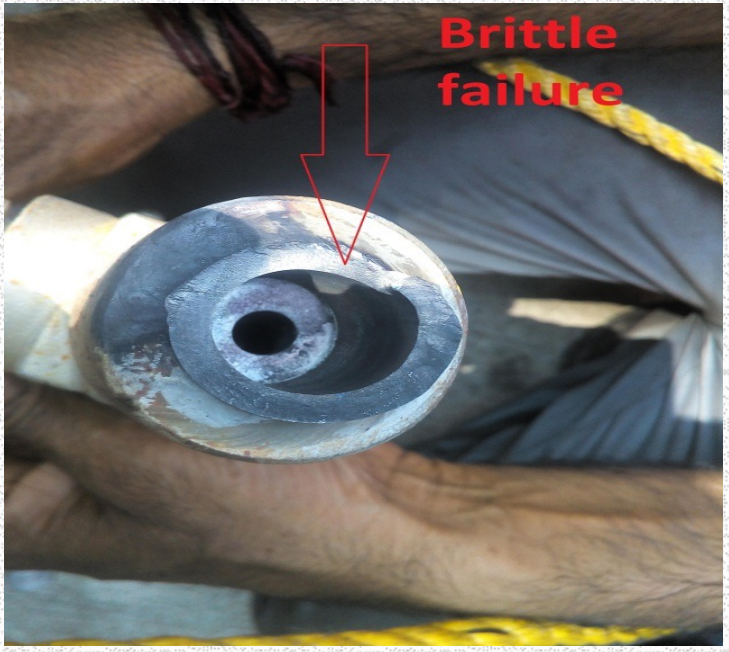

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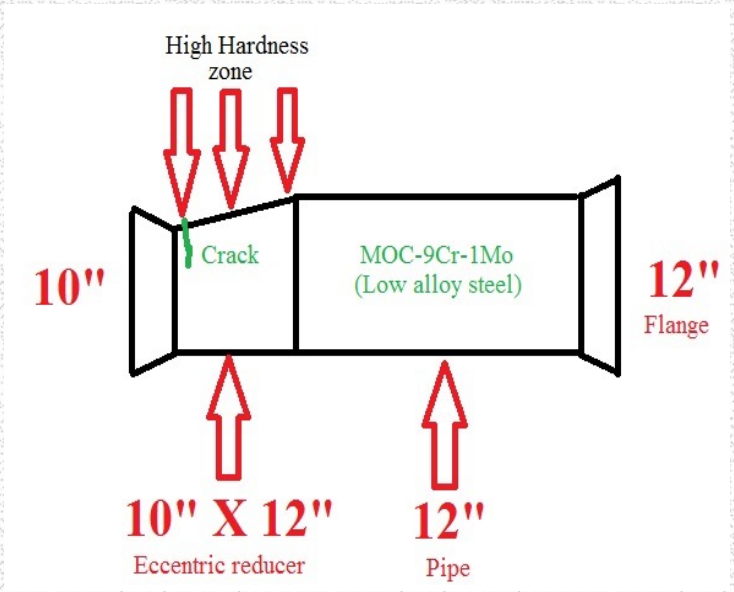
Learning from coke drum PSV line



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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 notices.
- 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?

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