HANDLING POWER AND STEAM OUTAGE IN DCU RECENT EXPERIENCES

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Introduction

- DCU Capacity 3MMTPA
- Licensor – Lummus technology
- 4 Drum operation with two heaters
- Commissioned on 02nd April 2014
- Turndown 50%
- Designed for coking cycle of 24 hours followed by a 24 hour de-coking cycle.
- Through Put Ratio = 1.10
- Design Feed TAN < 0.5%.

Feed Characteristics

S.NO	SPECIFICATION	DESIGN FEED CASE	Check case
1	Type of FEED stock	VR 550+ cut	560+
2	Feed rate (kg/hr)	375,000	3,70,000
3	API gravity	6.04	9.4
4	Viscosity	4040cst @ 120℃	1150 cst at 100℃
5	Sulfur content wt%	5.63	3.75
6	CCR, wt%	23.7	16
7	Asphaltene, wt%	19.6	11.0
8	Metals wppm (Nickel/Vanadium)	50 / 200	45/125

Process Yield

Products	Wt % Yield Design case
H_2S	1.46
Off-gas	3.72
LPG	3.00
LN	3.98
HN	5.31
LCGO	30.67
HCGO	22.27
Coke	29.66

Major Challenges faced

1. Power & steam failure at the time of switchover
2. Power & steam failure after 3.5 hours of switch over
3. Heater charge pump continuous cavitation
4. Coke drum MOV non operable - fractionator and Blowdown tower first Mov
5. Hotspot/Steam/Coke bed collapse while cutting
6. Choking of DTM lines
7. Blockage of passage in water quench cycle

Power & steam failure @ switchover

Drum	Status at the time of power failure on 06th Nov 2015 19.36 Hrs
Drum A	Fully coked & switch over progress (70% towards A)
Drum B	Vapour heated & switch over progress (30% towards B)
Drum C	Cutting in progress
Drum D	12 Hours Coking completed

Power & steam failure @ switchover (Cont..)

1. Total power and steam failure - Emergency steam activated
2. More steam went to Drum B than A
3. HP 11kg/cm2 and and MP 3kg/cm2 after 1hr pressure normalized.
4. Switch valve rotated towards Drum B
5. Utility MP steam diverted to drum A - 2T steam - high feed line pressure)
6. Emergency steam have high T &P
7. Switch over to Drum A to B
8. Drum A water quench started at 00.30hrs - 15M3/hr water -10.5 Kg/Cm2
9. After power clearance feed cut in done in Drum D @ 215℃
10. Feed line pressure 4.6Kg/Cm2 .

Power & steam failure @ switchover (Cont..)

11. Heater B and Drum D stabilized.
12. Drum B feed cut-in done at 9.30hrs - 35M3/hr
13. Drum A - 150M3 water - top water introduced - 80M3/hr
14. Drum A skin 100℃ with 240M3/hr
15. 850M3 water filled (3M above coke bed height) – soaking for a day
16. Drained to CCD to check any abnormality
17. Drained to maze – floating with blowdown tower till bed height
18. Water refilling and draining done(4 times)
19. No abnormality found while draining – Vent opened.
20. Cutting completed after 4 days of coking. Very fine powder coke observed.

Power & steam failure after 3.5 hours of switchover

Drum	Status at the time of power failure on 08th Sep'15 21:03 Hrs	Status after power and steam clearance
Drum A	Coking cycle 3.5 hrs	Heater Emergency steam kept on to fractionator
Drum B	Fast water cooling since 1 hr	Fast water cooling resumed and completed by 05:00 hrs on 09/09/15
Drum C	Cutting in progress	Cutting completed
Drum D	13 Hours Coking	Fast water cooling started at 05:15 Hrs on 09/09/15 (After completion of Drum B)

Power & steam failure after 3.5 hours of switchover

1. Drum A – Tarry drum
2. Power clearance after 1 hr
3. Emergency steam to Drum A to fractionator continued for 20hrs
4. VR circulation through heater B bypassing drum C/D started to increase fractionator bottom temperature 320℃
5. Heater A, Feed cut in done directly into Drum A without bypass

(keeping emergency steam on) at 18:30hrs on 09th Sep -15.

6. Initially feed line pressure increased to 4Kg/cm2 and soon got normal

7. COT increased and plant stabilized with heater A and Drum A.

Heater charge pump continuous cavitation

Event 1 (16th Jan 2015)

1. During start-up WGC continuously surging and not able to load the compressor
2. Compressor suction pressure was varied to check compressor loading.
3. Compressor problem solved by changing the gas in the system and by controller reset.
4. Heater charge pumps were cavitating and lot of coke particle observed in strainer
5. Lot of coke observed in fractionator bottom filter in recirculation loop
6. Heater charge pump started and stopped for several times for evacuation of coke from suction

Heater charge pump continuous cavitation (Cont..)

Event 2 (19th Feb 2015)

1. Both the heaters tripped with heater charge pump discharge pressure low low
2. Heaters were started with in 30min and heater pass flow increased to restore previous condition.
3. Heater A pass 1 skin temperature rapidly climbed to 668℃ with in 2 hours.
4. Some coils of Heater A were slagged and coil number 9 had a bulge at the middle
5. Replacement of coils done and unit restarted.

Heater charge pump continuous cavitation (Cont..)

Event 3 (28th Feb 2015)

1. Heater charge pump discharge pressure collapsed and standby pump auto cut-in happened.
2. Both the heater got tripped due to pressure low low
3. Both the heaters started back and pump cavitated beyond 300M3/hr flow
4. Same condition observed in standby pump also.

Heater charge pump continuous cavitation (Cont..)

Following action were initiated

1. Suction strainer of both pumps cleaned.
2. Flushing oil at the pump suction line blinded.
3. Back flushing with flushing oil system done to dechoke strainer and coke catcher
4. Fractionator bottom feed quality checked and found normal
5. Heater charge pumps MCF control valves checked and found ok
6. Pump suction pressure checked and found abnormal (350 M3/hr- 1.15Kg/cm2 and 522M3/hr – 0.95Kg/cm2 versus design 522M3/hr - 1.41Kg/cm2)
7. Shutdown initiated and fractionator opened for inspection

Heater charge pump continuous cavitation (Cont..)

Observation

1. Bottom section of the coke catcher crippled and there was no gap for liquid to flow at the bottom of the catcher.
2. Down comer pipes were broken and fallen down.
3. The chimney tray below wash grid had refractory damage.
4. Recirculation pump suction and discharge observed to be clean and intact.
5. Both HCGO wash header flanges gasket damaged

Heater charge pump continuous cavitation- Root cause analysis (Cont..)

1. **Foaming in Coke Drums**

   a. Higher viscosity and more coke bed height - High coke carryover

   b. Antifoam dosing on time basis not on tendency of foaming

   c. VR from two wide range viscosity processed

2. **Pressure surge**

   a. WGC surge while startup on 16th Jan leads to coke carry over to fractionator bottom.

   b. After plant startup frequent cleaning of charge pump suction strainer and tripping of heaters due to cavitation occurs.

   c. Coke catcher damage might initiated at this time.

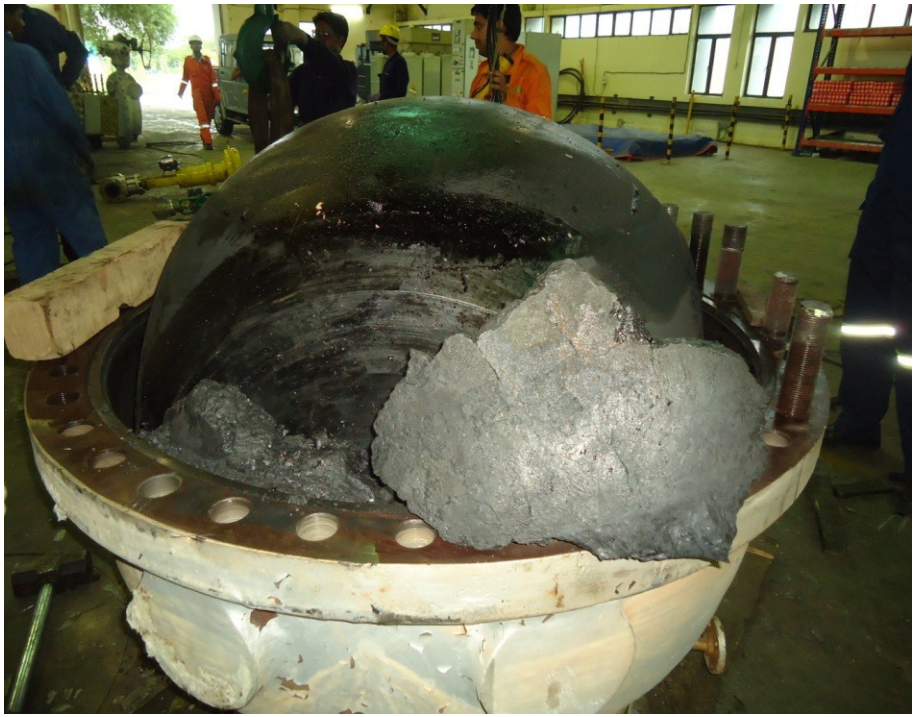
Heater charge pump continuous cavitation- Root cause analysis (Cont..)

3. Feed Interruptions

a. Feed interruption due to pump cavitation and localized heat flux leads to coke build up in heater coils

b. Feed interruption leads to high skin temperature – accelerate coke deposition in coils and shortening the run length of the heater


ESCORTS
K-10
10T



Thank you

Steam Eruption

1. Shot coke – Abnormal channeling – prevents uniform cooling
2. Un even cooling – Coke bed inside high temperature
3. Hot spot erupts violently when contact with water
4. Operating personnel exposed to high speed projectiles from the top flange