DCU FURNACE TROUBLESHOOTING: “HIGH TUBE METAL TEMPERATURE”

C K SINHA
Senior Manager Technical Services,
sinhack@indianoil.in
FURNACE OVERVIEW

- 2 - Pass Bottom Fired Natural draft Furnace
- Design Fired duty- 8.16 Gcal/hr
- Low Nox flat flame burner
- Total 36 no of tubes in radiation section
- Tube metal T t’couple on tube no 1,2,7,25,28 & shock zone (SZ) tube
PROBLEM

- Rise in tube metal temperature (TMT) in short time
- No on-line spalling facility
- Frequent SAD
- Frequent DCU outage
- Reduction in Refinery Profit
Problem Analysis
FIELD CHECKS

- CROSS CHECKING OF TMT BY THERMOGRAPHY
- FEED PROPERTY, FG PROPERTY
- CONTAMINATION OF FEED WITH RESIDUE
- FURNACE FEED PUMP SUCTION STRAINER
- START-UP CIRCULATION PUMP SUCTION STRAINER
- TRAMP AIR
- FIRED DUTY
TMT TREND OF PAST RUN-1

25TH TUBE

SHOCK ZONE

7TH TUBE & BELOW

Legend:
- 1-N
- 1-M
- 1-S
- 2-N
- 2-M
- 2-S
- 7-N
- 7-M
- 7-S
- 25-N
- 25-M
- 25-S
- 28-M
- SZ-1
- SZ-2
TMT TREND OF PAST RUN-2

SHOCK ZONE

25th TUBE

7th TUBE & BELOW
*One additional t’couple installed on 25th in Middle position and on 28th in Middle position.
CONVECTION COIL PRESSURE DROP

Series 1
Series 2

ConvDelP-1
ConvDelP-2
OPERATING CONDITIONS

- HC flow 29 m3/hr
- BFW to convection coil flow rate 0.32 m3/hr
- CIT- 325°C, COT- 492.5°C
- Furnace draft- 7 mmWC
- O2 analyzer reading- 8 vol%
- Convection O/L T- 433°C
- Stack T- 230°C
- Flue gas T at arch- 740°C
- Flue gas T at floor- 620°C
- Fuel Gas flow- 560 kg/hr
PROCESS TEMPERATURE DURING SAD WITH SAME DRAFT AND O2 IN FLUE GAS
OBSERVATIONS

- HIGH DRAFT, HIGH EXCESS AIR, HIGH TMT IN SHOCK ZONE & RADIANT TOP ZONE
- HIGH HEAT TRANSFER IN CONVECTION TUBES
- HIGH RADIATION INLET TEMP
- CONVECTION COIL FOULING
- HIGH AMOUNT OF HEAT AVAILABLE IN RADIATION TOP ZONE
- COKE FORMATION IN RADIATION TOP ZONE AT FAST RATE
- COKE LAYER IN 25TH & 28TH TUBE
- TUBE 1 & 2 VERY CLEAN
• Reduce the draft in the furnace box to shift the heat transfer to radiation bottom

• Increase the HC velocity at the radiation inlet to slow down coke layer formation in radiation top tubes
NEW OPERATING CONDITION

- HC flow 29 m³/hr/pass
- BFW to convection coil flow rate 0.32 m³/hr/pass
- BFW to radiation I/L coil flow rate 0.2 m³/hr/pass
- CIT- 325°C, COT- 495°C
- Convection O/L T- 420°C
- Furnace draft- 2.3 mmWC
- O2 analyzer reading- 3.2 vol%
- Stack T- 210°C
- Flue gas T at arch- 730°C
- Flue gas T at floor- 620°C
- Fuel Gas flow- 530 kg/hr
RESULTS
CONVECTION COIL PRESSURE DROP

Series1

Series2
NEW TMT TREND RUN-1

25TH & 28TH TUBE

7TH TUBE & BELOW

SHOCK ZONE
NEW TMT TREND RUN-2

7TH TUBE & BELOW

25TH & 28TH TUBE

SHOCK ZONE
BEFORE

AFTER
Thank you!