SULPHUR RECOVERY UNIT
START-UP CONSIDERATIONS

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Agenda

- Burner Management System
- Control Loops
- Refractory Dry-Out
- Start-up Experiences
Burner Management System

- For safe operation of reaction furnace and Incinerator
- To avoid any damage to burner and other equipments
- Basic Hardware Contains
  - Reaction Furnace Burner
  - Main Fuel Gas Burner
  - Retractable pilot equipped with an electronic ignition system
  - Flicker type Flame Scanners
  - Ceramic Thermocouples
  - Optical Pyrometers
Burner Management System

Typical Interlocks of BMS

- Low Low combustion air flow / Low Low Fuel Gas flow
  - To avoid backward flame and damage to burner

- High High fuel gas pressure
  - To avoid unstable flame

- High High levels in KO drums
  - To avoid carryover of liquid to burner, resulting in refractory damage

- High High Reaction Furnace Pressure
  - To avoid blowing off the sulphur seal pots
Burner Management System

Typical Interlocks of BMS

- High High Reaction Furnace Temperature
  - To restrict RF temperature below Refractory Design temperature and to avoid refractory damage
- Incinerator Shutdown
  - To avoid sending unreacted H$_2$S to Incinerator / Environment
- Flame Loss
  - To avoid having explosive mixture in RF during flame failure
Control Loops

Control Loops in SRU

- Reaction Furnace Combustion Air Control
Control Loops

Control Loops in SRU

- AAG Split in two zones of RF
  - To ensure temperature in zone 1 of RF for complete destruction of Ammonia
  - At least 40% AAG flow to zone 1 is maintained.

- Three Element Boiler Level Control
  - To avoid misleading response of level controller due to Boiler Swell
Control Loops

Control Loops in SRU

❖ RF Fuel Gas and Steam Ratio Control
  • To prevent excessive RF temperature and refractory damage
  • To avoid soot formation

❖ Incinerator Temperature Control/Oxygen Control
  • To control air flow to incinerator to destruct sulphur compounds
Control Loops

Control Loops in SRU

❖ Incinerator Temperature Control/Oxygen Control
Refractory Dry-Out

**Purpose**
- To cure the refractory properly to avoid damaging refractory when equipment is put in operation

**Methodology**
- Slower rates of temperature rise or longer periods of temperature soaks to avoid any damage to refractory
- Boil out of Waste Heat Exchangers and Condensers generally occurs in parallel
- Checkout of operating systems prior to actual start-up
- Converters and Condensers are bypassed during initial phases of dryout (Temp 540 C and below), start-up vent is used.
Refractory Dry-Out

- Typical Refractory Cure Schedule

Refractory Dry-Out of
Thermal Reactor Burner, Thermal Reactor, &
Waste Heat Exchanger 1st Pass & 2nd Pass

- Refractory - 75 mm insulating castable, 75 mm hot face castable, 230 mm hot face brick
Normal Operating Temperature = 1200°C

- Hold to get complete thermal expansion of all refractory
- Time may be extended depending on downstream dryout

- Hold to fully cure refractory near shell
- Hold to cure WHE tubesheet refractory
- Time may be extended depending on WHE boilout

- Light Main Burner, Temp will jump
- Stop Main Burner wherever unstable
- Stop Pilot when temperature stops decreasing

- Blow for 8 hours, then open manway, (allowed 6 hours to get manway open)
- Start air mover

The minimum recommended total dryout time for all equipment for planning purposes is 14 days. See composite curve.
Refractory Dry-Out

- Typical Refractory Cure Schedule

Refractory Dry-Out of Incinerator Burner, Incinerator, & Incinerator Waste Heat Exchanger

- Refractory - 150 mm thickness assumed, multiple systems
- Normal Operating Temperature = 816°C

- Time may be extended based on upstream dryout and boilout

- The minimum recommended total dryout time for all equipment for planning purposes is 14 days. See composite curve.
Refractory Dry-Out

- Typical Refractory Cure Schedule

Composite Refractory Dry-Out Schedule

1. See individual dry-out curves for more detail.
2. The minimum recommended total dryout time for all equipment for planning purposes is 14 days.
Refractory Dry-Out

Precautions

- Pressure in Waste Heat Boiler steam drum is increased in accordance to temperature rise in the Reaction Furnace.
  - At least 50% of Normal Operating Pressure before Reaction Furnace Temperature reach 1000 C
  - Normal Operating pressure before Reaction Furnace temperature exceeds 1100 C

- To limit the stress on the tubesheet refractory due to thermal expansion
- Two zone Reaction Furnace
- Amine acid gas partly introduced in zone 2
- Quantity of amine acid gas introduced in zone 1 is restricted to control elevated temperature in zone 1.
- Temperature above ~ 1300 C is maintained in combustion chamber (zone 1)
- Moles of H$_2$S fed to zone 1 will always be greater than one third of the total H$_2$S in all feed streams, to prevent SO$_3$ formation.
Initial Stabilization of SRU

Stabilizing SRU in absence of correct flow transmitter/ analyzer readings
- Maintain appropriate temperature in Reaction Furnace
- Maintain temperature profile across the unit
- Try to maintain some delta T across second converter
- Monitoring the sulphur flow from look boxes
Start-up Experiences

Nozzle Protrusion in Reaction Furnace

- Instrument nozzles were protruded beyond refractory lining and got damaged/corroded due to operating conditions in reaction furnace.
Ceramic Thermocouple Installation

- Tip of refractory well / ceramic thermowell should not be more than 1-1.5” beyond the refractory lining

25 mm
Start-up Experiences

**Inadequate condensate return from Sulphur Pit Pumps**
- common steam trap for condensate return from can pumps and condensate return from pump discharge line jacket
- Steam trap was not able to remove all the condensate formed in the pump can and discharge line
- Thereby leading to failure of pump
Start-up Experiences

SRU running at turndown flow for prolonged time
- Acid Gas available for SRU was very close to turndown flow
- Unit was in dual gas firing mode for extended period
- Temperature in tail gas line (after final condenser) was not adequate to avoid acid condensation
- Tail gas line corroded just before the entry point at Incinerator
Start-up Experiences

Final Condenser Tube leakage
- Final condenser as HP BFW preheater
- Pressure difference across the tube side and shell side very high
- Leakage in tube sheet leading to sulphur accumulation in condenser
Start-up Experiences

**Vibration in Incinerator**

- Due to resonance effect at particular flow rates
- Can be eliminated by anti-vibration rod or tabulator
Start-up Experiences

Gas nozzle on wrong side of waste heat boiler
- The gas outlet nozzle on Reaction Furnace Waste Heat Boiler was drilled on wrong side
- Missed out during VDR, Shop inspection
- Leading to extra work at site.
Pilot Nozzle on Acid Gas Burner

- Higher Schedule no. pipe used for Pilot nozzle on burner
- Due to reduced ID of nozzle, unable to accommodate pilot in the nozzle.
- Pilot nozzle neck was re-bored to increase the nozzle ID.
Start-up Experiences

Incinerator Burner Nozzle
- The holes were missing on the secondary burner nozzles of incinerator
- Missed out during shop inspection
Building a world of difference.

Together

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