REFINERY COLD TOWER OPERATIONAL CHALLENGES IN 2020

COQA Meeting
Virtual Session

Dennis Haynes
Senior Technical Consultant
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HOW DOES THIS FIT IN WITH CRUDE QUALITY

Crude Quality
• Assay
• Properties

Refinery Processes
• Processability
• Processing options

Product
• Quality
• Quantity

Goal
CRUDE UNIT CONNECTIVITY
TURNDOWN (PROCESS OR CIRCUIT)

- Changes to Corrosion Environment
  - Dew points
  - Salt Points

- Turndown Capability
  - Tray or packing types

- Reference
  ['Crude Unit Turndown’ Webinar (14 April 2020); Becht]
Components distill up the column
✓ Naphtha
✓ Steam
✓ Acid Gases (HCl, H₂SOₓ, H₂S, etc.)
✓ Bases (Ammonia, Amines, etc.)

Partial pressures of components and temperature determine
✓ Dew point
  ✓ Acids and bases may absorb in dew point
✓ Salts formation points
Components distill up the column
  ✓ Similar to overhead situation

Depending on partial pressures and process temperatures
  ✓ Dew point may occur
  ✓ Acids and Bases may absorb in dew point
  ✓ Salts formation

Monitoring becomes problematic

Reflux configuration and distribution important
Components distill up the column
- Similar to overhead situation
- Depending on partial pressures and process temperatures
  - Dew point may occur
  - Acids and Bases may absorb in dew point
  - Salts formation
- Monitoring becomes problematic
- Reflux configuration and distribution important
COLUMN TOP PUMP AROUND SECTION

- Multiple mechanisms possible
  - Azeotrope
  - Water
  - HCl
  - Salts
  - Corrosion byproducts (FeCl₂)
- Cooling environment on heat exchange surfaces
  - Soluble water may separate out
  - Acids may dissolve into water
- Monitoring becomes problematic
- Reflux configuration and distribution important
COLD DISTILLATION COLUMN CHALLENGES

- So...
- By reducing rates to the top of the column, there is the likelihood of adding significant complexity to base case operations
- Reducing flow rates via
  - Lower tower top temperatures
  - General Turndown
MONITORING FOR THE SYSTEM IS IMPORTANT

- Understand where the temperature limits are
  - Relative to dew points
  - Relative to salt points

- Quantifying any deposition on heat exchanger surfaces

- Being able to obtain and determine aqueous condensate sample

- Measurement of corrosion rates on process surfaces

- Ability to trend changes in composition of overhead condensate
CORROSION CONTROL APPLICATIONS

- Best in class chemistries
- Monitoring is very important
- Proven technologies exist
  - Neutralizer
  - Filmer
  - Wash Water
- Optimization based on knowledge is critical
OVERHEAD AND TOWER TOP MODELING

- 35+ year history
- Detailed Ion Balance Model

Determine Vapor-Liquid Equilibrium via Multiple Flashes

Determine Water Phase Partitioning
Determine Dew Point and Salt Points

Input Operating Conditions

Calculate pH Profile based on Ion Concentrations
HEAT TRANSFER RATING

- 25+ year history
- Rigorous thermodynamic model
- Heat exchanger network monitoring
  - Fouling Factors
  - U-values
  - Normalized Circuit Performance
APPROPRIATE SYSTEM SAMPLING

- OCS/AOCS in TPA applications for 25+ years
- Samples represent condensation that may form on heat exchange surface
- Can catch materials from the tower top internal that flow down into TPA
CRUDE UNIT OVERHEAD ONLINE ANALYSIS

- 3D TRASAR for Crude Overheads
  ✓ (3DTCOS)

- Online analysis for
  ✓ pH
  ✓ Iron
  ✓ Chlorides
  ✓ Ammonia
SUMMARY

- Changing process operational envelope may provide options for refineries

- Yet it also changes scope on how the distillation system will behave

- There are solutions available that have been applied with good track records

- Many monitoring technologies available but need to be creative

- A combination of the components discussed here can lead to optimized reliability