LPG Amine Treating Unit Retrofitted for Environment Compliance, Lower Operation Costs and Increased Reliability

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Agenda

• Introduction
• Background
• LPG – caustic process before revamp
• LPG Treating Project
• Technical Challenges
• Performance After Start up
• Concluding remarks and lessons learnt
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Introduction

Bapco LPG Amine Treating Project

• Olefinic LPG - produced in the Fluid Catalytic Cracking Unit (FCCU)
• LPG is converted to polymer gasoline
• LPG feed must be treated to remove sulphur compounds to meet the product specifications and to prevent catalyst poisoning
• Historically LPG was treated using caustic only
• LPG Treating Project launched to improve the treating process by using a retrofitted column for bulk sulphur removal using diethanolamine (DEA)
• The project has been a great success
LPG - Caustic Process before Revamp

- **H₂S removal by Caustic treating - very old technology, operator intensive**
  - Semi-batch operation - 20°Be caustic solution in stagnant continuous phase and LPG in flowing dispersed phase
  - Caustic strength regularly measured - fresh caustic makeup when strength below 10 wt%
  - Significant spent caustic generation - an issue
  - Frequent dump and recharge of the spent caustic solution posed a safety risk to operators
LPG Treating Project

- Objectives and driving forces
  - Improve process efficiency
  - Improve operability and reliability
  - Substantial reduction in caustic usage and spent caustic waste
  - Enhance environmental performance and compliance
  - Reduce personal safety and health risks (caustic handling)
  - Reduce supply chain risks
  - Increase profitability
  - Minimum capital investment
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LPG Treating Project (cont'd)

- LPG From FCCU
- Lean DEA
- LPG-Amine contactor
- Mercaptan Absorber
- Residual H₂S Absorber
- Caustic Regenerator
- Knockout Drum
- Water Wash Column
- Treated LPG
- Spent caustic To WWTP
- Water
- 120 psig, 103°F
- 137 psig, 104°F
- Regenerated Caustic
- Caustic Make up
- Caustic circulation Pump
- Lean DEA booster Pump
- Lean DEA
- Coolant
- Rich DEA to regenerator
- Regenerated Caustic
- Spent caustic To WWTP
- Caustic circulation Pump
- Water Wash Column
- Treated LPG
Technical Challenges

- Existing redundant column dimensionally suitable but had to be retrofitted:
  - Column T/T height - 65 ft, Diameter - 5 ft 6 in - adequate for process requirement
  - New nozzles / manways / random packing / new foundation for column to suit increased weight load
- Lean DEA supply pressure was low
  - New amine booster pumps
- Lean DEA supply temperature is 135°F - at this temperature LPG would vaporise
  - New lean DEA trim coolers
Technical Challenges (cont’d)

• Traditionally LPG-Amine contactors have amine in continuous phase. This requires a downstream coalescer to separate entrained amine.
  – Column is designed for LPG in continuous phase
  – Amine-LPG interface is maintained at bottom of column
  – Minimal entrainment - hence, coalescer not required - cost reduced

• Increased risk of LPG breakthrough into the rich DEA
  – An additional independent level indicator with low level alarms and an emergency shut-off valve provided
Performance After Start Up

• Current operation
  – Unit operating at normal LPG and DEA flow rates
  – $\text{H}_2\text{S}$ removal efficiency is as expected (>99%)
  – All operating parameters are in normal range
  – Treated LPG meets the required specifications (At amine-LPG contactor outlet, guaranteed $\text{H}_2\text{S}$ in LPG was <100 vppm, actual achieved is <10 vppm)
  – $\text{H}_2\text{S}$ absorber caustic dump & recharge no longer a daily routine
  – No spent caustic in the refinery effluent
Concluding Remarks and Lessons Learnt

• Project has been an outstanding success
  – Overall LPG treating more effective and more efficient
  – Small quantity of spent caustic waste used as feed to new waste water treatment plant (MBR)
  – Significant reduction in operator workload and less exposure to caustic
  – Minimised caustic exposure for the operations personnel
  – Improved reliability, less operating problems, fewer tankers on the road, less caustic inventory required at refinery, seamless integration with existing DEA facility
Concluding Remarks and Lessons Learnt (cont’d)

• Key Success Factors
  – Multi-disciplinary teams for project development & implementation
  – Conceptual process designs done in-house
  – In-house technical strength
  – Close working relationship with vendors
Thank You