FCC International Technical Symposium 2018, Islamabad

Tom Nicholson
Revamp of Existing Burners to Increase Efficiency

Tom Nicholson
Presentation Outline

- Application Overview
- Zeeco Single-Jet Ultra-low NOx Emissions Burner
- CFD Study
- Combustion Testing
- Burner Installation
- Conclusion
Application Overview

- Downfired Primary Reformer Furnace
- European Ammonia Production Facility
- 105 Downfired Burners > 40 years old
- NOx emissions in range of 200-300 mg/Nm³
- Customer wanted to re-use burner windbox and damper
Zeeco Solution

- Supply GB Single-Jet Ultra-Low Emissions Kit:
  - Gas lance / tips
  - Cone
  - Burner Tile

- Retain existing:
  - Windbox
  - Damper / damper controls
  - Pilot

- Guaranteed NOx emissions of 120 mg/Nm³ on Natural Gas
- Design for 10% excess air (≈2.1% O₂ by vol. of dry flue gas)
Zeeco Solution
Zeeco Single-Jet Ultra-Low Emissions Burners

- Firing Ports
- Inert Flue Gas
- Combustion Air
- Fuel Gas
Zeeco Single-Jet Ultra-Low Emissions Burners

- IFGR Zone
- Combustion Air Zone
- Staged Air Zone
CFD Study

- Gas Temperature Contours
CFD Study

- CO Contours confirmed minimum flame interaction
Burner Testing at ZEECO

- Combustion test performed at Zeeco Global HQ.
- Multi-burner testing to verify NOx emissions
- 80-90 mg/Nm$^3$ NOx
- Confirmation of no flame-to-flame interaction
- Proven flame stability at 1.1% O$_2$ (Dry Basis)
Burner General Arrangement Drawing
Installation

- Burners were installed early 2018
- Retrofit kits minimised installation time and labour requirements
- Burners utilised Zeeco ProFlame Scanners for flame detection
- Flexible hoses used for gas connections
Burner Performance

- Burners are achieving 90 mg/Nm$^3$ NOx which is significantly lower than the guaranteed NOx (120 mg/Nm$^3$)

- 2.0% O$_2$ measured in the flue gas

- No flame-to-flame interaction

- Improved heat flux profile

- Lower NOx possible if the heater excess oxygen is trimmed further
Conclusion

- Zeeco supplied 105 GB Single-Jet Inserts for a Downfired Reformer at a European Ammonia Facility
- NOx Emissions, Heat Flux Profile, and Flame-to-Flame Interaction were Confirmed by CFD and Burner Testing
- Current NOx Emissions average 90 mg/Nm³ at 2% O₂ which meets European Legislation and NOx Guarantees
- Burners are Operating with Lower Excess Air Therefore Fuel Gas Consumption Rate is Lowered
- NOx Emissions can be Reduced Further if the Excess Air is Trimmed