قافكو
QAFCO
شركة قطر للأسمدة الكيماوية
QATAR FERTILISER COMPANY

the Jewels of Growth

De-NOx Implementation and Experience in QAFCO

Prepared by: Sultan Jassim Darwish

September 2018

Disclaimer

Disclaimer

This presentation is intended only for the use of the individual or entity to which it is addressed. Any use, dissemination, distribution, or copying of this presentation in any form either in part or complete, without explicit permission from the concerned authorities at QAFCO, is strictly prohibited. Qatar Fertiliser Company (P.S.C.) shall not be responsible for any content or interpretation of the presentation.

Mission & Vision

Our Mission

We shall operate the plants Efficiently, Safely, and in an Environmentally Responsible manner to Produce and Supply Ammonia, Urea, Urea Formaldehyde and Melamine at the Quality required by our Customers and to carry out investments to Maximize Shareholders Returns.

Our Vision

Largest Quality Ammonia and Urea Producer.

Satisfy QAFCO's needs for Urea Formaldehyde.

Quality Melamine Producer.

Content

1. Introduction
2. NOx reduction techniques
3. 19% Ammonia and 32.5% Urea infrastructure
4. Ammonia-3 Plant NOx emissions – Brief
5. De-NOx Technologies – Ammonia-3 Primary reformer, HRSG and Auxiliary Boiler
6. De-NOx Technology – Auxiliary Boiler A3
7. Ammonia-4 Plant NOx emissions – Brief
8. Decommissioning of Boilers in Ammonia-1, 2, 3 and ongoing work
9. Conclusion

1. Introduction

What is NOx?

- Combined emissions of Nitric Oxide (NO) and Nitrogen dioxide (NO_2).
- Produced by reaction between N_2 and O_2 during combustion.

What are the harmful effects of NOx?

- Affects human respiratory system.
- NOx when react with atmospheric moisture acid rain will form.

Background

- Monitoring of emissions by Statutory authorities.

2. NOx reduction techniques

Technique	% NOx reduction
○ Low NOx burners	- 50 – 60 %
○ Flue Gas Recirculation	- 50 – 75 %
○ SNCR technique (Selective Non Catalytic Reduction)	- 50 – 60 %
○ SCR technique (Selective Catalytic Reduction)	- 70 – 80 %
○ Low excess air	- 01 – 15 %
○ Steam Injection	- 40 – 70 %
○ Reduced Air preheat	- 25 – 65 %

(*) Source: Select right NOx control technology –Wood Jan'1994

3. 19% Ammonia and 32.5% Urea infrastructure

- The SCR and SNCR technologies requires NH_3 solution or Urea solution as NOx reducing agent.

- **Objective**

  To support De-NOx projects at QAFCO plants &

  To supply 19% Ammonia and 32.5% Urea outside QAFCO if required (other plants).

- The De-NOx reaction with Urea solution

  $$NH_2CONH_2 + 2\,NO + \tfrac{1}{2}\,O_2 \longrightarrow 2\,N_2 + CO_2 + 2\,H_2O$$

- For Ammonia

  $$4\,NH_3 + 4\,NO + O_2 \longrightarrow 4\,N_2 + 6\,H_2O$$

4. Ammonia-3 Plant NOx emissions – Brief

- Plant Commissioned in 1997.
- UHDE Design, Capacity - 1500 mtpd Ammonia.
- Major stack emissions : Primary reformer, Auxiliary Boilers and HRSG.
- NOx emissions – 210 mg/Nm^3 average.
- New Boiler installed in 2006 (200 t/h) with FGR technology.
  - Low NOx burners
  - FGR fan for recirculation of flue gas

5. DeNOx Technologies – Primary Reformer A3

SNCR Technique:

- Urea & Aqueous ammonia solutions readily available as a reducing agent.
- Adequate temperature for SNCR reaction i.e. 875–1030°C.
- Adequate injection space in transition duct for mixing.
- Keeping adequate distance from coils to avoid liquid Impingement.

DeNOx Technologies – Primary Reformer

SNCR NOx Reduction Process

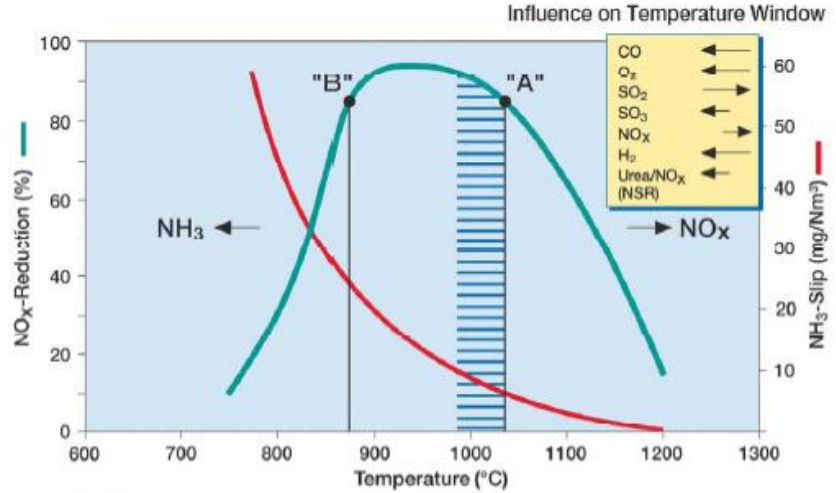


Figure 1: NOx Reduction as a Function of Temperature

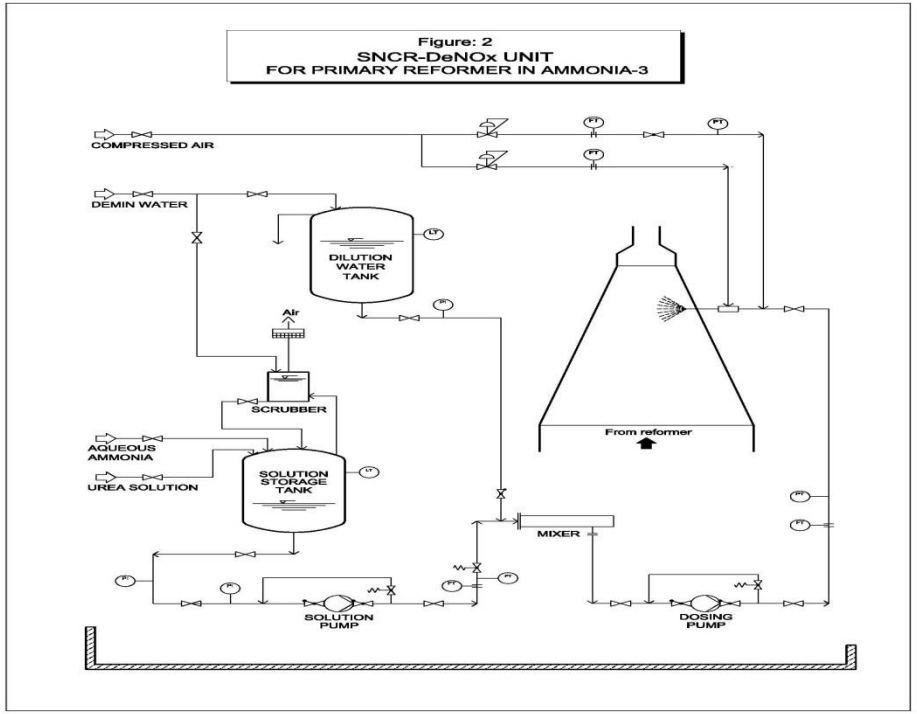
DeNOx Technologies – Primary Reformer

SNCR DENOX

- Solution tank
- Water tank
- Injection pumps
- Injection nozzles
- Compressed air

Process:

- Constant dilution water flow
- Ammonia injection adjusted to control NOx.
- Sprayed in transition duct.



6. De-NOx Technologies – Auxiliary Boiler A3

Choice of technique for Auxiliary Boiler NOx reduction:

- Low NOx Burners with FGR(Flue Gas Recirculation)
- Replacement of conventional burners with Low NOx burners,
- FGR connected with FD fan suction.

De-NOx Technology for Heat Recovery Steam Generator

SCR Technique:

- Chosen as temperature is low (500 to 550°C).
- Urea or Aqueous ammonia solution available.
- Space available for installation of catalyst bed. Installed between Evaporator and Economizer.
- Temperature range of catalyst 250 to 480°C
- Negligible impact on GT performance
- Able to reduce NOx by 70 - 80%.
- Catalyst Life >3 years.

7. Ammonia-4 Plant NOx emissions – Brief

- UHDE Design, 2000 mtpd Ammonia Commissioned in 2004.
- Major stack emissions: Primary reformer, two Auxiliary Boilers.
- Average NOx emissions – 130 ~ 160 mg/Nm^3.
- Boiler burner internals replaced with low NOx design installed in 2017. (Burner gas swirler assembly).
- Reformer DeNox project implementation in progress.

Statutory limits by Ministry of Municipality and Environment

Primary Reformer:	<125 mg/NM^3
HRSG:	<55 mg/NM^3
Auxiliary Boiler:	<55mg/NM^3

Nox Emissions before implementing De-Nox projects

Primary Reformer:	230mg/NM^3
HRSG:	210mg/NM^3
Auxiliary Boiler:	210mg/NM^3

8. Decommissioning of Boilers in Ammonia-1, 2, 3 and ongoing work

- Ammonia-1 four Auxiliary Boilers – decommissioned in 2015.
- Ammonia-2 Auxiliary Boiler – planned to decommission later this year.
- Ammonia-3 Temporary Boiler – decommissioned in 2016.
- Ammonia-4 Primary Reformer – Reformer DeNox project implementation in progress.

9. Conclusion

- Successful implementation of all De-NOx projects in Ammonia-3 plant i.e. SNCR in primary reformer, SCR in HRSG, Low NOx burners with FGR facility in Auxiliary boiler.
- Reduced NOx emissions by 55 MT per month in Ammonia-3.
- Successful implementation of De-NOx project in Ammonia-4 plant for Auxiliary Boiler-1/2 and NOx has been reduced by 8 MT/month.
- Ammonia-4 Primary Reformer DeNox project implementation in progress.

قافكو
QAFCO
شركة قطر للأسمدة الكيماوية
QATAR FERTILISER COMPANY

the Jewels of Growth

Thank You