INNOVATIVE SCR TECHNOLOGIES FOR NOx – VOC – CO – ODOR - REDUCTION

APRIL 2016
CONTENT

- SCHEUCH COMPANY
- SCR TECHNOLOGIES - BASICS
- GERMAN EMISSION STANDARDS 17.BIMSCHV
- AVAILABLE SCR TECHNOLOGIES
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COMPANY DEVELOPMENT

Traditionally innovative

Worldwide working specialist for Ventilation and Environmental Technology Headquartered in Aurolzmünster 780 employees

WE ARE TECHNOLOGY FOR CLEAN AIR

Tinsmith in Ried/Innkreis; 6 employees
PRODUCT PORTFOLIO

- High-dust SCR system
- Semi-dust SCR system
- DeCONOX
- eXmercury
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NO\textsubscript{x} - BASICS (SCR / SNCR)

Basic chemical reaction

4 NO + 4 NH\textsubscript{3} + O\textsubscript{2} \rightarrow 4 N\textsubscript{2} + 6 H\textsubscript{2}O

6 NO\textsubscript{2} + 8 NH\textsubscript{3} \rightarrow 7 N\textsubscript{2} + 12 H\textsubscript{2}O

A catalyst reduces the activation energy!

Definitions:

**SCR** Selective Catalytic Reduction

**SNCR** Selective Non Catalytic Reduction
NO\textsubscript{x} - BASICS (SCR / SNCR)

Basic chemical reaction

\[4 \text{NO} + 4 \text{NH}_3 + \text{O}_2 \rightarrow 4 \text{N}_2 + 6 \text{H}_2\text{O}\]
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- **SNCR**: Selective Non Catalytic Reduction
NO\textsubscript{x} - BASICS (SCR / SNCR)

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A *catalyzer* reduces the activation energy!

*Definitions:*

**SCR** Selective Catalytic Reduction

**SNCR** Selective Non Catalytic Reduction
Where are SCR and SNCR installations in a cement kiln?
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**NOx - BASICS (SCR / SNCR)**

**SCR**
- **Selective Catalytic Reduction**
- **Reaction Temperature**
  > 200°C < 400°C
- **Stoichiometry factor** ≤ 1
- **Efficiency** > 90%
- **Ammonia slip** < 5 mg/Nm³ possible

**SNCR**
- **Selective Non Catalytic Reduction**
- **Reaction Temperature**
  900°C – 1,000°C
- **Stoichiometry factor** 2 - 3
  
  Comment: part of NH₃ can be oxidized:  
  \[ 4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O} \]
- **Efficiency** up to 80% possible
- **Ammonia slip** critical
NO\textsubscript{x} - BASICS (SCR / SNCR)

**SCR**
Selective Catalytic Reduction

*Reaction Temperature*

> 200°C < 400°C

Stoichiometry factor \( \leq 1 \)

Efficiency > 90%

Ammonia slip < 5 mg/Nm\(^3\) possible

**SNCR**
Selective Non Catalytic Reduction

*Reaction Temperature*

900°C – 1.000°C

Stoichiometry factor 2 - 3

Comment: part of NH\(_3\) can be oxidized:

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4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}
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NOx - BASICS (SCR / SNCR)

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  \[ 4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O} \]

- **Efficiency** 60% to 80% possible

- **Ammonia slip** critical
**NO\textsubscript{x} - BASICS (SCR / SNCR)**

**SCR**
- **Selective Catalytic Reduction**
- **Reaction Temperature**
  \( > 200°C < 400°C \)
- **Stoichiometry factor** \( \leq 1 \)
- **Efficiency** \( > 90\% \)
- **Ammonia slip** \( < 5 \text{ mg/Nm}^3 \) possible

**SNCR**
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- **Reaction Temperature**
  \( 900°C – 1.000°C \)
- **Stoichiometry factor** 2 - 3
  
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Emission limits as per 17. BImSchV without special permits in [mg/Nm³]

<table>
<thead>
<tr>
<th></th>
<th>regular values</th>
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<tr>
<td></td>
<td>daily-average limit</td>
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<td>NOx</td>
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<td>NH₃</td>
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<tr>
<td>CO</td>
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<td>TOC</td>
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<tr>
<td>SO₂</td>
<td>50</td>
</tr>
<tr>
<td>dust</td>
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<tr>
<td>Hg</td>
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**Stack Emissions**

**Emission limits – REDUCTION – POSSIBILITIES – PERFORMANCE DATA**

<table>
<thead>
<tr>
<th>Emission Limits acc. 17. BlmSchV</th>
</tr>
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<tbody>
<tr>
<td><strong>regular values</strong></td>
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<td>Hg</td>
</tr>
</tbody>
</table>

Stack emission values after a DeCONOX and an SCHEUCH EMC bagfilter.

SOx Reduction with DeCONOX not possible – however a bagfilter provides some “desulphuration effects”.

The SCR installation doesn’t change the Hg load – however a bagfilter influence the circle behavior.
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AVAILABLE SCR - TECHNOLOGIES

Low Dust -> versus High Dust Arrangement

LOW DUST (TAIL-END)

„end – of – pipe“ arrangement

Tail-End SCR
• Installation after bagfilter
• Heat transfer system necessary

SCHEUCH - A combination between a RTO (Regenerative Thermal Oxidizer and a low-dust SCR

HIGH DUST

„process – integrated“ arrangement

High-dust SCR
• Installation after preheater tower (exposed to dust load)

Semi-dust SCR
Additional pre-separator (hot gas ESP) reduces the inlet dust concentration
LOW DUST (TAIL-END)

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AVAILABLE SCR - TECHNOLOGIES

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AVAILABLE SCR - TECHNOLOGIES

LOW DUST (TAIL-END)

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• Heat transfer system necessary

HIGH DUST

"process – integrated“ arrangement

High-Dust SCR
• Installation after preheater tower
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Semi-Dust SCR
Additional pre-separator (hot gas ESP / cyclone) reduces the inlet dust concentration

SCHEUCH - De CONOX
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LOW DUST (TAIL-END)

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A combination between a RTO
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Semi-dust SCR
Additional pre-separator (hot gas ESP) reduces the inlet dust concentration
LOW DUST SCR “CLASSIC”

Typical integration of the SCR unit
LOW DUST SCR “CLASSIC”

Cross-section of the SCR unit with heat-exchanger
LOW DUST (TAIL-END)

“end – of –pipe“ arrangement

Tail-End SCR
- Installation after bagfilter
- Heat transfer system necessary

SCHEUCH - DeCONOX
A combination between a RTO (Regenerative Thermal Oxidizer and a low-dust SCR)

HIGH DUST

“process – integrated“ arrangement

High-dust SCR
- Installation after preheater tower (exposed to dust load)

Semi-dust SCR
Additional pre-separator (hot gas ESP) reduces the inlet dust concentration
Typical integration of the SCR unit (=Kirchdorfer Zement Plant)
1st DECONOX worldwide at Kirchdorfer Zement - Austria

Design Data:

- 1100 t/d
- Flow: 151,000 Nm³/h
- Temp: 120°C – 220°C
- Dust: < 5 mg/Nm³

Target:

- < 200 mg/Nm³ NOx
- < 20 mg/Nm³ NH₃
- < 10 mg/Nm³ VOC
- > 99% reduction of CO; max. 100 mg/Nm³
Site Impressions DECONOX - Kirchdorfer Zement
LOW DUST SCR

1st feedback since plant start end of 08/2015

• successful Start – Up
• DeCONOx now in permanent operation
• CO and VOC reduction > 99%
LOW DUST SCR

1st feedback since plant start end of 08/2015

- successful Start – Up
- DeCONOx now in permanent operation
- CO and VOC reduction > 99%
- DeCONOx operates autotherm
LOW DUST (TAIL-END)

Tail-End SCR
- Installation after bagfilter
- Heat transfer system necessary

HIGH DUST

High-dust SCR
- Installation after preheater tower
  (exposed to dust load)

Semi-dust SCR
Additional pre-separator (hot gas ESP) reduces the inlet dust concentration
Typical integration of the High Dust - SCR unit
HIGH DUST SCR

Typical arrangement of the High Dust - SCR unit

LEVEL 1
LEVEL 2
LEVEL 3 (spare layer)

CAT cleaning with soot blowers
**DESCRIPTION - SCR - TECHNOLOGIES**

**LOW DUST (TAIL-END)**

"end – of – pipe“ arrangement

Tail-End SCR
- Installation after bagfilter
- Heat transfer system necessary

**HIGH DUST**

"process – integrated“ arrangement

High-dust SCR
- Installation after preheater tower (exposed to dust load)

**Semi-Dust SCR**
Additional pre-separator (hot gas ESP / cyclone) reduces the inlet dust concentration
Typical integration of the SCR unit
1st SEMI-DUST SCR worldwide at Lafarge Mannersdorf - Austria

Design Data:
- 2500 t/d
- Flow: 180,000 Nm³/h
- Temp: 290°C – 350°C
- Dust: 180 g/Nm³ (before ESP)
  < 2 g/Nm³ (after ESP)

Concept:
ESP instead of cyclone-upgrade
(idea to adjust SCR inlet dust concentration for test – purpose to receive design data for other Lafarge plants)

Target:
- < 200 mg/Nm³ NOx (at the main stack)
- < 20 mg/Nm³ NH3
Results: emission measurement June 2012

Project Targets

TÜV measuring campaign June 2012

<table>
<thead>
<tr>
<th>Conc. [mg/Nm³]</th>
<th>NOx [mg/Nm³]</th>
<th>NH3 [mg/Nm³]</th>
<th>VOC [mg/Nm³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>after 1st layer</td>
<td>837</td>
<td>235</td>
<td>21</td>
</tr>
<tr>
<td>catalyst outlet</td>
<td>158</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>
WE CREATE
TECHNOLOGY
FOR CLEAN AIR

WWW.SCHEUCH.COM

März 2015