NO TROUBLE WITH NO_x

AN ADVANCED CONCEPT FOR EFFECTIVE NO_x REDUCTION

ATEC

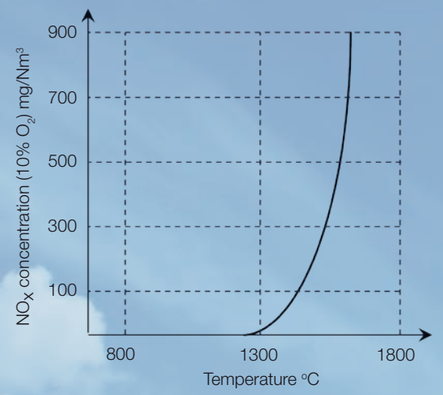
World Leader in Cement Pyroprocess Technology

NO_X FORMATION AND ABATEMENT: SOLUTIONS FOR < 200 mg/Nm³ NO_X EMISSIONS

A TEC

THE DRIVERS

In addition to the formation by the nitrogen content of the used fuel, NO_X emissions in the flue gas of the cement clinker production process are mainly formed by the high temperature that is required for the process. Influenced by aspects, such as the plant configuration (type of kiln, preheater, calciner, clinker cooler, etc.) and its operation, the peak process temperature ends up in the range of the exponential growth of NO_X emissions and leads to significant production of these undesired gas components.



NO_X ABATEMENT

To reduce the NO_X emissions of thermal applications, two main routes can be used separately or combined. These are called primary and secondary methods.

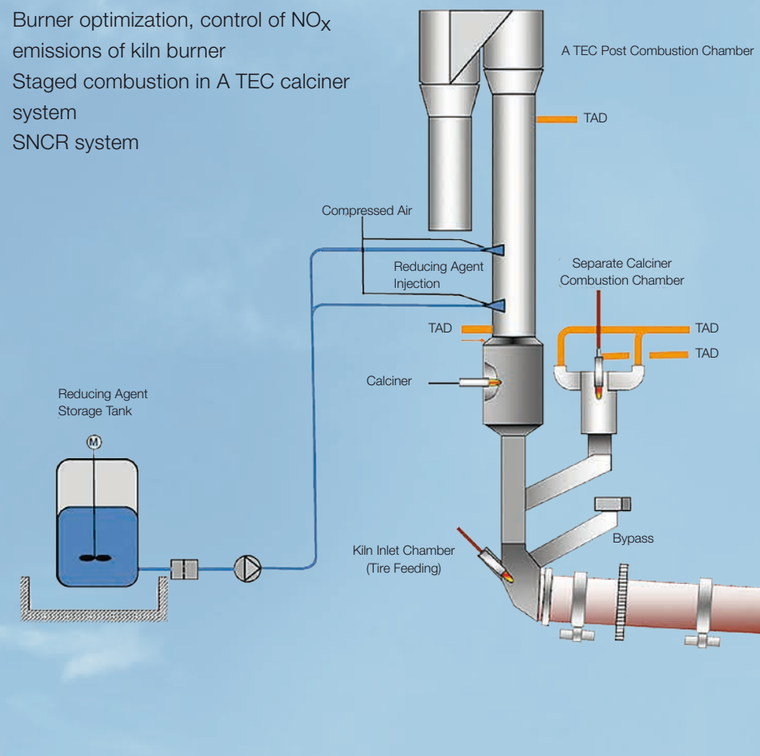
Primary NO_X reduction
Primary measures for NO_X reduction set a focus on avoiding the formation of nitrogen oxides by intelligent combustion control. Based on this philosophy no additional chemicals are needed. Optimized burner design and operationas well as staged combustion in the calciner lead to a lower formation rate of NO_X. Basic idea:

- Reduction of the combustion peak temperature
- Limitation of oxygen content in the hot combustion area

Secondary NO_X reduction
Secondary measures focus on the reduction of NO_X which has already been formed and are implemented if emission limits cannot be reached by using only primary measures. Injection of reducing agent (NH_3 or urea) into the NO_X contaminated hot flue gas is the most commonly used method for downstream NO_X reduction in the cement industry. This technology is called: Selective non-catalytic reduction (SNCR).

A TEC SOLUTION. THE WAY TO < 200 mg/Nm³ NO_X

- A combination of primary and secondary measures is required
- Burner optimization, control of NO_X emissions of kiln burner
- Staged combustion in A TEC calciner system
- SNCR system



LESS EMISSIONS BY SMART SOLUTIONS: THE A TEC CONCEPT FOR PRIMARY NO_X REDUCTION

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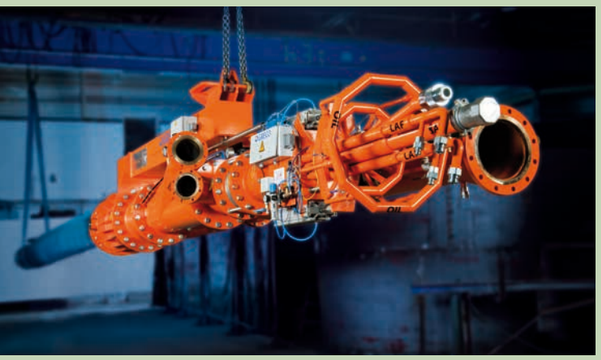
FLEXIFLAME™ – ROTARY KILN BURNER

FLEXIFLAME™ burners use three shaping air flows and a unique design to optimize complex fuel firing and provide better control over NO_X emissions. FLEXIFLAME™ burner versatility and features make it the best option for applications where NO_X emissions control is mandatory or when the firing includes complex fuels.

Advantages

- High control of NO_X emissions
- Enhanced control of sulphur cycle
- More flexibility in on flame control



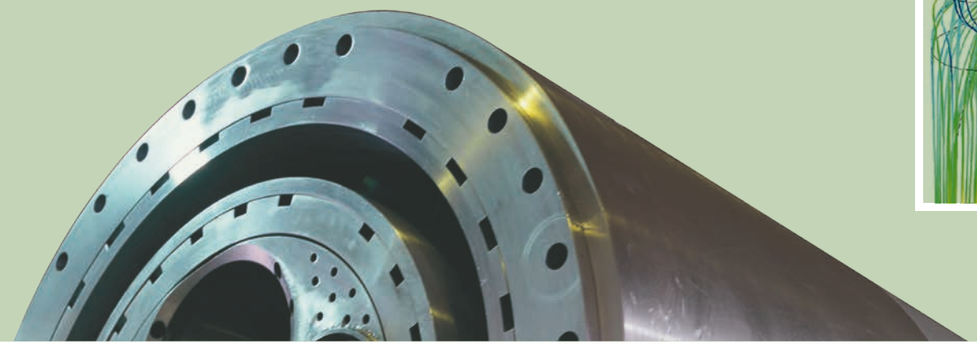
A TEC GRECO
Intelligent Combustion Solutions

STAGED COMBUSTION IN THE A TEC CALCINER SYSTEM

The A TEC calciner system is a key feature for primary NO_X reduction and mainly consists - in addition to the conventional calciner duct - of a multi stage firing, a staged tertiary air injection and meal feed, a separate combustion chamber and the A TEC Post Combustion Chamber (PCC). By the staged combustion process, a reduction zone is created, which forms fuel radicals to reduce NO_X. While afterwards at the outlet of the calciner or in the PCC, the missing amount of oxygen is added to complete the combustion step.

Advantages

- Effective limitation of NO_X formation
- Perfect control of atmosphere by separate combustion chamber
- Uniform reaction temperature by staged meal inlet
- Minimization of local hot spots
- Suitable for alternative fuels
- High residence time and turbulence
- Prepared for SNCR reagent injection



COMBUSTION CHAMBER

The A TEC combustion chamber significantly improves the combustion process by using tertiary air with 21% oxygen. Another advantage is the increase in retention time, which allows improved combustion of bigger particles.

Advantages

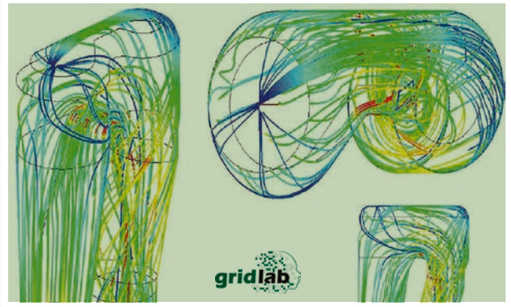
- Combustion on a very high efficiency level
- Intense combustion zone allows low quality fuels use
- Combustion of bigger particles
- Perfect control of atmosphere for NO_X reduction

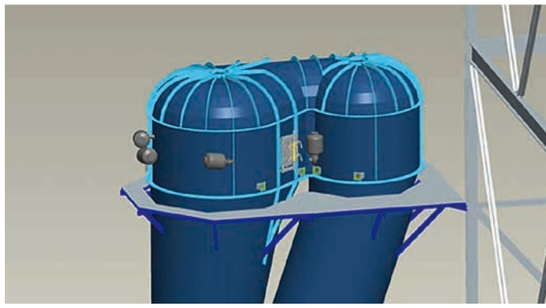
POST COMBUSTION CHAMBER

This installation, which is placed on the top of the calciner loop duct, helps ensure that main criteria of good combustion (residence time, turbulence) are fulfilled. The design increases gas residence time and causes larger unburned particles to fall back into the calciner. The entrance to the downward loop duct is designed eccentrically which produces a high mixing energy. This is a big advantage for the reduction of CO emissions as well as for avoiding unreacted SNCR to slip out.

Advantages

- Increase of gas residence time
- Complete combustion
- Perfect mixing of gaseous components
- Lowest emissions
- Lower ammonia slip
- Minimization of SNCR reagent consumption





COMPLETE THE OPTIMIZATION: SECONDARY MEASURES FOR NO_X REDUCTION AND USING CFD OPTIMIZATION

SELECTIVE NON-CATALYTIC REDUCTION (SNCR)

SNCR is currently the most practical solution for the cement industry. The reducing agent is injected at the suitable temperature range either at the kiln inlet chamber or at the calciner (depending on the kiln type and the selected reducing agent). The system is designed to provide sufficient residence time in the required temperature range for the reducing agent to react with the NO_X. To improve the mixing of the reducing agent with the gas stream, the Post Combustion Chamber (PCC) is an essential part. This lowers the required residence time and minimizes the amount of unreacted reducing agent (low NH_3 slip).

Advantages

- Low consumption of reducing agent
- Maximized conversion of NO_X
- Perfect for revamping to meet strict NO_X limits

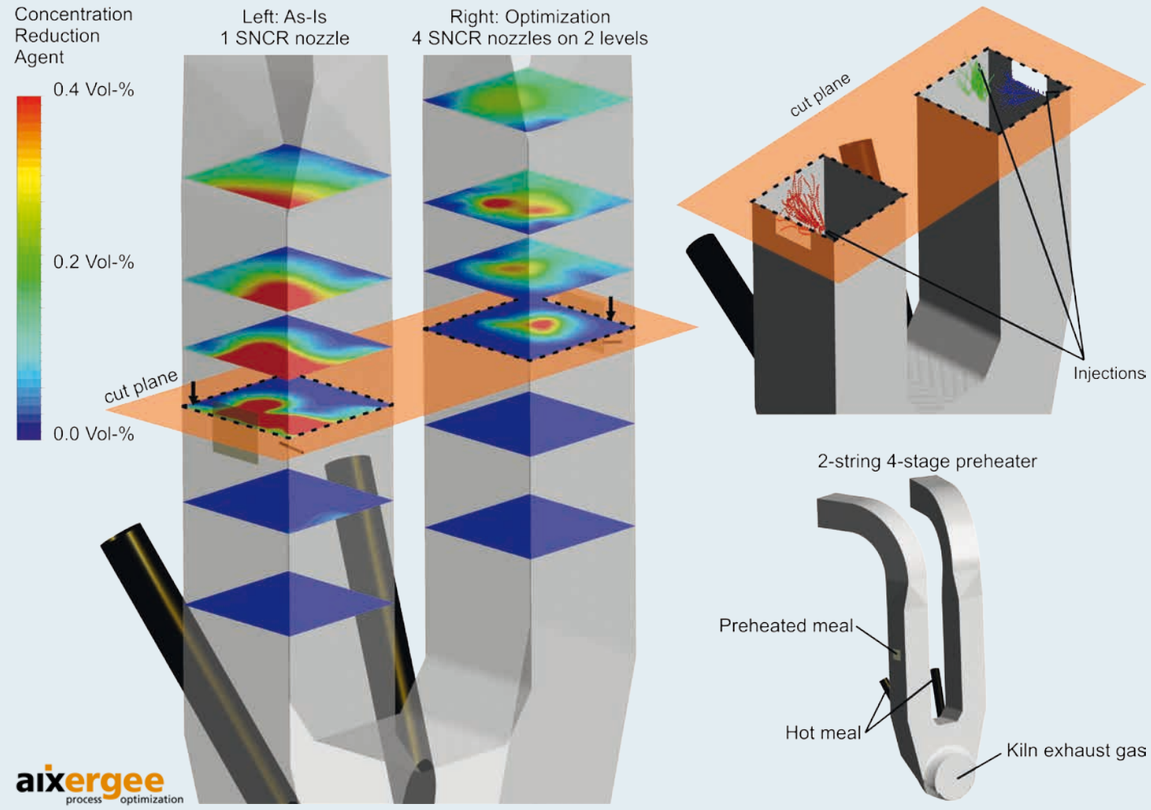
CFD OPTIMIZATION

For further optimization of the system, also regarding NO_X reduction, A TEC offers together with a well-known industry partner the possibility to evaluate the system with the latest high sophisticated CFD technology.

Advantages

- Find optimum position for reducing agent injections
- Identification NO_X layer formation
- Optimization of reagent reaction
- Flow optimization for sufficient mixing
- Minimization of SNCR reagent consumption

EXAMPLE OF A CFD EVALUATION



CFD evaluation of different possibilities of reducing agent injection and the resulting effect on agent conversion in the gas stream.

A TEC

SOLUTIONS ARE PROVEN WORLDWIDE: SELECTED REFERENCES

Leube
Gartenau, Austria

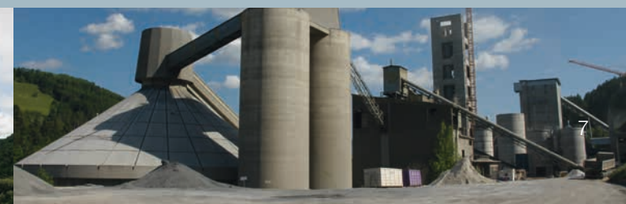
Production increase up to 2200 t/d, < 300 mg/Nm³ (with SNCR) achieved during long term operation

Cementizillo,
Fanna, Italy

Production increase from 1700 to 2450t/d, NO_X reduction from 2000 to 600 mg/Nm³, 100% pet coke

W&P
Wietersdorf, Austria

Production increase from 1000 up to 2400 t/d and NO_X: 250mg/Nm³



Head Office
A TEC Holding GmbH
A TEC Production & Services GmbH
Kasernstrasse 16-18
3500 Krems, Austria
Phone: +43 2732 75680 0
Fax: +43 2732 75680 201
sales@atec-ltd.com
www.atec-ltd.com

Technical Center
A TEC Production & Services GmbH
Finkensteinerstrasse 9
(Gewerbepark Zufahrt A)
9585 Gödersdorf, Austria
Phone: +43 4257 3600
Fax: +43 4257 3600 101
office@atec-ltd.com

www.atec-ltd.com

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