One Source

NO_x reduction solutions

FLSmidth

Choose wisely with the market's widest range of alternatives

Key benefits

- **Reliable NO_x reduction**
- **Full spectrum of solutions for an ideal match**
- **Expertise to help plants weigh costs and benefits**
- **Solutions with guaranteed performance**
- **Evaluation of potential process effects**

Primary methods

- Improve burning process
- Optimise automatic kiln operating control
- Optimise chemical control
- Improve raw material burnability by adjusting chemical and physical properties
- Modify existing pyro process

Secondary methods

- Install a Selective Non-Catalytic Reduction (SNCR) system
- Install alternative technology

Targeting precisely what you need

Reducing nitrogen oxide (NO_X) successfully requires more than just buying a particular product, or injecting ammonia or urea into a system.

It's a matter of process optimisation and evaluating your present system to explore a range of potential reduction methods. It also requires weighing costs and benefits to find the correct solutions. In other words, it's not just about installing systems.

FLSmidth offers the entire spectrum of low NO_X alternatives, since there can be a variety of ways to achieve the results you're looking for. And we have the expertise to recommend exactly which is optimal for your plant.

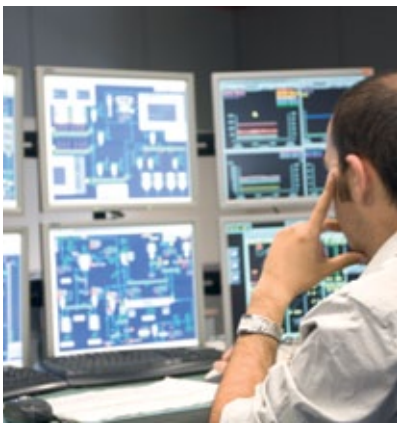
We strive to optimise your entire system – and we do so with a professional approach that utilises the full potential NO_X reduction capability of your existing system. We don't automatically recommend that our clients install secondary measures like Selective Non-Catalytic Reduction (SNCR).

Reliable primary and secondary reduction solutions

Increasingly stringent regulations mean it's more important than ever to be sure that your plant complies with the norms at any time. With FLSmidth you get proven solutions, delivered by experienced professionals with vast process knowledge.

You will benefit from our many years of experience with customised computer models that accurately predict NO_X emissions. You'll also appreciate our advanced test facilities, where we research and develop the market's leading solutions. These tools are refined by experienced commissioning engineers and process engineers, data collected from the field, and a Research and Development department that continuously improves the foundation of our NO_X reduction capabilities.

So whether your challenges require a primary or secondary reduction method, you can be sure the solution will be developed with the professionalism the industry expects from FLSmidth.



Primary NO_x reduction – the easy way

Process optimisation starts with process audit

The first step in virtually any low NO_X reduction project is the process audit. The purpose of reviewing a cement plant for process optimisation is to ensure that the present system secures the lowest possible NO_X emissions.

A process audit investigates the system through a review of plant measurements, operational stability, chemical study, burner optimisation and preheater design. The preheater design review can be especially important, as fuel or tertiary air are not always introduced in locations favourable for reducing NO_X. Introducing raw meal correctly and operating the calciner/riser at the optimal temperatures is essential for NO_X reduction by primary measures.

Once the process audit is complete, the plant and FLSmidth must agree on a course of action – including minor or major design changes – while weighing the costs and benefits of the different alternatives.

Automated control with Expert Control System (ECS)/ ProcessExpert

Process optimisation/NO_X reduction can also be achieved using advanced ECS/ProcessExpert automated process control.

Using a sophisticated toolbox and specialised application modules, the automated process control continuously performs complex analyses of your plant's process conditions. This enables it to adjust the process more frequently and reliably than human operators can. The result is stable temperature control in the calciner, stable burning zone temperature in the kiln for good clinker quality, and stable cooler operation, which helps reduce NO_X emissions from the pyro system.

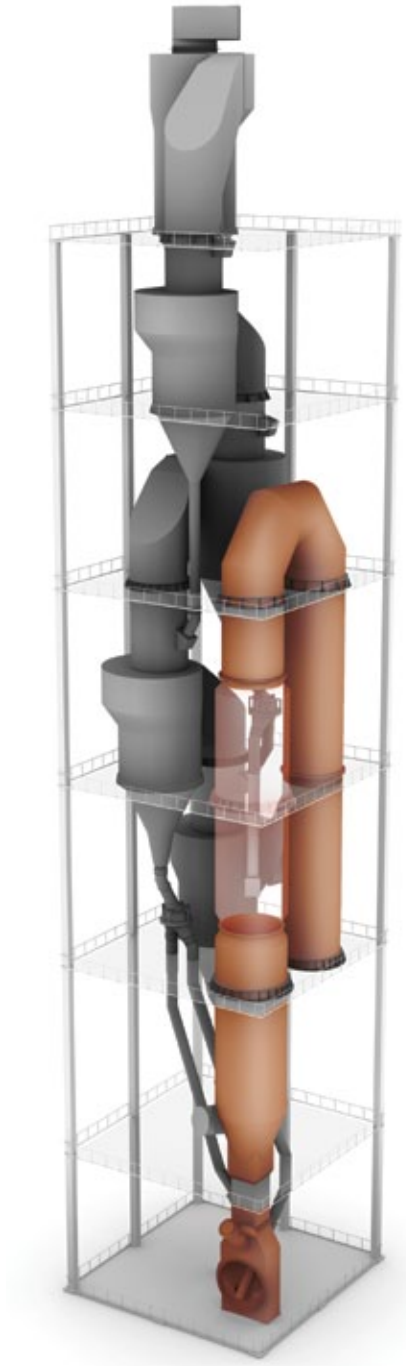
FLSmidth also offers training of operators in the high-tech ECS™ CEMulator® cement process simulator. This helps operators better utilise the full NO_X-reducing potential of the system.

Typical steps

1. **Conduct process optimisation, including audit**
2. **Decide course of action, weighing costs and benefits**
3. **Make necessary operational and design changes**

Automated control ensures a timely and correct response to process changes. The result is a stable pyro system and reduced NOx emission.

Primary NO_x reduction – optimise your system



FLSmidth® In-Line Calciners are found on some of the lowest NO_x-emitting plants in the world.

The ILC sets high standards for primary reduction

Simple construction and simple operation are keywords when it comes to the FLSmidth® In-Line Calciner (ILC). Unlike many more complicated systems, our ILC makes it easy to reduce the thermal NO_X generated in the kiln and limit the formation of fuel NO_X in the calciner. FLSmidth In-Line Calciners are found on some of the lowest NO_X-emitting plants in the world.

Flexible when it comes to fuel

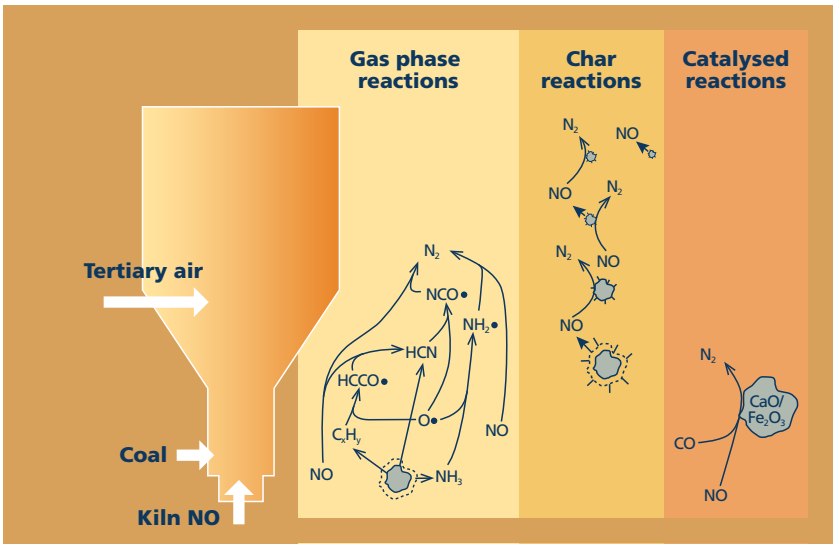
Both flexible when it comes to fuel and highly reliable, our ILC achieves proven NO_X reduction from high-temperature, "stage-less" combustion. This is incorporated into the standard design of the ILC preheater. It's a simple and effective way to create low NO_X emissions with only one firing location, one meal split and one tertiary air stream entering tangentially to the calciner.

Optionally, the second- or third-lowest stage cyclone material can be further split to allow for diversion of a portion of the meal directly into the upper section of the calciner. This creates a "hot zone" in the lower section of the calciner that is conducive to burning difficult fuels and increasing NO_X reduction.

Highly reliable operation

Fuel is injected into the kiln riser below the area where the tertiary air enters at the base of the calciner. This so-called reduction zone, sized for a particular gas retention time, has an oxygen-deficient atmosphere that promotes NO_X reduction. The optimum temperature in the zone is controlled by a material split from the second-lowest stage between the calciner and the kiln riser.

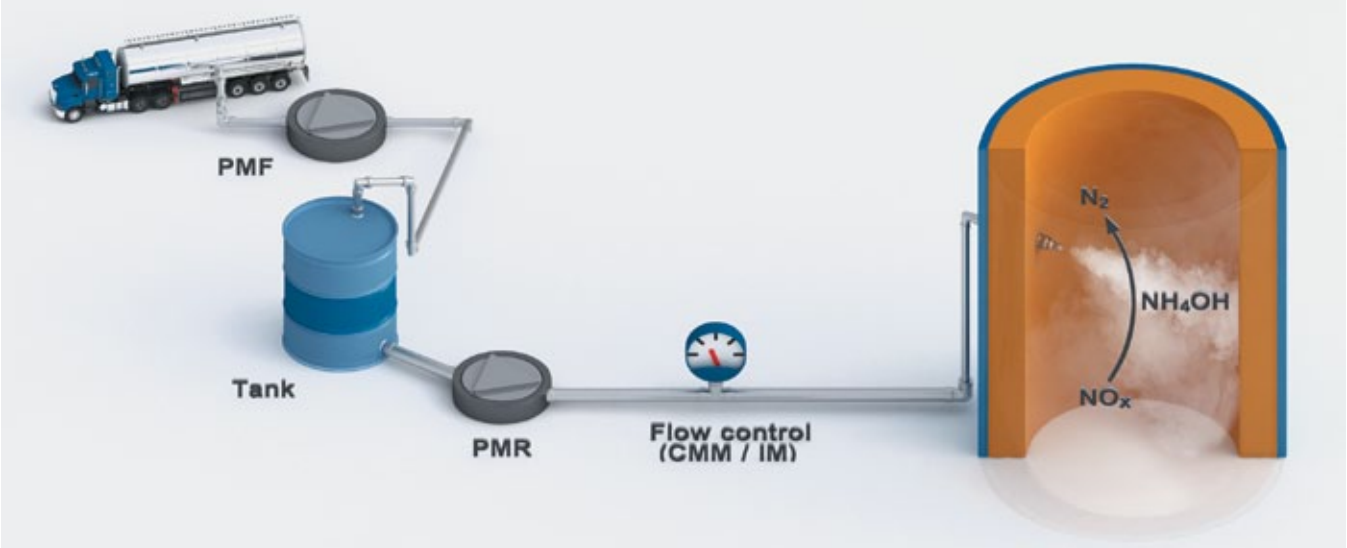
This material split is also used to control possible build-up within the kiln riser for operational stability. Above the reduction zone is the main calciner vessel, which is divided into two or more sections separated by a notch. The changes in cross-sectional areas create turbulence that ensures effective mixing of fuel, raw meal and gas, improving heat transfer and combustion.



Reaction pathways occurring in an oxygen-deficient atmosphere in the lower part of the calciner.

A look at the SNCR system

A typical delivery in the SNCR system consists of a pump module for filling (PMF), a tank, a pump module for reductant (PMR), flow control (CMM), individual lance flow control (IM) and the lances for injecting the reductant.



Secondary reduction measures – superior alternatives

SNCR systems reduce NO_x up to 80%

Primary NO_X abatement techniques are not always sufficient to comply with the most stringent emission requirements. Therefore plants are increasingly considering secondary reduction methods such as the FLSmidth® Selective Non-Catalytic Reduction (SNCR) system.

A properly implemented SNCR system can reduce NO_X by up to 80%. FLSmidth has a proprietary SNCR system with proven, highly efficient performance. Furthermore, the FLSmidth SNCR system combines easy operation and maintenance with safety.

How the SNCR system works

An SNCR system reduces NO_X by injecting an aqueous ammonia (or urea) solution into the flue gas at an optimum temperature window. The NH_3 converts into NH_2 radicals that can react with NO_X, forming atmospheric nitrogen and water. Usually the ammonia solution is injected in the outlet of the calciner, due to optimal operating temperatures here in a typical calciner system.

FLSmidth's SNCR includes unloading pump modules, storage tank facilities, reductant pump modules, reagent flow control modules, injection modules and specially engineered spray lances with nozzles. The system can be configured to include any number of pumps, tanks and injection modules. It's all tied together by a dedicated, comprehensive electrical and control system to ensure the best performance in a truly integrated system.

A wide range of advantages

- Combined with the initial audit performed by our experienced process engineers, the ammonia consumption is low – which reduces operational costs
- FLSmidth's extensive experience with the pyro process ensures your SNCR system is highly incorporated with the kiln system for optimal operational efficiency
- Little to no ammonia slip or CO, with a properly installed and operated SNCR system.
- FLSmidth offers the possibility of SNCR trials with our mobile SNCR test rig, to determine the optimal injection and NOx reduction
- In addition to SNCR, FLSmidth offers the possibility of reducing NO_X by more than 80% with other, superior technology.

One Source

www.flsmidth.com

Project Centre Denmark
FLSmidth A/S
Vigerslev Allé 77
DK-2500 Valby
Copenhagen
Tel: +45 3618 1000
Fax: +45 3630 1820
E-mail: info@flsmidth.com

Project Centre USA
FLSmidth Inc.
2040 Avenue C
Bethlehem, PA 18017-2188
Tel: +1 610-264-6011
Fax: +1 610-264-6170
E-mail: info-us@flsmidth.com

Project Centre India
FLSmidth Private Limited
FLSmidth House
34, Egatoor, Kelambakkam
(Rajiv Gandhi Salai, Chennai)
Tamil Nadu – 603 103
Tel: +91-44-4748 1000
Fax: +91-44-2747 0301
E-mail: indiainfo@flsmidth.com

CM 02-12 200-11-ENG

FLSmidth