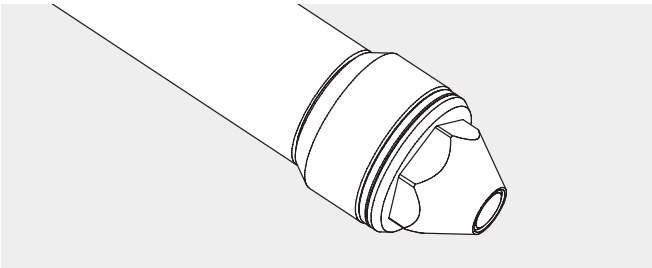
Special twin-fluid nozzles for DeNOx applications

Laval nozzle

In DeNOx applications with SNCR processes, small Laval nozzles are usually used. These nozzles are characterized by a high discharge velocity, enabling the optimum droplet spectrum to be introduced into the reactor with a great penetration depth. Our research has shown that the discharge velocity has a greater effect on the denitrification process. Moreover, these nozzles without internals are extremely insensitive to clogging and can be precisely controlled.

Special properties

- **Small spray angle** (15°), suitable for small cross-sections and horizontal ducts
- **Turn-down ratio** of 20:1 (in some cases up to 40:1)
- **Typical pressure range** Liquid 1-6 bar, g Atomizing air 1-6 bar, g
- **Adjustment of the droplet spectrum** by changing the air/fluid ratio
- **Very fine droplet spectrum**



Spray pattern of a Laval nozzle

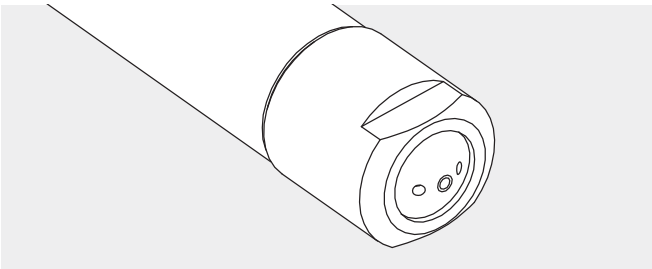
For SCR processes and special SNCR processes there are special nozzles which have been developed to meet the specific requirements. The same principles regarding control and operation apply for all twin-fluid nozzles, irrespectively of the type.

Laval flat fan nozzle

The Lechler Laval flat fan nozzle atomizes according to the principle of inside mixing. The air/fluid mixture exits via three outlet holes creating a wide and flat spray with an even better surface coverage. The droplet spectrum and the pulse of the droplets can be adapted by changing the air/fluid ratio.

Special properties

- **Wide and flat jet,** spray angle 60°
- **Turn-down ratio** of over 10:1
- **Typical pressure range** Liquid 1-5 bar, g Atomizing air 1-5 bar, g
- **Spray alignment possible**
- **Adjustment of the droplet spectrum** by changing the air/fluid ratio



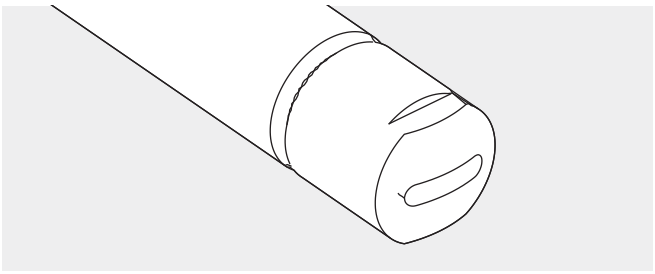
Spray pattern of the flat fan nozzle

MasterNOx® for DeNOx processes

The Lechler *MasterNOx*® nozzles are usually used in the non-catalytic denitrification of flue gases (SNCR process). They are usually designed as flat fan nozzles and achieve a high spraying range to make the liquid penetrate as far as possible into the boiler. The nozzle specially developed for the retrofitting of existing power plants is characterized by a small outer diameter, so that it can fit between the pipes of the boiler wall. It can also have a protective flow of barrier air around it without the need for the pipes to be bent aside.

Special properties

- **Spray angle** 15°, 30°, 60°
- **Turn-down ratio** of over 50:1
- **Typical pressure range** Liquid 1-10 bar, g Atomizing air 1-6 bar, g
- **Adjustment of the droplet spectrum** by changing the air/water ratio



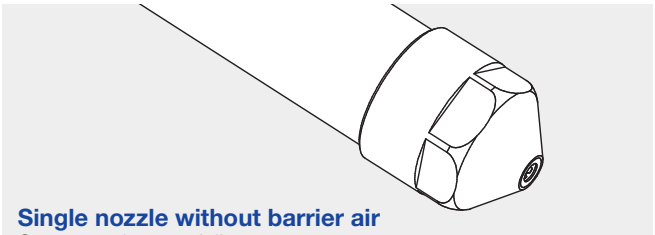
Spray pattern of the *MasterNOx*® nozzle 30°

1AW nozzle

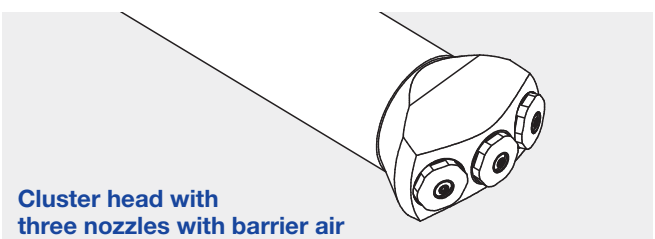
The Lechler 1AW nozzle works according to a newly developed and patented atomization principle. It divides the supplied atomizing air into a primary and secondary air flow. Thanks to the specific inflow geometry, the secondary air exits through an annular gap causing a very fine atomization in the edge region of the spray. This twin-fluid nozzle enables finest droplet spectra and shortest evaporation distances while also allowing very good controllability of the flow rate. Cluster heads designed specifically for these nozzles multiply the flow rates and adapt the spray pattern to the requirements at the point of injection.

Special properties

- **Spray angle of the individual nozzle** 15° as full cone
- **Turn-down ratio** of 10:1
- **Typical pressure range** Liquid 1-5 bar, g Atomizing air 1-5 bar, g
- **Particularly fine droplets** thanks to tertiary atomization
- **Design** as single or bundle nozzle lances
- **Adjustment of the droplet spectrum** by changing the air/fluid ratio



Single nozzle without barrier air
Spray angle 15°; full cone



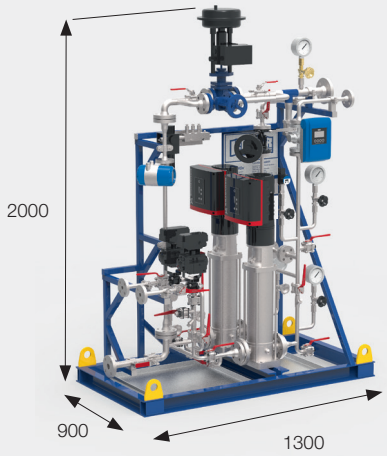
Cluster head with three nozzles with barrier air
Spray width approx. 55°, spray depth approx. 15°; flat fan

Spray pattern of the 1AW nozzle

SmartNOx®
The powerful starter system

Lechler *SmartNOx*® is the entry-level system for the SNCR process. Standardized units with fixed components allow for affordable pricing, all while maintaining Lechler's famous high quality standard.

Included with delivery are a valve skid unit including pumps and fittings for media control as well as individual modules enabling the lance levels to be connected and disconnected. The components of the valve skid unit are connected with pipes and assembled on a compact base frame including all brackets. Assembling in a two-door closed cabinet is also possible as an option.



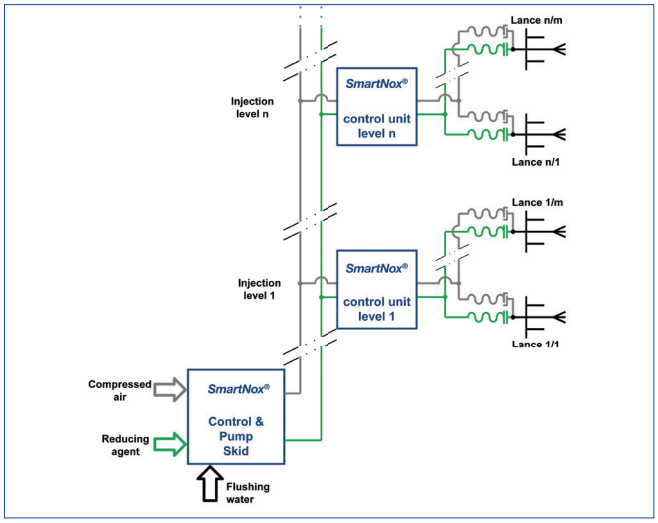
***SmartNOx*® on steel frame**

***SmartNOx*® in cabinet**

Features:

- Two sizes
- Reducing agent injection quantities of 0.005 – 1.0 m^3/h or 1.0 – 2.7 m^3/h
- Frequency-controlled pumps with magnetic couplings (duplicated)
- Permanently technically sealed in accordance with DIN EN 1127-1
- Optional integrated gas detector
- Integrated drip tray
- In accordance with DIN EN 1295 2-14: X-ray examination of 10 % of all welds capable of validation
- 3.1 material certificates in accordance with DIN EN 10204
- Integrated flush connection
- Integrated air flushing for non-active levels
- Standardized technical documents for simple implementation in higher-level operating documentation

The Lechler *SmartNOx*® system is an independent SNCR system and is not designed for later upgrading with more efficient Lechler systems.



Lechler *SmartNOx*® system

VarioClean® - NOx

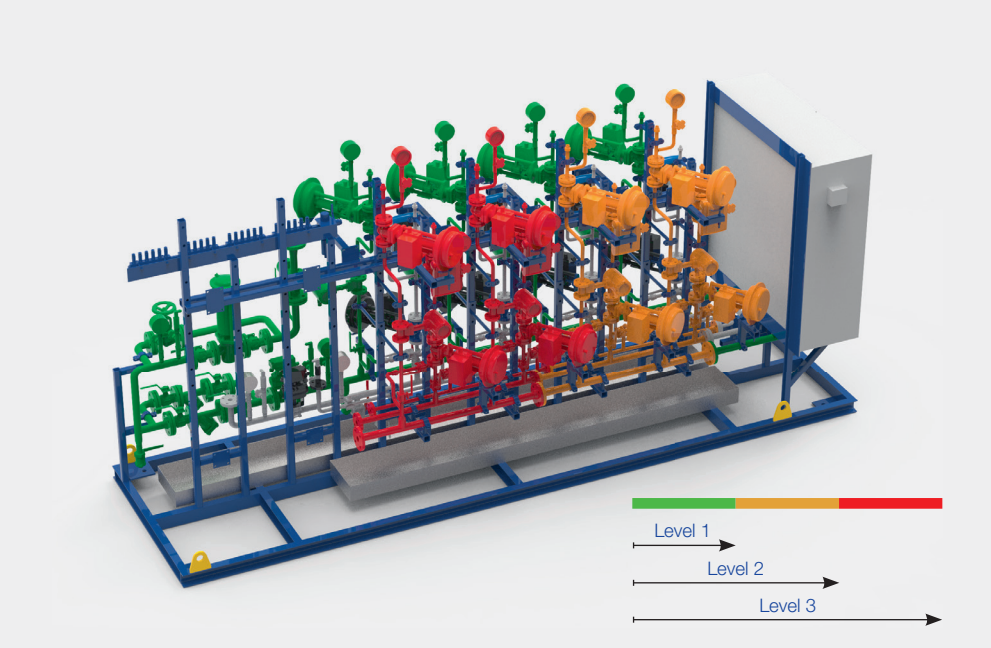
The denitrification solution that grows with you

The limit values for NOx emissions and ammonia slip (NH_3 slip) are expected to be reduced further in the coming years. To enable a profitable production of cement all the same, processes must be observed and optimized with intelligent control strategies.

For this purpose, Lechler has joined forces with STEAG to develop an SNCR concept that reliably ensures compliance with the limit values in force: *VarioClean*® - NOx.

Three steps for any requirement

Depending on (what is required by) the legal situation, the modular system *VarioClean*® - NOx can be flexibly upgraded across the three configuration levels Basic, Efficiency and High Efficiency SNCR. The base frame and the base modules are identical for all three configurations. The difference lies in the number of lances and injection levels, as well as in the software and sensor packages for the successful control of all necessary influencing factors.



Basic SNCR

The control of flue gas denitrification is based on a NOx measurement at the flue. Both aqueous ammonia and urea can be used as a reagent for the denitrification. All existing lances are controlled by the conventional control – depending on the NOx concentration measured. The Basic SNCR is primarily used where comparatively high NOx limit values or no limit values must be observed for the NH_3 slip and there are very stable temperature conditions.

The base frame of the valve skid unit and the installed fittings are designed for later upgrading. Further lances can be integrated using additional distributor pieces. Since individually controllable lances can be used from the start, a Basic SNCR system can be extended to both of the next configurations without any problems.

Efficiency SNCR

In the case of higher requirements in terms of the limit values to be complied with and less stable temperature conditions, the "efficiency SNCR" (eSNCR) with a larger number of lances is ideal. The lances are installed on at least two levels and each lance is individually supplied with the reagent.

In addition, a software-based "intelligent controller" is connected with the PCS via an interface and supplied with current process signals. This allows the NOx concentration in the raw gas to be estimated and thus enables a more accurate and more economical dosing of the reagent.

High Efficiency SNCR

The "high efficiency SNCR" (heSNCR) meets the highest NOx reduction demands while at the same time keeping reagent consumption to a minimum. It has further lances, which are normally installed on at least three different levels. The control is extended to include online CFD simulating the temperature and flow conditions in the injection area. Together with the estimated amount of NOx in the raw gas and the NOx concentration measured in the clean gas at the flue, the spray behavior of each lance can be individually controlled for an optimal use of the reagent.

The scopes of delivery for the 3-level SNCR are as follows:

Basic SNCR

- Starter package with 4 nozzle lances
- Lances controlled as network by conventional control
- NOx measurement at flue required

eSNCR

- Basic SNCR
- 2-3 additional lances
- Lance installation on at least two levels with individual reagent supply
- Intelligent control with interface to the PCS
- Raw NOx soft sensor
- NOx and ammonia slip measurement at flue required

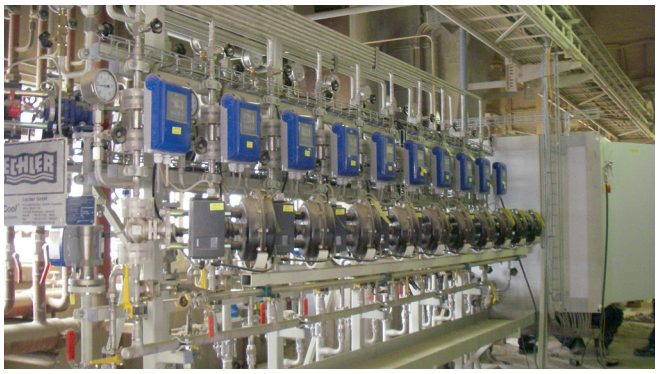
heSNCR

- eSNCR
- Optimal number of lances: 8-10
- Lance installation on at least three levels with individual reagent supply
- Online-CFD for permanent modeling of temperature and flows in the injection area
- heSNCR control with continuous consideration of optimal temperature frame for the injection

A total of up to 10 lance units can be flexibly mounted on the base frame. Irrespectively of the respective SNCR level, the basic structure includes the junction box, the drip tray and all necessary brackets for the respective units.

Video: SNCR concept with STEAG

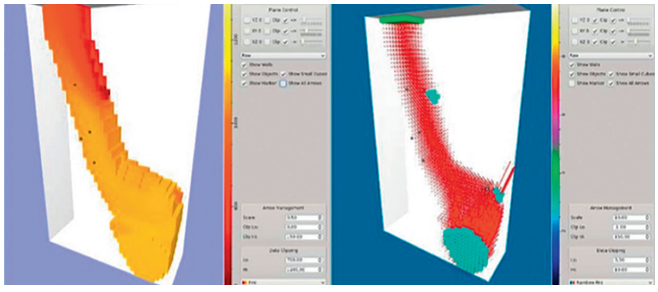
http://www.lechler.de/lechlersteagsncr



Controlled section of a heSNCR

Benefits:

- Systems grow with the legal requirements
- No unnecessary investments
- Modular design in three upgradable configuration levels
- Optimal reagent use resulting in reduction of operating costs
- High NOx reduction (suitable solutions for requirements of differing complexity)
- Low NH_3 slip (adapted solutions for reduction of NH_3 slip)



Signal analysis and online-CFD

Talk to us

Different systems require different strategies. The largest and most comprehensive solution is not always the best one. Let us discuss your requirements and work together to find the denitrification system that is a perfect fit today and will grow tomorrow to keep up with rising demand.