

# Single-step dust, NO<sub>x</sub>, SO<sub>x</sub> and NH<sub>3</sub> removal in lime kilns

Whether to establish a commercial advantage, ensure regulatory compliance or pursue corporate sustainability agendas, lime and cement producers today seek to limit or eliminate harmful emissions from their processes. Catalyst technology can provide key know-how to develop filter bag systems designed to treat such exhaust gases.

■ by **Haldor Topsøe A/S**, Denmark

Effective emission control is vital in lime kilns – and there are big operating benefits to be had if dust filtration can be combined with the removal of gaseous emissions.

## Catalyst know-how applied

Denmark-based Haldor Topsøe has applied its specialist know-how of catalyst technology to develop and perfect a breakthrough catalytic filter bag technology especially designed to treat off-gases in the high-dust environments of lime and cement kilns, glass and steel production, waste incineration and pulp and paper manufacturing.

This breakthrough solution is based on decades of technological leadership in many aspects of all catalytic processes,

*“This breakthrough solution is based on decades of technological leadership in many aspects of all catalytic processes, thousands of high-profile reference installations and especially vast experience with the much-used stationary selective catalytic reduction (SCR) installations traditionally used to remove gaseous pollutants.”*

thousands of high-profile reference installations and especially vast experience with the much-used stationary selective catalytic reduction (SCR) installations traditionally used to remove gaseous pollutants. The catalytic filter bags enable companies to transform the economics of compliance with increasingly stringent emissions restrictions.

## The “magic” behind the technology

CataFlex™ is the ideal choice for facilities already using fabric filters. Each CataFlex bag consists of a catalytic fabric layer inside a standard outer filter bag. The catalyst formula as well as the fabric materials used in the catalytic inner layer and the dust filtration layer are configured and optimised to meet the specific requirements encountered in each customer's processes and hardware – thus eliminating the need for costly, space-demanding gas removal equipment.

Everything works in the same way as with the plant's existing filtration systems. CataFlex bags have service lives similar

Figure 1: CataFlex™ catalytic filter bags mounted inside a dust filter bag



**Table 1: process data for a lime kiln in China**

Parameter	Design case
Flue gas flow – wet (Nm <sup>3</sup> /h)	135,792
Flue gas temperature (°C)	210
NO <sub>x</sub> inlet (mg/Nm <sup>3</sup> )	800
SO <sub>x</sub> inlet (mg/Nm <sup>3</sup> )	30
Dust (mg/Nm <sup>3</sup> )	50,000
Emission level (mg/Nm <sup>3</sup> )	Observed
NO <sub>x</sub> emission	<80
Dust emission	<5

to conventional fabric filter bags and the same mechanical stability. The catalyst embedded in the inner bag is well protected from poisoning because the dust is removed by the outer bag.

The “magic” behind CataFlex comes from the catalytic system based on vanadium pentoxide and titanium dioxide. This catalytic system has been precisely engineered by Haldor Topsøe and has been proven for decades in more than 1500 conventional SCR references.

CataFlex builds on the same superior catalyst – now further optimised for catalytic filtration.

### Single-step removal of dust, NO<sub>x</sub>, NH<sub>3</sub>, SO<sub>x</sub> and dioxins

CataFlex technology enables companies to deal effectively with many different

kinds of emissions – both gaseous and in particle format – in a single step.

**NO<sub>x</sub>**  
CataFlex employs SCR to remove NO<sub>x</sub> from exhaust gases, either by using ammonia present in the exhaust or flue gas as a reducing agent, or via ammonia injection upstream from the filter. The NO<sub>x</sub> is converted into harmless nitrogen and water.

**NH<sub>3</sub>**  
CataFlex eliminates any NH<sub>3</sub> slip from upstream selective non-catalytic reduction (SNCR). This complies with most NH<sub>3</sub> emissions requirements and makes it easier to control SNCR operations.

**SO<sub>x</sub>**  
Injection of sorbents upstream of the filter house can allow the reduction of >90 per cent SO<sub>2</sub> and other acid gases present in the flue gas. In this case, the need for a downstream DeSO<sub>x</sub> installation is eliminated.

**Dioxins**  
CataFlex ensures the destruction of >99 per cent of dioxins and furans by

*“The “magic” behind CataFlex comes from the catalytic system based on vanadium pentoxide and titanium dioxide.”*

converting them into harmless compounds and reducing concentrations to below 0.1ng-TEQ/Nm<sub>3</sub>.

### Benefits

The benefits of this advanced filter technology include:

- dust and multiple gaseous compounds removed in one single step
- bags can be inserted into existing filter housings – as drop-in replacements for traditional filter bags
- up to 80 per cent savings can be achieved compared with expensive tail-end gas removal equipment thanks to the system’s small footprint and low capital expenditure.
- service life and pressure drop specs are fully comparable with traditional fabric filters
- no need for costly new ID fans or compressed air
- no actual contact between catalyst and potentially harmful particles exists.

### Deals with dust and flue gas in one drop-in unit

Designed for easy use in most industries that require cost-effective flue gas cleaning, CataFlex catalytic filter bags provide a straightforward, effective way to treat exhaust gases at the same time as trapping dust – with a reliable drop-in solution that saves space and does not involve large capital expenditure or production-denting construction work.

CataFlex catalytic filter bags are a well-proven solution that is easy to implement. They are currently in operation in multiple lime kilns with outstanding results.

### Proven results for lime kilns

As an example of the results with catalytic filter bags, an existing lime plant in China with no room for SCR needed a solution for NO<sub>x</sub> removal. The plant’s NO<sub>x</sub> levels of 500-1000mg/Nm<sup>3</sup> required a reduction to a new NO<sub>x</sub> emission limit of 100mg/Nm<sup>3</sup>.

Table 1 shows the inlet and outlet data for the installation. The NO<sub>x</sub> emission level after replacing the existing bags with CataFlex filter bags was <80mg/Nm<sup>3</sup>. ■

Figure 2: catalytic filter through a microscope. The catalytic material is placed between the fibres of the filter media

